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Outlet of Matejcek Dam Downstream Channel – Forest River in Walsh County, North Dakota

MIDDLE-SOUTH BRANCH FOREST RIVER DAM NO. 1 (MATEJCEK DAM)

Existing Conditions Assessment Report (DRAFT)

NRCS
Natural Resources Conservation Service

MIDDLE-SOUTH BRANCH FOREST RIVER DAM NO. 1(MATEJCEK DAM)

EXISTING CONDITIONS ASSESSMENT REPORT

December 13th, 2019

DRAFT

Walsh County Water Resource District

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I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Engineer under the laws of the State of North Dakota.

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EXECUTIVE SUMMARY

Middle-South Branch Forest River Dam No. 1, also known as Matejcek Dam, is located in Sections 23/24 of Cleveland Township, Walsh County, ND. The drainage area to Matejcek Dam is approximately 121 square miles and is shown in **Figure 1-1**. The dam was built primarily to provide flood control along the Forest River, and secondarily to provide recreation opportunities. The dam was designed and constructed by the Soil Conservation Service, now the National Resource Conservation Service (NRCS), in 1964, and was constructed in 1966. Matejcek Dam had a design life of 50-years, which was exceeded in 2016. The top of Matejcek Dam also serves as Walsh County Road 14 which is used to cross the Forest River Valley. Information on critical elevations, storage capacities, and surface areas for Matejcek Dam are displayed in **Table 1-1**.

This report provides information on the existing condition of Matejcek Dam. Field survey data for the channel downstream of Matejcek Dam, the dam embankment, spillways, and bathymetric survey data for the pool upstream of the dam was collected for this analysis. The survey data was used in the hydrologic and hydraulic models of the upstream watershed, Matejcek Dam, and the Forest River channel downstream of the dam.

Previous work in the Forest River Watershed has been completed through the Regional Cooperation Partnership Program (RCPP). Existing conditions data developed through the RCPP effort was used throughout this assessment, and any changes made to the existing hydrologic and hydraulic modeling data were detailed in this report.

Whitman and Sarnia Dams are located upstream of Matejcek Dam in the Forest River Watershed. Each dam has a contributing drainage area of approximately 56.7 square miles, and 19.8 square miles, respectively. An additional 172 square miles indirectly contributing to Matejcek Dam via the Michigan Spillway Flood Control Project. The Michigan Spillway Flood Control Project was completed in June of 2016 with the purpose of removing water from the McHugh Slough-Lake Laretta area (Nelson County, ND) and minimize flooding in the City of Michigan, as well as Enterprise, Sarnia, Rubin, and Michigan Townships of Nelson County, ND. The drainage area for the Michigan Spillway Flood Control Project and the locations of other dams in the watershed are shown in **Figure 1-1**.

A probable maximum precipitation event was developed using Hydrometeorological Report No. 52 to analyze the larger spillway design events for Matejcek Dam. Spillway design hydrographs were then developed based on criteria in *Technical Release 210-60: Earth Dams and Reservoirs* (NRCS, 2019). The capacity of the principal spillway structure was determined to be inadequate based on guidance in *TR 210-60*. Additionally, the capacity and integrity of the auxiliary spillway, with respect to the freeboard hydrograph, is inadequate for Matejcek Dam.

A geologic investigation was also conducted as part of this analysis. The investigation indicated that the current drain fill does not meet criteria for seepage control. The investigation also concluded that further analysis would need to be conducted to determine the potential impacts from slope stability and seepage for the dam as it relates to the design of alternatives.

A review and inspection of Matejcek Dam was conducted in the fall of 2019. The inspection indicated that the concrete riser structure was in good condition with no immediate action items identified. Several minor

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structural deficiencies were noted for the principal spillway conduit and outlet, but it is still considered adequate. The condition of the dam embankment and auxiliary spillway were also determined to be adequate with only minor issues that included: small trees growing on the embankment near the water line, and some large, round hay bales located upstream of the control section of the auxiliary spillway.

Finally, a dam breach analysis was conducted, and a hazard classification was determined for Matejcek Dam. The peak discharge criteria for the breach was determined based on guidance from *TR 210-60*. The peak discharge was determined to be 160,000 cubic feet per second. The breach was simulated through the hydraulic model and mapped to show at-risk structures and roads within the breach zone. After review of the results of the breach scenario, it was determined that Matejcek Dam is best classified as a high hazard dam.

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1 DAM SUMMARY DATA

Table 1-1: *Matejcek Dam Summary Data*

General Data	
Year Designed	1964
Year Constructed	1966
Purpose	Flood Control, Wildlife, and Recreation
Original Hazard Classification	Significant
Current Hazard Classification	High
Design Life	50 Years
Original Design Drainage Area	45.9 square miles
Revised Drainage Area (Direct)[1][2]	121.2 square miles
Revised Drainage Area (Indirect)[3]	171.9 square miles
Maximum Dam Height	76 feet
Embankment Length	1,150 feet
Embankment Top Width[4]	32 feet
Embankment Upstream Slope	3.5H:1V
Embankment Downstream Slope	2.5H:1V
Critical Elevations (NAVD88)[5]	
Principal Spillway SAF Stilling Basin Invert	1279.38 feet
Principal Spillway Conduit Outfall Invert	1296.22 feet
Principal Spillway Orifice Inverts (First Stage Inlet)	1335.43 feet
Principal Spillway Riser Tower Crest (Second Stage Inlet)	1354.88 feet
Auxiliary Spillway Crest	1361.79 feet
Top of Dam	1368.16 feet
Storage Capacities[5]	
Principal Spillway Orifice Inverts (First Stage Inlets)	2,271 acre-feet
Principal Spillway Riser Tower Crest (Second Stage Inlet)	5,608 acre-feet
Auxiliary Spillway Crest	7,274 acre-feet
Top of Dam	9,060 acre-feet
Pool Surface Areas	
Principal Spillway Orifice Inverts (First Stage Inlets) [5]	122 acres
Principal Spillway Riser Tower Crest (Second Stage Inlet)[1]	222 acres
Auxiliary Spillway Crest[1]	261 acres
Other Features	
Principal Spillway Orifice Sizes	2 - 14 inch by 5.5 feet orifices
Principal Spillway Conduit Size	54 inches x 55 inches
Principal Spillway Conduit Length	339 feet
Principal Spillway Riser Tower Crest Length	42 feet
Auxiliary Spillway Width	375 feet

[1] Revised using LiDAR data collected in 2008.

[2] Includes non-contributing drainage area within the watershed, and controlled drainage area above Whitman and Sarnia Dams

[3] Indirect drainage area is the Michigan Spillway Project drainage area, which has a regulated discharge of 50 cfs.

[4] Includes roadway width of Walsh County Road 14

[5] Values based on survey data collected in 2018

2 FIELD SURVEY

Survey data for the Matejcek Dam Rehabilitation Plan was collected in the fall of 2018 and the spring of 2019. Survey data for the Forest River and other streams in the Forest River Watershed has been collected intermittently beginning in 2013. The data collected specifically for the Matejcek Dam Rehabilitation Plan includes surveyed cross sections for the downstream channel, a topographic survey of the dam embankment and auxiliary spillway, and a bathymetric survey in the reservoir upstream of the dam. Each of the survey processes is described in more detail in the following sub-sections.

2.1 DOWNSTREAM CHANNEL SURVEY

The channel survey conducted in the Forest River began in the fall of 2018 and was completed in the spring of 2019. The extent of the survey spanned from the outlet of Matejcek Dam to downstream of North Dakota State Highway 18. The survey consisted of river channel cross sections, and river channel hydraulic structures that had not been surveyed through previous planning efforts in the watershed.

2.1.1 METHODS

A spacing of 500 feet was used between surveyed channel cross sections. Forest River channel cross section survey data in portions of Sections 1, 11, 12, and 14 in Inkster Township was not collected due to landowners not providing consent to access their property. The Forest River channel survey data collected is shown in **Figure 2-1**.

Five temporary control points were set for the downstream channel survey using GPS and MidStates VRS. The temporary control points used are shown in **Figure 2-1.** The cross sections and profile of the downstream river channel were surveyed using RTK GPS equipment. Cross section data is supplemented with LiDAR collected in 2008 (IWI, 2008-2009). The horizontal datum used throughout the downstream channel survey collect was NAD83 (Conus), GeoID12B, North Dakota State Planes, North. The vertical datum used was NAVD 1988.

2.2 MATEJCEK DAM TOPOGRAPHIC SURVEY

The topographic survey of Matejcek Dam was conducted in the fall of 2018. Some of the elements of the dam that were surveyed include the dam centerline along Walsh County Road 14, edge of asphalt, spot points for the upstream dam face, and spot points for the downstream dam face. The principal spillway outlet structure was surveyed as well with data points for the top of the concrete riser structure, orifice openings in the riser, and the outlet of the structure into the Forest River. The auxiliary spillway was also surveyed from the upstream side of the dam near the normal pool to downstream of the dam where the spillway enters in the Forest River channel. **Figure 2-2** shows the topographic data collected at Matejcek Dam. **Appendix B** contains additional maps showing the topographic survey collected at Matejcek Dam. Supporting information on topographic survey data can be found in **Appendix C**.

2.2.1 METHODS

A maximum spacing of 50 feet was used to collect cross sections across the dam. The maximum distance between profile shots for the top of dam and emergency spillway centerline was also 50 linear feet.

Four temporary control points were set for the topographic survey using GPS and MidStates VRS. Four nails with ribbon were used for survey control. A level circuit was run through all 4 control points with a level

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to verify vertical accuracy and continuity. The control points used for the topographic survey of the dam are shown in **Figure 2-2**. A robotic total station was used to survey the profile of the dam, profile of the spillway, and elements of the principal spillway structure. RTK GPS equipment was used to survey cross sections of the dam. The horizontal datum used throughout the topographic survey collect was NAD83 (Conus), GeoID12B, North Dakota State Planes, North. The vertical datum used was NAVD 1988.

2.2.2 CHANGES IN ELEVATION

The topographic survey was compared to key elevations shown on the As-Built drawings presented in **Appendix A.** Elevations in the As-Built drawings reference the NGVD 1929 vertical datum. Elevations at the dam site can be converted from NGVD 1929 to NAVD 1988 by adding approximately 1.2 feet based on the Vertical Datum Conversion Program (VERTCON) available through the National Geodetic Survey (NGS, 2018). For example, the principal spillway orifice inverts are at elevation 1334.80 feet in the As-Built drawings (NGVD 1929), so the elevation of the principal spillway orifice inverts would be at 1336.00 feet in NAVD 1988. The elevation of the principal spillway orifice inverts that was surveyed is approximately 1335.43 feet (NAVD 1988). Therefore, the elevation of the principal spillway orifice inverts is approximately 0.57 feet lower than expected. Similarly, the principal spillway riser tower crest was 0.52 feet lower than expected.

The elevation of the invert of the principal spillway conduit was not obtained due to the inability to access the conduit. Water was flowing through the principal spillway structure at the time of the survey and accessing the conduit through the outlet was not possible due to the flow and small size of the conduit. However, the elevation of the invert of the conduit can be estimated by using similar conversions that were obtained from the other key principal spillway elevations. So, the elevation of the conduit invert would be the invert elevation from the As-Built drawings, plus 1.20 feet, minus 0.55 feet, or 1306.00 + 1.20 – 0.55 = 1306.65.

The elevation of the auxiliary spillway crest was approximately 0.2 feet lower than expected and the elevation of the top of the dam was approximately 1 foot higher than expected. The top of Matejcek Dam is also used as Walsh County Road 14 which is a paved road. An overlay of Walsh County Road 14 would cause the elevation of the top of dam to differ from the expected elevation.

2.3 NORMAL POOL BATHYMETRIC AND SEDIMENTATION SURVEY

The normal pool bathymetric and sediment surveys were done simultaneously in June of 2019. The elevation of the reservoir at the time was 1336.34 feet (NAVD 1988).

2.3.1 METHODS

Bathymetry data for the reservoir at Matejcek Dam was collected using a GPS linked, multi-frequency sonar or, more specifically, Specialty Device Inc.'s BSS+ Sediment Profiling System. Core samples were collected to calibrate the sonar returns from the BSS+ System using a vibrating head core sampler. The grid spacing during the bathymetric survey did not exceed 250 feet in any direction. The survey data points collected are shown on **Figure 2-3**. The survey provided existing sediment elevation and the elevation of the original ground before construction of the dam. The existing sediment elevations are shown on **Figure 2-4**.

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2.3.2 RESULTS

The analysis of the bathymetric survey indicated that the amount of storage available below the 1st stage principal spillway elevation of 1335.43 feet (NAVD 1988) is approximately 2,271 acre-feet. The original design for Matejcek Dam used 2,747 acre-feet of storage at the principal spillway elevation (see Section 4.1 for stage-storage curve). The estimated volume of sediment that has accumulated in the reservoir since its construction in 1966 computed from the multi-frequency sonar data was 305 acre-feet. This equates to a sedimentation rate of 0.13 acre-feet per year per square mile of uncontrolled drainage area. A Supplemental Watershed Work Plan for Matejcek Dam (Grand Forks, Nelson, and Walsh Counties, 1970) indicates that the sedimentation rate predicted was 0.14 acre-feet per year per square mile, and the total sediment storage was estimated to be 333 acre-feet. The distribution of the sediment covers the length of the reservoir at varying depths and is shown in **Figure 2-5**. Additional maps showing reservoir elevations and sediment depths are shown in **Appendix B**.

3 INFLOW DESIGN HYDROGRAPHS

3.1 HYDROLOGY MODEL

Several hydrologic modeling efforts have been completed or are currently underway for other projects in the Forest River Watershed. In 2011, the United States Army Corps of Engineers (USACE) along with local sponsors began work on the development of hydrologic models from Halstad, MN, to the international border (including the Forest River Watershed) using HEC-HMS (V.3.5) as part of the *Red River of the North Hydrologic Modeling – Phase 2* report (USACE, 2013). Methods developed as part of the Phase 2 study were aimed at developing a consistent method to analyze hydrology within the Red River Basin while still accounting for unique characteristics within each subwatershed.

Further development of the hydrologic model was done through the *Forest River Watershed Comprehensive Detention Plan* (Red River Joint Water Resource District, 2013). This effort focused on the development of potential storage sites in the watershed. Through the study, detail was added to the hydrologic model and input parameters were refined through calibration efforts beyond the Phase 2 report.

Recently, ongoing efforts toward a Watershed Plan through the Regional Cooperation Partnership Program (RCPP) have enabled further refinement of the hydrologic model for the Forest River Watershed. As part of the RCPP, an *Existing Conditions Hydrology and Hydraulics Report* for the Forest River Watershed was completed by Houston Engineering Inc. (2019). The hydrologic model detailed in that report was used for this assessment with some minor modifications. Changes to the model and other important elements associated with the hydrology of Matejcek Dam are described in the following sub-sections.

3.1.1 SUBBASIN BOUNDARIES

Subbasins developed through previous modeling efforts included non-contributing drainage areas which were developed to evaluate potential for hydrologically closed basins within the watershed. Non-contributing drainage areas were used for the Principal Spillway Inflow Hydrograph simulation described in Section 3.3.1.

For the Auxiliary Spillway and Freeboard Inflow Hydrographs, all drainage area in the watershed upstream of Matejcek Dam was assumed to contribute runoff. That is, non-contributing areas were not used to simulate the larger runoff events. For the drainage area to Matejcek Dam, the non-contributing areas

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accounted for approximately 6.6 square miles of the total 121.2 square mile drainage area. Nine subbasins upstream of Matejcek Dam were developed, with an average drainage area of 13.5 square miles with all area contributing. The subbasins used in the HEC-HMS model for the larger runoff events are shown in **Figure 3-1**. The subbasins used for the Principal Spillway Hydrograph simulation can be seen in the *Existing Conditions Hydrology and Hydraulics Report* for the Forest River Watershed.

3.1.2 UPSTREAM DAMS

Whitman and Sarnia Dams are also in the HEC-HMS model and are upstream of Matejcek Dam. The performance of these dams has a direct impact on the inflow hydrograph to Matejcek Dam. As-Built drawings for both dams were reviewed to develop accurate elevation-storage-discharge relationships for each dam. The drainage area to Whitman and Sarnia Dams is approximately 56.7 square miles and 19.8 square miles, respectively. The drainage areas for each of the upstream dams is shown in **Figure 3-2**.

3.1.3 MICHIGAN SPILLWAY

The Michigan Spillway Flood Control Project was completed in June of 2016 with the purpose of removing water from the McHugh Slough-Lake Laretta area (Nelson County, ND) and minimize flooding in the City of Michigan, as well as Enterprise, Sarnia, Rubin, and Michigan Townships of Nelson County, ND. The project provides the ability to pump water into the Forest River Watershed upstream of Matejcek Dam at a maximum rate of 50 cubic feet per second. Historically, the region that the Michigan Spillway Project pumps from is a closed, 172 square mile basin. If water were to leave the basin in the past, it would have flowed away from the Forest River Watershed. The historically closed basin and drain associated with the Michigan Spillway Project are shown in **Figure 3-2.**

To simulate the Michigan Spillway Project in the hydrologic model, a source was added with a constant 50 cubic feet per second discharge upstream of Sarnia Dam and was assumed to be constant through all simulations. Simulations were started several days before rainfall events began to allow the regulated discharge to make its way through the hydrologic system.

3.2 PROBABLE MAXIMUM PRECIPITATION

The probable maximum precipitation (PMP) event for Matejcek Dam was developed using Hydrometeorological Report No. 52 (HMR52) (Hansen, Schreiner, & Miller, 1982). The HMR52 storm development method made available through HEC-HMS version 4.2.1 (U.S. Army Corps of Engineers, 2017) was used to assist in PMP development for a 72-hour duration storm. Depth-area-duration data for the watershed upstream of Matejcek Dam was developed based on Hydrometeorological Report No. 51 (Schreiner & Riedel, 1978).

The storm centroid and orientation were adjusted to obtain the maximum stage in the reservoir at Matejcek Dam. The preferred orientation for storms near Matejcek Dam is 250 degrees measured counterclockwise from North based on Figure 8 of HMR52. The orientation that produced the highest stage level at Matejcek dam was determined to be 165 degrees. When the orientation of the storm differs by more than 40 degrees from the preferred orientation, a reduction factor can be applied to rainfall depths based on Figure 10 of HMR52. However, the storm pattern area determined for Matejcek Dam is 300 square miles. In that case, HMR52 specifies that there would not be a reduction to PMP depths.

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The resulting storm pattern overlaid with the average PMP rainfall depth for each Forest River subbasin is shown in **Figure 3-3**. (Note: development of PMP values specific to the state of North Dakota is underway and will be considered in future analysis).

3.3 SPILLWAY DESIGN HYDROGRAPHS

Spillway design hydrographs were developed based on criteria in *Technical Release 210-60: Earth Dams and Reservoirs* (NRCS, 2019), also known as *TR 210-60*. Matejcek Dam is considered a high hazard dam (hazard classification is discussed further in Section 8 - Dam Breach Analysis and Hazard Classification). The minimum precipitation criteria outlined in *TR 210-60* for high hazard dams is shown in **Table 3-1**, and each of the design hydrographs is described in more detail in the following sub-sections.

Table 3-1: TR 210-60 *Minimum Precipitation Data for High Hazard Dams*

Design Event	Hydrologic Criteria [1]	Depth (inches)
Principal Spillway	P_{100}	4.70 [2] 7.35 [3]
Auxiliary Spillway	P_{100} + 0.26(PMP - P_{100})[4]	7.60 [5]
Freeboard	PMP	27.71 [5]

[1] P_{100} represents the precipitation for the 100-year return period
[2] Runoff depth based on *NEH Part 630 Chapter 21*. See Section 3.3.1
[3] Rainfall depth based on *NOAA Atlas 14*. See Section 3.3.1
[4] P_{100} depth used to calculate the Auxiliary Spillway depth utilized the NOAA Atlas 14 published depth for equivalent duration events.
[5] Depths represent the maximum rainfall depths during the simulation. See Sections 3.3.2 and 3.3.3

3.3.1 PRINCIPAL SPILLWAY INFLOW HYDROGRAPH

Based on *TR 210-60*, the principal spillway of a high hazard dam must pass the 100-year return period storm (minimum) with a duration not less than 10-days without activating the auxiliary spillway. For Matejcek Dam, two methods were used to determine the critical event; runoff volume maps and runoff curve number procedure (NRCS, 2019).

Runoff volume maps presented in Figure 21-2 of *NEH Part 630 Chapter 21* (NRCS, 2019) were used to estimate the 100-year 10-day runoff at 4.7 inches. No areal reduction is applied to the 100-year 10-day runoff depth for the runoff volume maps.

The runoff curve number procedure was used to simulate summer rainfall events for the principal spillway criteria. Rainfall depths for 24-hour, 4-day, and 10-day durations were obtained from *NOAA Atlas 14* (NOAA, 2017). Areal reduction factors were applied to the rainfall depths. The areal reduction factors were based on the drainage area to Matejcek Dam and were obtained from *Technical Paper No. 49 – Two- to Ten-Day Precipitation for Return Periods of 2 to 100 Years in the Contiguous United States* (Miller, 1964). The resulting rainfall depths for the 24-hour, 4-day, and 10-day durations after applying the reduction factors, are shown in **Table 3-2**.

Guidance from *NEH Part 630 Chapter 21* was used to develop the principal spillway mass curve, or runoff distribution curve, for the 10-day runoff event. For Matejcek Dam, 1-hour time increments were used to develop the distribution. Using equation 21-2 from *NEH Part 630 Chapter 21*, the total runoff at any given time during the event can be calculated. These 1-hour values can then be arranged in either a decreasing order (Curve A), an increasing order (Curve B), or a critical stacking order (Curve C). The principal spillway

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mass curves are used with the 4.7 inches of runoff from the runoff volume maps in *NEH Part 630 Chapter 21* (NRCS, 2019) and are shown on **Figure 3-4**.

***Table 3-2**: Principal Spillway Inflow Hydrograph Data*

Method	Duration	Rainfall/Runoff Distribution	Rainfall/Runoff Depth (in)	Peak Inflow to Matejcek (cfs)
Runoff Volume Maps	10-day	*TR 210-60* Curve A	4.7	2,064
Runoff Volume Maps	10-day	*TR 210-60* Curve B	4.7	4,385
Runoff Volume Maps	10-day	*TR 210-60* Curve C	4.7	3,523
Runoff Curve Number	24-hour	Nested	4.90	2,263
Runoff Curve Number	4-day	Nested	6.20	2,625
Runoff Curve Number	10-day	Nested	7.35	2,007

Rainfall events are simulated using a nested distribution as described in the *Forest River Watershed Plan – Existing Conditions Hydrology and Hydraulics Report* (Houston Engineering Inc., 2019). The nested distributions for all three durations are shown on **Figure 3-4.** Curve Numbers used in the simulations represented average antecedent moisture conditions (AMC II).

Quick Return Flow (QRF) is the rate of discharge that persists beyond the flood period of the principal spillway hydrograph. Based on Figure 21-4 in *NEH, Part 630, Chapter 21*, the QRF for Matejcek Dam is approximately 1.5 cubic feet per second, per square mile. This results in a QRF of approximately 172 cubic feet per second (cfs) for Matejcek Dam.

The six different scenarios described were applied to the HEC-HMS model to develop inflow hydrographs at Matejcek Dam. The resultant inflows to the dam were input into the SITES program and adequacy of the principal spillway was evaluated (See Section 5). The inflow hydrographs to Matejcek Dam for all six scenarios relevant to the principal spillway hydrograph are shown on **Figure 3-5**. The peak inflow to Matejcek Dam is listed in **Table 3-2**.

3.3.2 AUXILIARY SPILLWAY INFLOW HYDROGRAPH

The auxiliary spillway hydrograph was developed by using NOAA Atlas 14 rainfall depths and the rainfall depths from the PMP event described in Section 3.2. The dimensionless rainfall distribution used for the analysis was obtained from Figure 21-9 in Chapter 21, Part 630 of the National Engineering Handbook (NRCS, 2019) and is shown on **Figure 3-6**. Based on guidance from *NEH 210-60*, a short duration storm is to be used to check the stability of vegetated auxiliary spillways. For this analysis, 6-, 24-, and 48-hour storms were evaluated for the auxiliary spillway hydrograph. The maximum precipitation depths for each duration are shown in **Table 3-3**.

The three durations were simulated in the HEC-HMS model to develop inflow hydrographs at Matejcek Dam. The resultant inflows to the dam were input into the SITES program and adequacy of the auxiliary spillway was evaluated (See Section 5). The inflow hydrographs to Matejcek Dam for the three durations relevant to the auxiliary spillway hydrograph are shown on **Figure 3-7**. The peak inflow to Matejcek Dam is listed in **Table 3-3**.

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***Table 3-3**: Auxiliary Spillway Inflow Hydrograph Data*

Duration	Maximum Rainfall Depth (in)	Peak Inflow to Matejcek (cfs)
6-hour	7.60	4,298
24-hour	10.06	8,752
48-hour	11.01	9,022

3.3.3 FREEBOARD INFLOW HYDROGRAPH

The minimum design event for the freeboard hydrograph (FBH) defined by *NEH 210-60* is the probable maximum precipitation event described in Section 3.2. The duration of the FBH was developed based on guidance from *TR 210-60*. That guidance states that both the 6- and 24-hour storm durations shall be analyzed, and *NEH, Part 630, Chapter 21* states that a storm duration equal to or greater than the time of concentration shall be analyzed. The time of concentration for subbasins contributing to Matejcek Dam were developed through a calibration effort which is described in the *Forest River Watershed Plan – Existing Conditions Hydrology and Hydraulics Report*. Those subbasins were used to estimate the total time of concentration to Matejcek Dam to be between 36 and 42 hours. Therefore, the durations analyzed for the FBH are 6-, 24-, 48-, and 72-hours, and the most critical duration was evaluated for spillway adequacy. 24-hour Curve Numbers with an average antecedent moisture condition (AMC II) were used to simulate all of the events.

A nested rainfall distribution was used for the 72-hour PMP event within the HEC-HMS software. That distribution was then used to develop the 48-, 24-, and 6-hour dimensionless rainfall distributions by removing incremental rainfall from the beginning and end of the longer duration events. For example, the 48-hour rainfall distribution was produced by taking the 72-hour cumulative rainfall and removing the starting 12 hours of precipitation and ending 12 hours of precipitation. The resulting rainfall distributions for all PMP durations simulated are shown in **Figure 3-8**.

The maximum PMP precipitation depth for each of the durations simulated is shown in **Table 3-4** along with the peak inflow to Matejcek Dam. The resultant inflows to the dam were input into the SITES program and adequacy of the auxiliary spillway was evaluated (See Section 5). The inflow hydrographs to Matejcek Dam for the four durations relevant to the freeboard hydrograph are shown on **Figure 3-9**.

***Table 3-4**: Freeboard Inflow Hydrograph Data*

Duration	Maximum Rainfall Depth (in)	Peak Inflow to Matejcek (cfs)
6-hour	19.09	24,475
24-hour	24.74	34,252
48-hour	26.65	35,866
72-hour	27.71	36,918

4 STAGE-STORAGE-DISCHARGE RELATIONSHIP

The stage-storage-discharge relationships for Matejcek Dam were developed based on topographic survey, bathymetric survey, and LiDAR data (IWI, 2008-2009). The stage-storage and stage-discharge relationships were plotted and are explained in the following sub-sections.

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4.1 STAGE-STORAGE

The bathymetric survey data discussed in Section 2.3 and LiDAR data (IWI, 2008-2009) were used to develop a stage-storage curve for both the existing condition of the reservoir and the original reservoir condition when the dam was built. **Figure 4-1** shows the computed elevation-storage for existing and original conditions, as well as the As-Built elevation-storage curve for the dam. The As-built curve is similar to the original curve developed from the bathymetric survey. At a specific elevation, the difference between the storage of the original curve and existing curve is the volume of sediment at that elevation. For example, at the low-level drawdown elevation of 1309.76 feet (NAVD88) the volume for the existing ground curve is 268 acre-feet and the volume for the original curve is 387 acre-feet. The difference of those two volumes is 119 acre-feet which would be the volume of sediment below the low-level drawdown elevation.

4.2 STAGE-DISCHARGE

The stage-discharge relationship was developed based on survey data collected at the site (see Section 2.2) and As-Built data (see **Appendix A**) for the dam.

4.2.1 PRINCIPAL SPILLWAY STAGE-DISCHARGE

The principal spillway structure elevations were surveyed in the field. The principal spillway rating curve is shown on **Figure 4-2**. The principal spillway structure is a two-stage concrete riser tower. The first stage is two 14-inch by 5.5 feet rectangular orifice openings. The second stage is the opening at the top of the riser tower which contains a weir length of approximately 42 feet. The rating curve was developed from weir and orifice equations and was verified by modeling the structure using HEC-RAS to account for tailwater effects.

4.2.2 AUXILIARY SPILLWAY STAGE-DISCHARGE

The auxiliary spillway for Matejcek Dam is a vegetated earthen spillway that is approximately 375 feet in length and has an exit slope of approximately 10%. The auxiliary spillway rating curve was developed by modeling the spillway with the HEC-RAS program.

5 SPILLWAY ADEQUACY

Inflow design hydrographs were input into the SITES program (USDA and Kansas State University, 2014). The program was then used to determine the hydrologic adequacy of the principal spillway, auxiliary spillway, and freeboard design of Matejcek Dam. The inflow hydrographs were developed using methods detailed in Section 3.3. Matejcek Dam is classified as a high hazard dam. The following sub-sections provide further discussion about the hydrologic adequacy of Matejcek Dam. More information on the SITES inputs and outputs is provided in **Appendix D**.

5.1 PRINCIPAL SPILLWAY

The principal spillway criteria for a high hazard dam is a 10-day, 100-year event. To pass the criteria, the dam must be able to pass the design event without activation of the auxiliary spillway. Based on the results shown in **Appendix D**, (with the current configuration of the principal spillway structure) the auxiliary spillway crest would need to be raised several feet for all scenarios examined to pass the principal spillway hydrograph. The Runoff Volume Maps procedure with incremental rainfall depths occurring in a critical stacking order (Curve C from **Figure 3-4**) produced the highest required auxiliary spillway crest.

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Additionally, the principal spillway structure should empty at least 85 percent of the principal spillway hydrograph routed through the retarding pool in 10 days or less (NRCS, 2019). The results in **Appendix D** show that all of the scenarios that were simulated for the principal spillway hydrograph would need more than 10 days to draw down the reservoir to the required 15 percent storage.

5.2 AUXILIARY SPILLWAY

The auxiliary spillway hydrograph is primarily used to investigate the stability of the auxiliary spillway. Based on guidance from *TR 210-60*, a short duration (6-hour) rainfall event must be used to evaluate stability of the auxiliary spillway. The auxiliary spillway hydrograph event increases the 100-year, 6-hour rainfall depth by a portion of the PMP rainfall depth.

The stability design event was simulated using the SITES program. Based on the results presented in **Appendix D,** a resultant stress of 0.79 pounds per square foot was attained during the short duration event. The maximum exit velocity for the stability design event was 14.3 feet per second.

5.3 FREEBOARD

The freeboard hydrograph design event for a high hazard dam is a probable maximum precipitation event, which produces the probable maximum flood (PMF). To pass the criteria, the dam must be able to pass the PMF through the principal spillway structure and the auxiliary spillway without overtopping the dam. Durations of 6-, 24-, 48-, and 72-hours were simulated. Based on the results shown in **Appendix D**, the top of dam elevation would have to be raised approximately 4 feet to pass the 72-hour PMP event.

The freeboard hydrograph is also used to evaluate the integrity of the auxiliary spillway. Based on guidance from *TR 210-60* the auxiliary spillway must not breach during passage of the freeboard storm. Integrity analysis was completed by using the SITES software. Results shown in **Appendix D** show that the auxiliary spillway would breach during passage of the freeboard hydrograph. Sensitivity analysis on some of the parameters showed that even with less conservative values the spillway would still breach. Therefore, the integrity of the auxiliary spillway at Matejcek Dam is considered inadequate.

A summary of all identified deficiencies for the spillways associated with Matejcek Dam is provided in **Appendix D**.

6 GEOLOGIC INVESTIGATION

A geologic investigation was conducted by Gannett Fleming, Inc. The purpose of the geologic investigation was to develop profiles and geotechnical data for evaluation of the spillway integrity and for characterization of the embankment and foundation soils.

Soil borings were done at 6 different locations for Matejcek Dam. Several laboratory tests were conducted on soil samples obtained from the soil borings. The tests performed include tests for moisture content, unit weight, soil strength, and several others. A map showing the location of each soil boring is displayed in **Appendix E** along with the results of the laboratory tests conducted and the general findings from the geotechnical exploration.

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Geotechnical analyses were performed based on the data obtained from the geotechnical exploration. The analyses completed included the SITES analysis (see **Appendix D** for more information on SITES modeling), drain fill compatibility analysis, seepage analysis, and slope stability analysis.

The drain fill compatibility analysis indicated that the existing drain fill does not meet drain fill gradation criteria for seepage control. A mortar sand meeting the gradation requirements would be adequate to protect the embankment from dispersive soils. Seepage models showed good correlation with observed piezometer measurements.

The steady-state seepage load condition for normal pool and flood surcharge pool conditions did not meet the required minimum factor of safety in *TR 210-60* when bentonite interbedding within the Pierre Shale is considered. The factor of safety for rapid drawdown loading of the upstream slope is greater than the required minimum factor of safety in *TR 210-60*, however the modeled slip surface is very deep relative to typical rapid drawdown failures. Additional investigations into determining potential impacts from slope stability and seepage should be considered for future analysis and design of alternatives for Matejcek Dam.

7 REVIEW AND INSPECTION OF STRUCTURE

Several site inspections of Matejcek Dam were conducted by Houston Engineering Inc. from August to October 2019. The inspections were to assess the condition of all elements of the dam including the embankment, slope protection, inlet structure, spillway conduit, stilling basin, spillway channel, auxiliary spillway, and all related miscellaneous elements. A dam inspection checklist was used to record findings and is presented in **Appendix F**. Photographs were also taken during all inspection visits. Photographs of the dam site as well as photographs of any noted deficiencies during the site inspections are also presented in **Appendix F**. Previous inspection reports were reviewed to verify existing conditions and to evaluate deteriorating conditions. The reported conditions are based on observations of field conditions at the time of inspection and it is important to note that the condition of the various elements of the dam depend on numerous and constantly changing internal and external factors. Continued care, maintenance, and inspections are necessary to detect unsafe conditions.

7.1 CONCRETE RISER TOWER

All visible sections of the concrete spillway riser structure were inspected for potential damage or movement. Drone footage was used to inspect any visible areas that were not able to be reached by foot. Due to the water levels and debris/trash rack system on the top of the riser, the inside portions of the concrete spillway riser structure were not able to be inspected. No external evidence was observed of any settlement or movement of the structure. External hairline cracking was observed at several levels on the concrete riser walls. It appears this cracking has taken place at possible construction joint locations where a surface treatment has been applied. These cracks do not appear to be significant and do not impact the performance of the structure. There are no signs of significant debris/trash accumulation around the weir openings and all debris/trash cages appear to be in good condition. It has been noted on previous inspection reports that the draw down gate mechanism has not been operable since 1973. Overall, the visible portions of the concrete spillway riser structure appear to be in good condition and no immediate action items were identified.

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7.2 PRINCIPAL SPILLWAY CONDUIT AND OUTLET

Due to the flow through the principal spillway conduit, it was not possible to visibly inspect the conduit sections and joints near the inlet of the structure. It is noted from previous inspections that the conduit joints are constructed with anti-seep collars. The stilling basin headwall, wall sections, joints, and wingwalls were inspected for any visible deterioration or damage. The sections were numbered to reference the locations of the observations made. Section numbers are identified in **Appendix F**. A summary of the deficiencies that were found are noted in **Table 7-1**.

Chute blocks, floor baffle blocks, and the end sill at the conduit outlet were submerged and could not be observed. Chute and/or floor baffle blocks have been previously reported to be completely deteriorated with only exposed rebar remaining. Overall, the condition of the principle spillway conduit, and the stilling basin is adequate. It is recommended that joint openings be sealed to mitigate water and backfill migration, and additional backfill placed in voided areas. All structure elements should continue to be monitored on a regular basis.

7.3 EMBANKMENT AND AUXILIARY SPILLWAY

Overall, the condition of the dam embankment and auxiliary spillway were found to be in good condition. The vegetative cover of the upstream and downstream slopes was in good condition with no bare areas. Small trees were found growing along the waterline and were starting to encroach onto the south side of upstream embankment from the nearby native woodland. A one-acre area of small willows was found growing on the lower portion of the upstream slope at the abutment. There were also two small trees growing just above the St. Anthony Falls (SAF) stilling basin at the safety fence line. The majority of the trees were less than 1 inch in diameter and can be controlled by mowing or spraying.

The vegetative cover of the auxiliary spillway was in good condition. Seventeen large, round hay bales were scattered on the upstream side of the control section for the auxiliary spillway and should be removed.

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Table 7-1: *Matejcek Dam Structural Deficiency Summary*

Deficiency Location	Description
Southeast Wingwall	▪ Evidence of minor erosion of backfill behind wing and under riprap. ▪ Hairline cracking and minor concrete spalling observed on face of wingwall at 45-degree bend.
Section 21	▪ Hairline cracking observed on both interior faces of concrete walls. ▪ Minor concrete spalling at top of wall support beam.
Joint 20	▪ 2” separation observed at top of joint. Appears to be consistent all the way down the wall. ▪ Spalling of concrete observed at north side joint with exposed/failed water stop. Evident migration of sediment through joint. ▪ A large sink hole observed in backfill at north side of joint. Void in backfill behind wall sections is approximately 4’-6” deep x 4’ long x 1’-6” wide.
Section 20	▪ Hairline cracking observed on both interior faces of concrete walls. ▪ Damage to north wall support beam corbel.
Joint 19	▪ 1 ¾” separation observed at top of joint. Appears to be consistent all the way down the wall. ▪ Large spall and crack on south interior face of sections at joint location.
Section 19	▪ Hairline cracking of wall sections and minor spalling observed at grade break point in walls.
Joint 18	▪ Joint separation less than ½” observed. ▪ Minor spalling of concrete at joint observed.
Section 18	▪ Generally, in good condition. No deficiencies noted. ▪ No flow was observed through drain pipe through south face of wall.
Joint 17	▪ Joint separation approximately ½” observed. ▪ Exposed joint filler material observed. ▪ Minor spalling of concrete at joint observed.
Northeast Wingwall	▪ Evidence of minor erosion of backfill behind wing and under riprap. ▪ Hairline cracking and minor concrete spalling observed on face of wingwall at 45-degree bend.

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8 DAM BREACH ANALYSIS AND HAZARD CLASSIFICATION

The breach analysis and hazard classification of Matejcek Dam were evaluated based on guidelines established in *TR 210-60* (NRCS, 2019). The sub-sections that follow describe how the breach analysis was conducted, the results from the dam breach scenario, and the resulting hazard classification associated with Matejcek Dam.

8.1 PEAK BREACH DISCHARGE CRITERIA

The peak discharge criteria for the dam breach were developed using equations found in Chapter 1 of *Technical Release 210-60 Earth Dams and Reservoirs* (NRCS, 2019). Based on *TR 210-60*, the failure or breach of the dam is to be evaluated with the water surface elevation of the reservoir at the dam crest or the peak reservoir stage resulting from the probable maximum flood (PMF). The PMF occurs as a result of the runoff from a PMP event. Equations in Part I of *TR 210-60* were used to compute the peak breach discharge for Matejcek Dam. The peak breach discharge calculated for the dam was approximately 160,000 cubic feet per second.

The downstream water surface profiles for the dam breach were developed using the HEC-RAS program (U.S. Army Corps of Engineers, 2018). The extent of the model and elements used in the model are shown in **Figure 8-1**. Details on the development of the HEC-RAS model are explained in the *Existing Conditions Hydrology and Hydraulics Report* for the Forest River Watershed (Houston Engineering Inc., 2019). To meet the peak breach discharge, the elevation of the reservoir was set to the peak water surface elevation reached during simulation of the freeboard hydrograph, and the breach formation time was altered in the model to yield a peak flow of 160,000 cubic feet per second. The resulting outflow hydrograph from the breach simulation is shown in **Figure 8-2**.

8.2 BREACH RESULTS

The inundation produced from the simulated breach based on *TR 210-60* criteria is shown through the breach zone on **Figure 8-3**. **Figure 8-4** through **Figure 8-7** show more detailed views of the inundation mapping along with structures affected, and roads overtopped throughout the breach zone. The breach zone was established as the area downstream of Matejcek Dam where the water surface elevation for the breach scenario on the mainstem of the Forest River was within half a foot of the water surface elevation for the 100-year synthetic rainfall event.

All homestead structures impacted by the dam breach are summarized in **Table 8-1**. Structures were identified within the HEC-RAS modeling extents via imagery made available through the National Agriculture Imagery Program (NAIP) (United States Department of Agriculture, 2018). Data is provided on maximum inundation depth of the structure, maximum velocity of flow at the structure location, and the amount of time it would take for the breach discharge to reach the structure. In addition to the homestead structures impacted by the breach, an estimated 133 non-homestead structures would be impacted. The additional structures consist mostly of agricultural storage facilities, grain bins, and other buildings used for agricultural production.

Information about roads that are overtopped during the breach scenario is provided in **Table 8-2**. The top of Matejcek Dam also serves as Walsh County Road 14 which would become impassible if the dam were to breach. Only roads and structures within the breach zone were tabulated.

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Table 8-1: *Homestead Structures Impacted by a Breach of Matejcek Dam*

Structure ID	Depth (ft)	Velocity (ft/s)	Arrival Time[1] (hours)
S1	0.1	<0.1	1.3
S2	3.0	1.9	1.2
S3	4.7	1.9	2.8
S4	0.2	4.1	6.5
S5	0.3	<0.1	16.3
S6	0.4	0.3	18.7
S7	1.0	0.1	17.5
S8	0.9	0.1	19.3
S9	0.4	0.5	21.3

[1] Breach arrival time is relative to the initiation of the dam breach

Table 8-2: *Roads Overtopped During a Breach of Matejcek Dam*

Road ID	Road Name	Depth (ft)	Velocity (ft/s)	Arrival Time[1] (hours)
R1	56th Street NE	26.1	9.7	0.7
R2	55th Place NE	24.6	15.5	0.8
R3	127th Avenue NE	20.0	13.9	0.8
R4	ND Highway 32	7.3	8.2	1.2
R5	129th Avenue NE	11.5	14.9	1.5
R6	County Road 12	5.4	3.7	2.7
R7	133rd Avenue NE	7.5	2.2	4.5
R8	134th Avenue NE	8.4	1.1	6.0
R9	35th Avenue NE	8.8	2.7	7.8
R10	36th Street NE	5.5	1.1	13.0
R11	35th Street NE	<0.1	<0.1	16.2
R12	35th Street NE	0.1	<0.1	16.0
R13	35th Street NE	1.3	1.3	15.0
R14	34th Street NE	<0.1	<0.1	19.3
R15	34th Street NE	3.2	1.6	14.7
R16	34th Street NE	0.3	0.1	17.3
R17	34th Street NE	<0.1	0.2	18.2
R18	54th Street NE	0.4	0.6	20.5
R19	54th Street NE	7.1	2.9	16.0

[1] Breach arrival time is relative to the initiation of the dam breach

8.3 HAZARD CLASSIFICATION

Title 210, National Engineering Manual, Part 520 Subpart C "Dams" (NRCS, 2017) describes the hazard potential resulting from failure of dams. According to this guidance, a High Hazard Potential is "Dams where failure may cause loss of life or serious damage to homes, industrial or commercial buildings, important public utilities, main highways, or railroads."

A similar definition is outlined in Article 89-08 of the North Dakota Century Code (ND SWC, 2015) where a High Hazard Dam is defined as, "A dam located upstream of developed or urban areas where failure may cause serious damage to homes, industrial and commercial buildings, and major public utilities. There is potential for the loss of more than a few lives if the dam fails."

Based on the data presented in Section 8.2, Matejcek Dam is classified as a high hazard dam.

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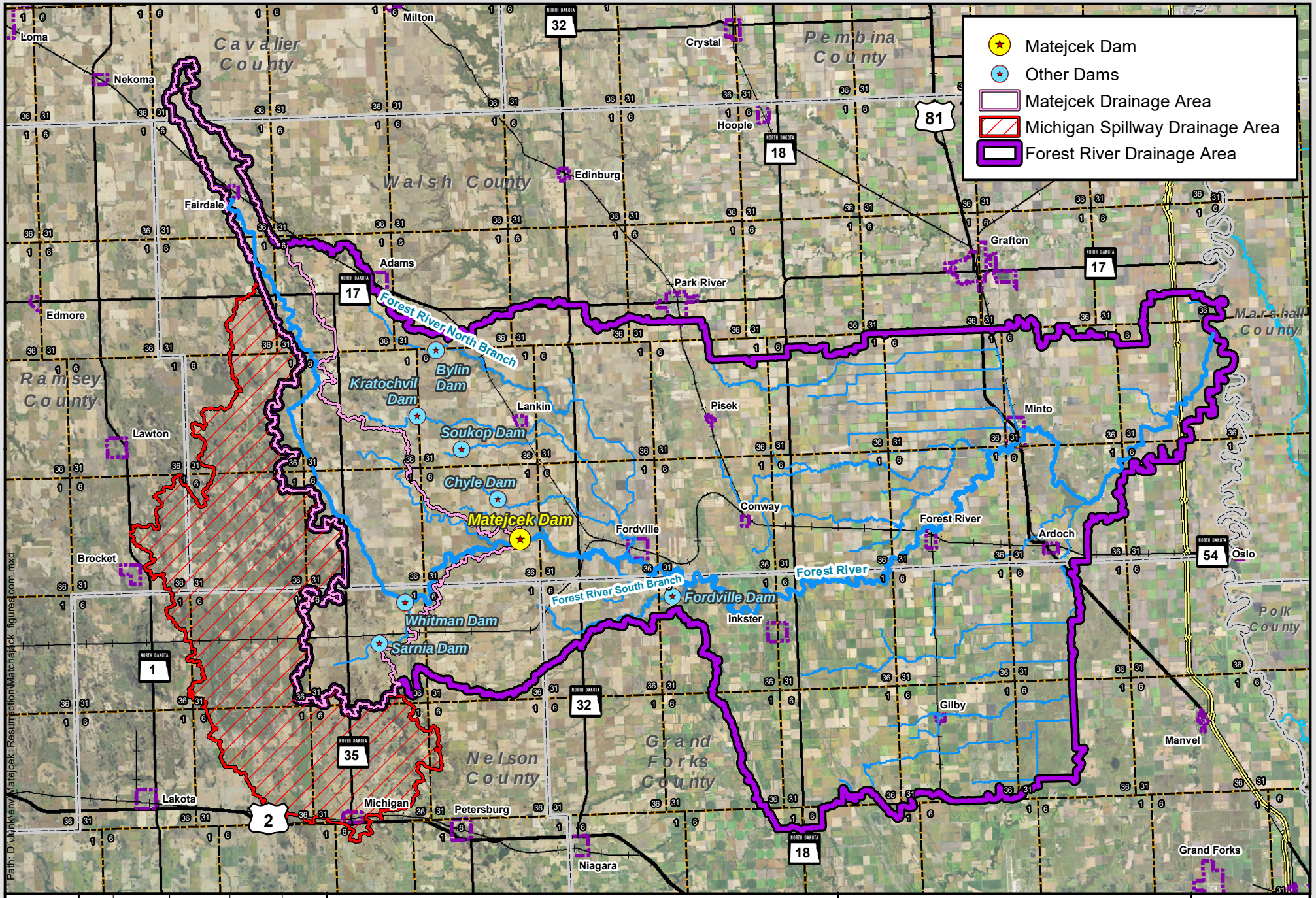
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Figure 8-7: Matejcek Dam Breach Inundation - 4

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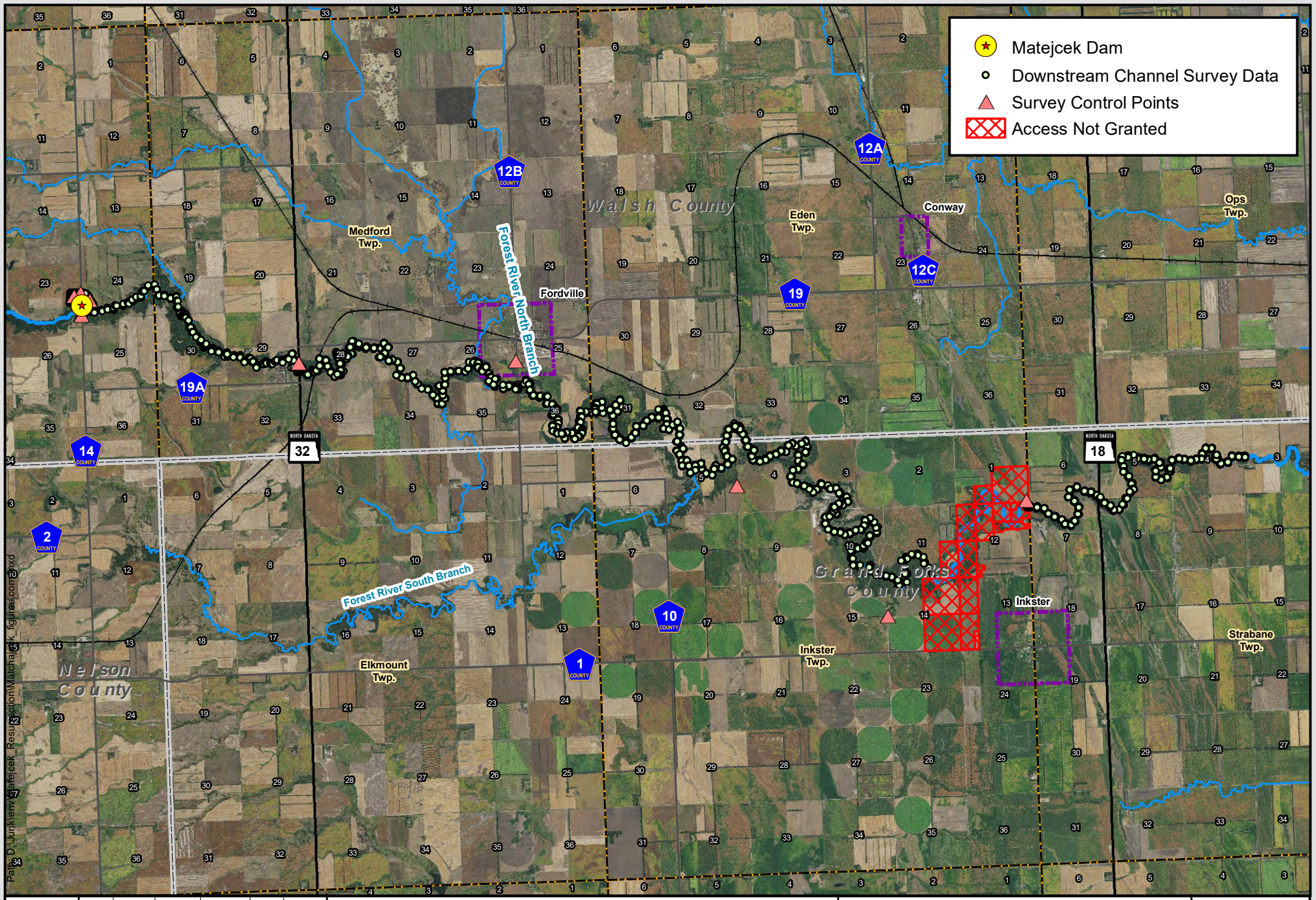
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Figure 1-1: Matejcek Dam Drainage Area

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 7 14 Miles

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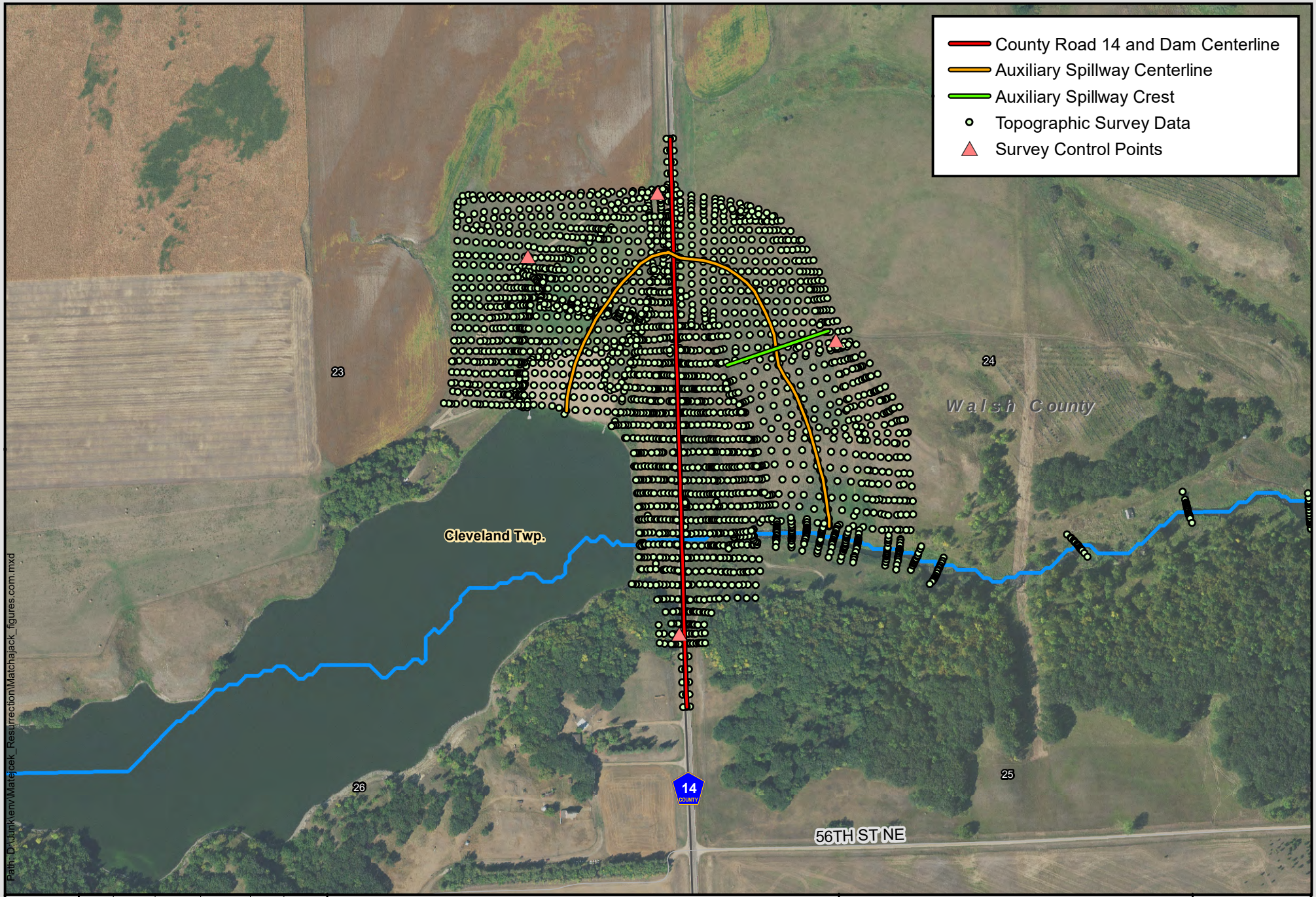
Figure 2-1: Downstream Channel Survey

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

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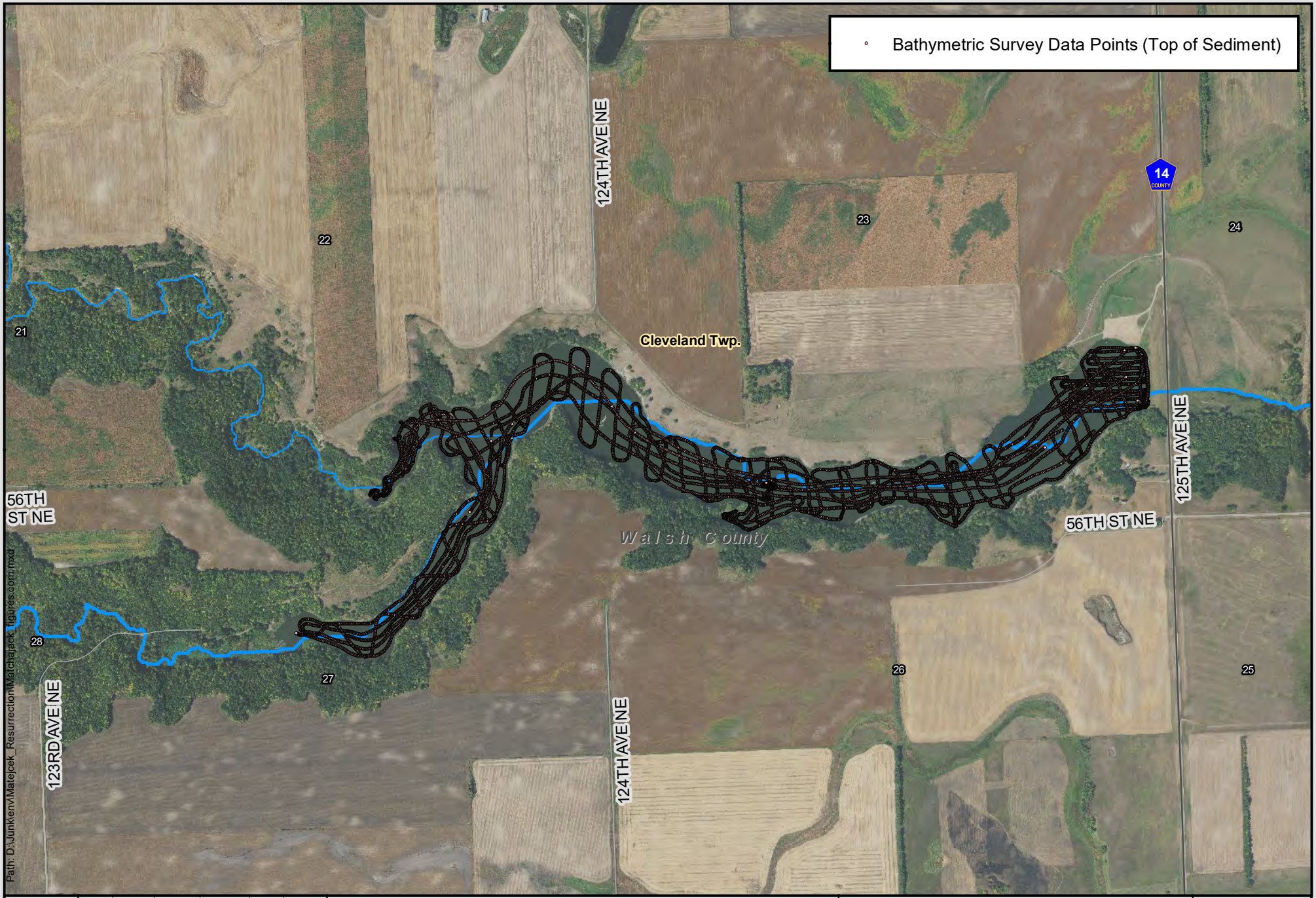
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Figure 2-2: Matejcek Dam Topographic Survey

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 500 1,000 Feet

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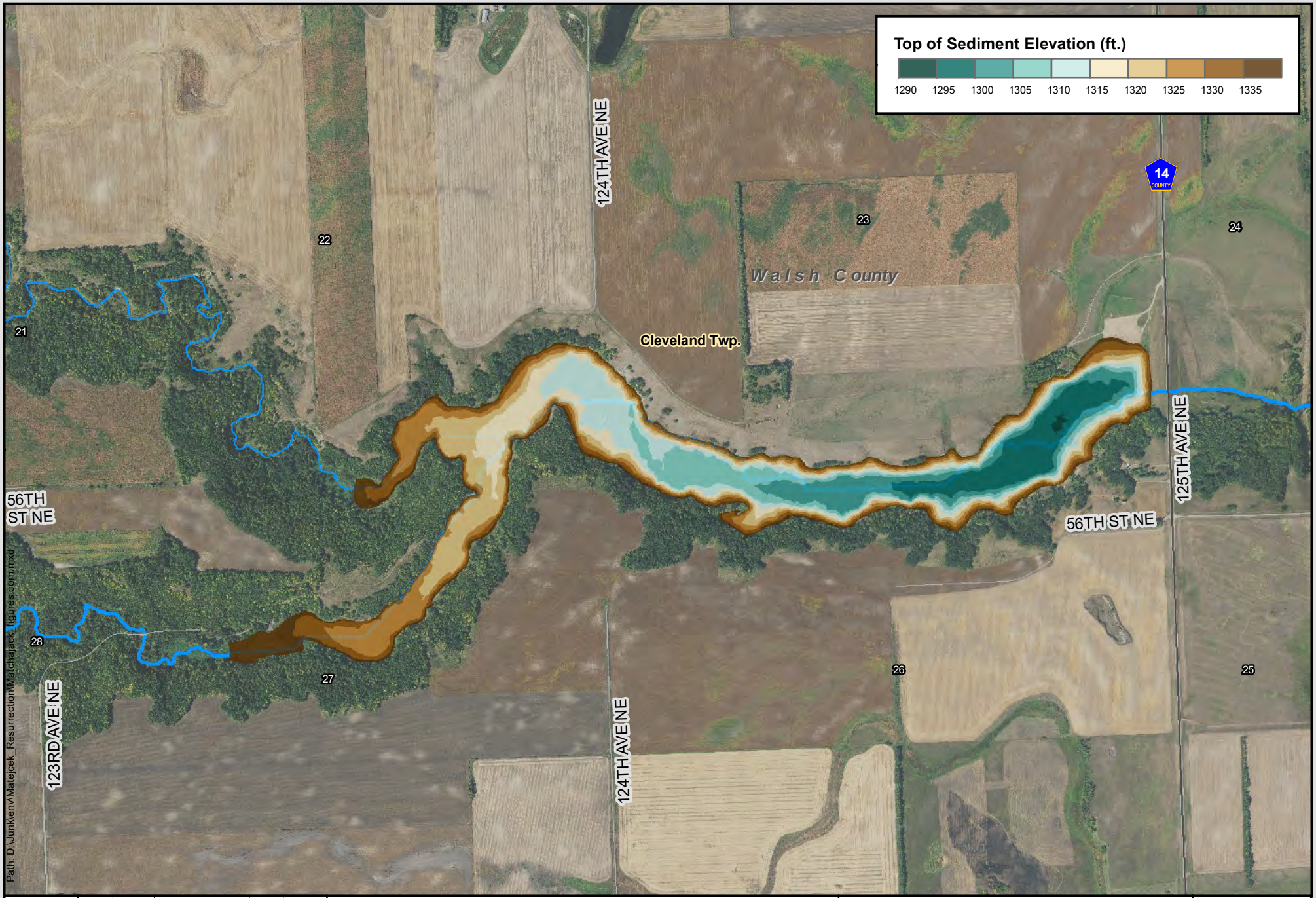
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Figure 2-3: Matejcek Dam Bathymetric Survey Data Points

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 1,250 2,500 Feet

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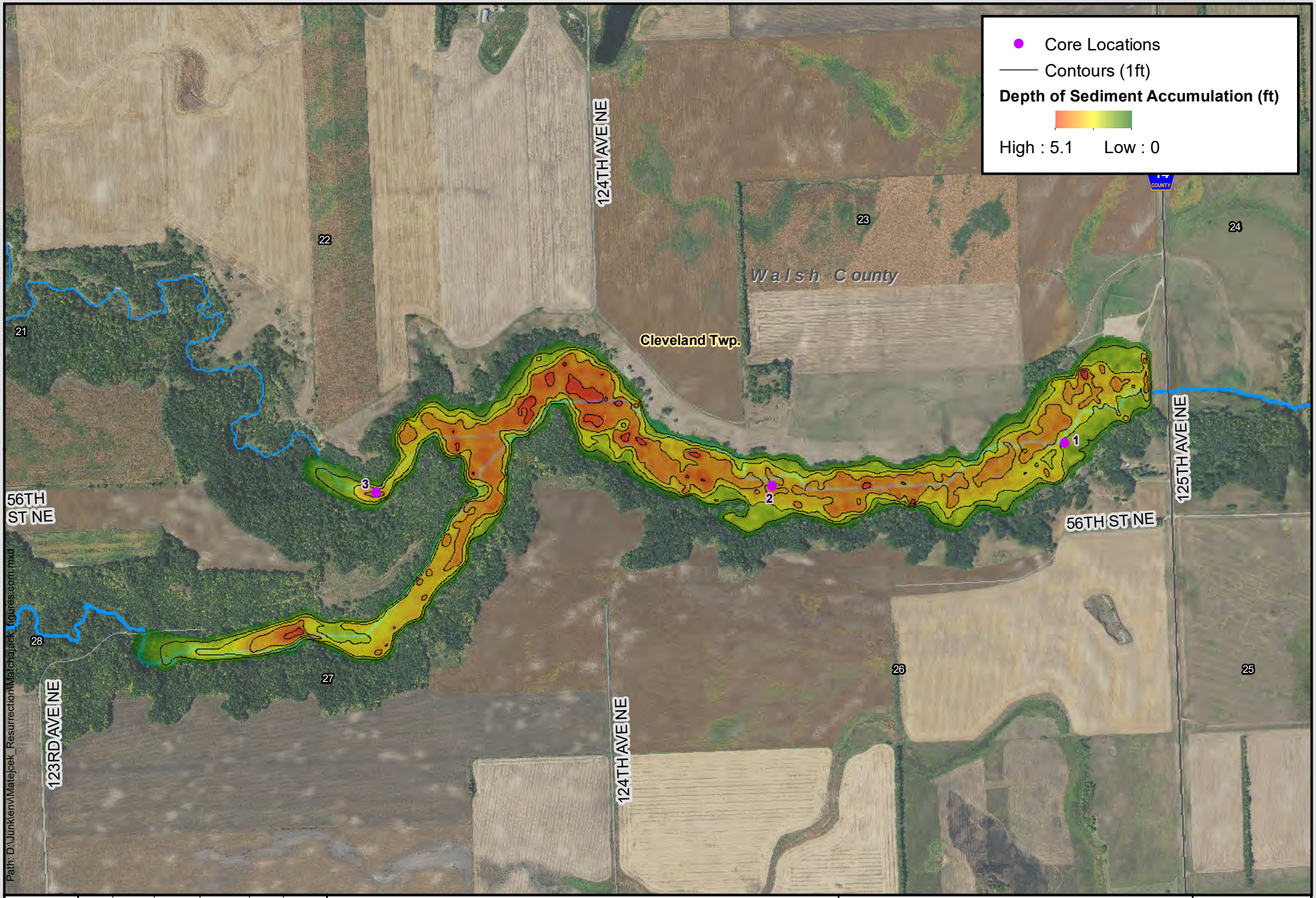
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Figure 2-4: Matejcek Dam Existing Ground Surface Below the Normal Pool

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 1,250 2,500 Feet

N W E S



Path: D:\Junk\env\Matejcek_Resurrection\Matchajack_figures.com.mxd

F2-5

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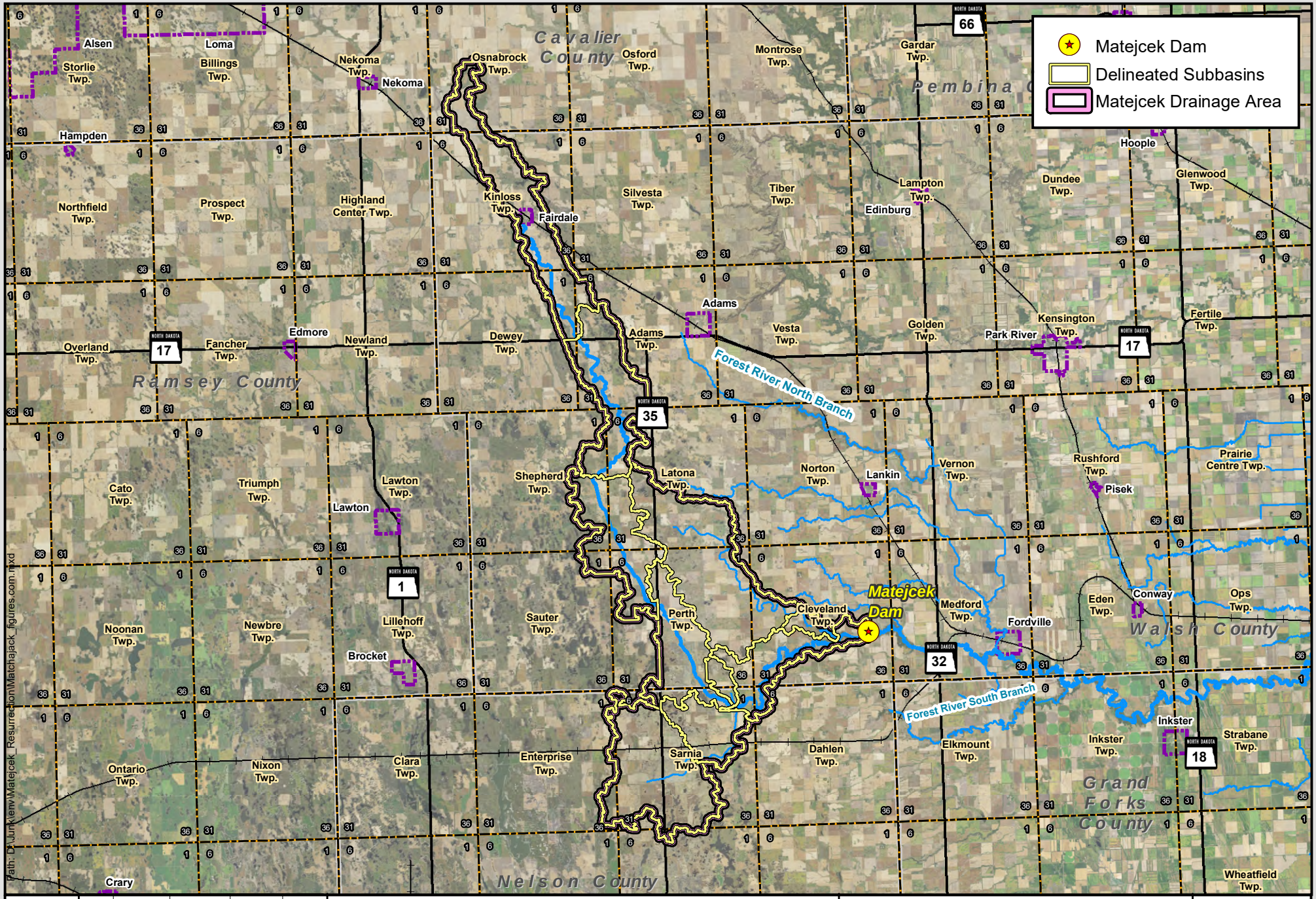
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Fargo, ND 58102
701.237.5065

Figure 2-5: Matejcek Dam Sediment Depth in Reservoir

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 1,250 2,500 Feet

N W E S



F3-1

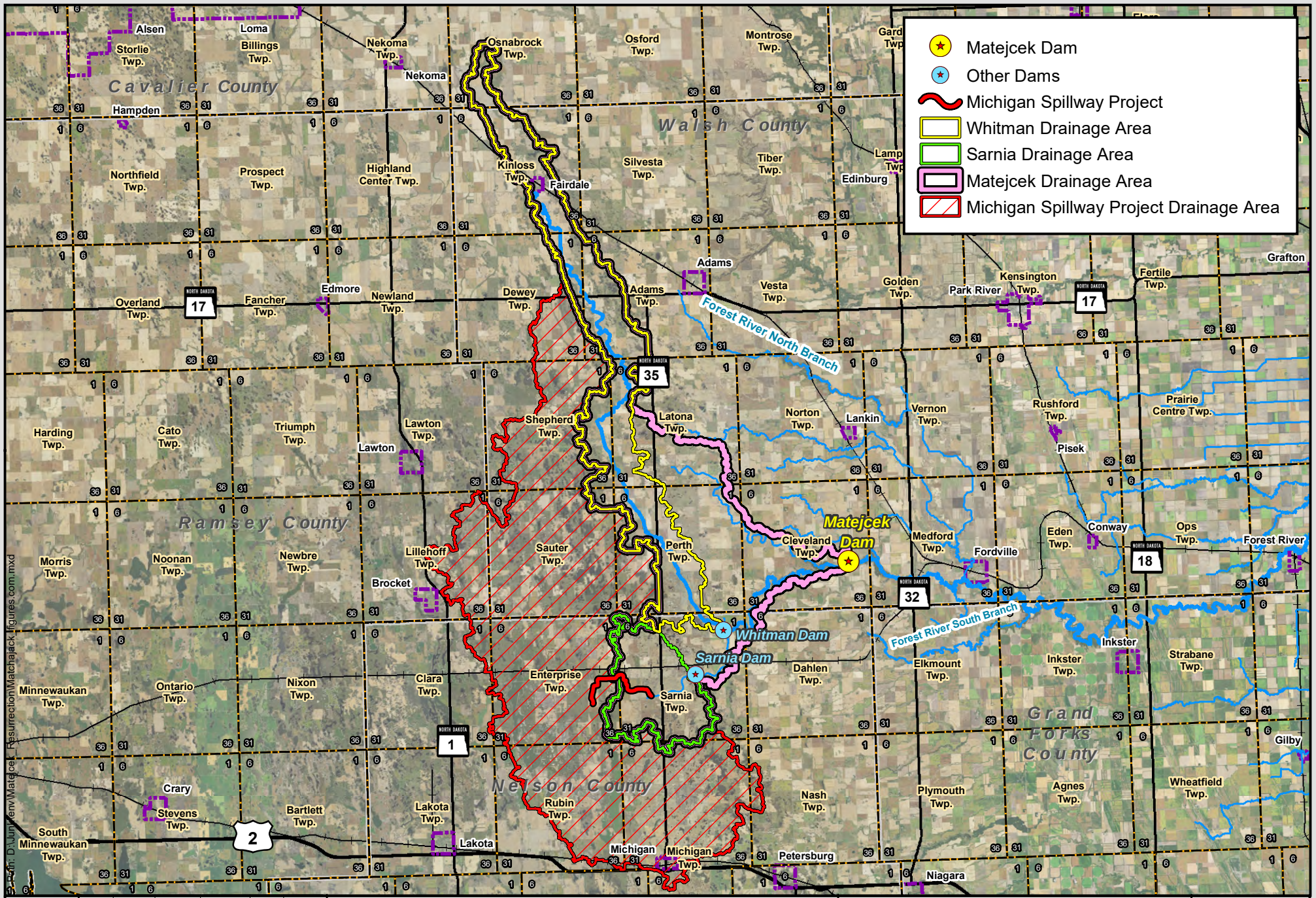
Scale:	Drawn by:	Checked by:	Project No.:	Date:
AS SHOWN	NRI	PDL	7135-0033	10/15/2019

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701.237.5065

Figure 3-1: Subbasins Contributing to Matejcek Dam

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

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F3-2

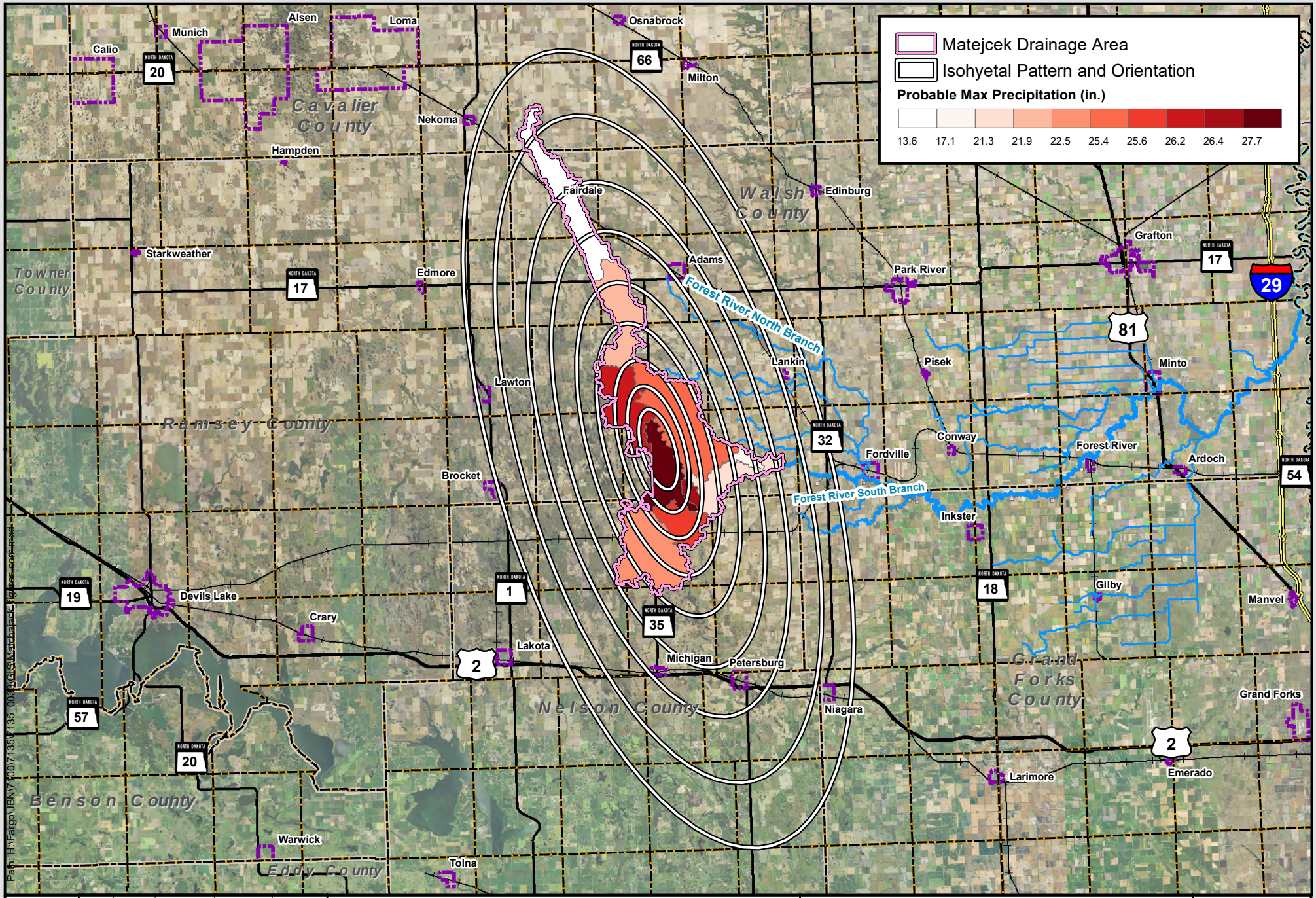
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AS SHOWN	NRI	PDL	7135-0033	10/15/2019	2 of 6

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Figure 3-2: Drainage Area to Upstream Dams

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

J:\Projects\7135-0033\Env\Matejcek_ResurrectionMatchajack_figures_com.mxd



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F3-3

Scale:	Drawn by:	Checked by:	Project No.:	Date:
AS SHOWN	NRI	PDL	7135-0033	10/16/2019

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Figure 3-3: PMP Storm Pattern, Orientation, and Depths

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

***Figure 3-4**: Principal Spillway Mass Curves*

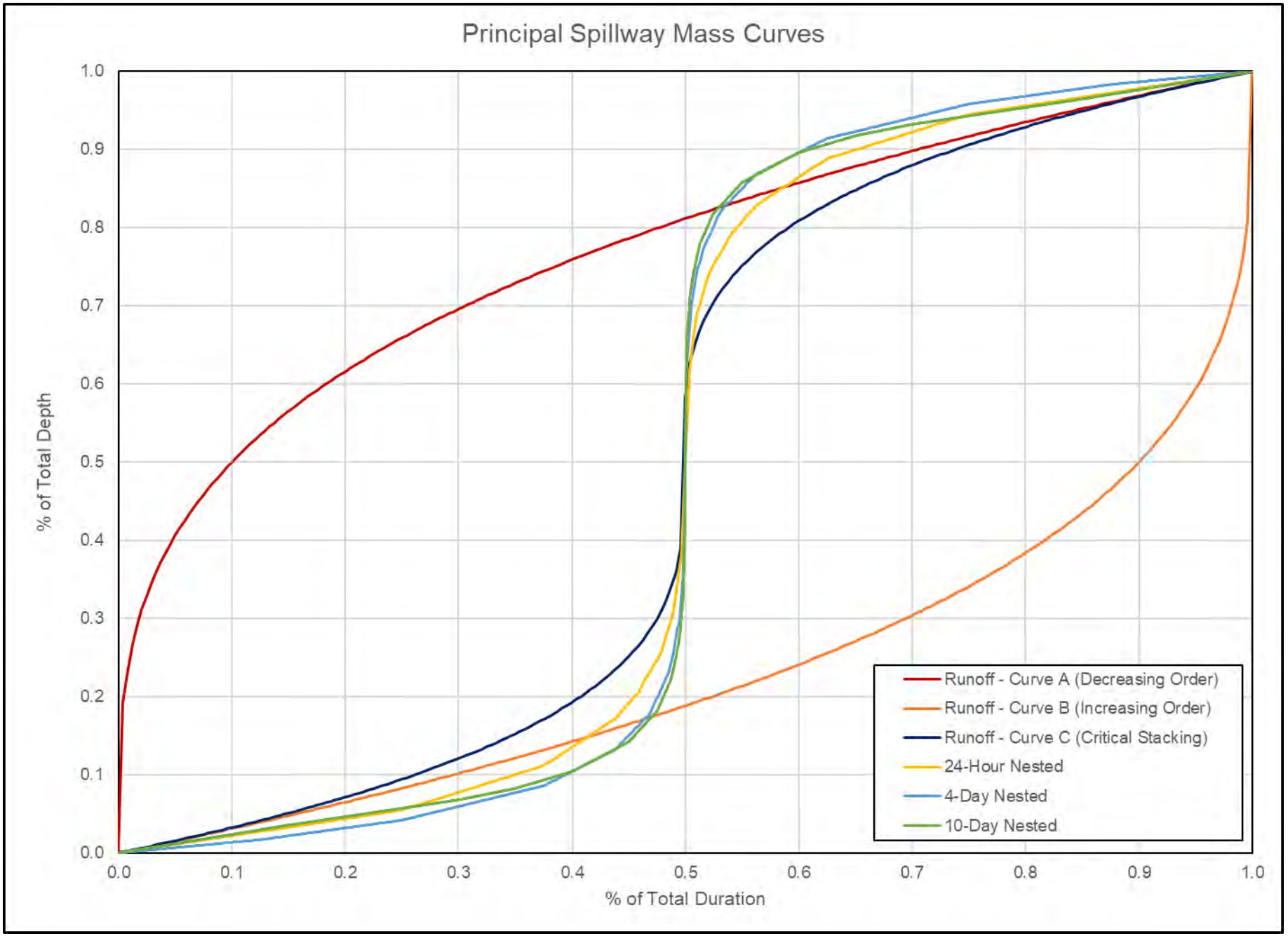


***Figure 3-5**: Principal Spillway Inflow Hydrographs*

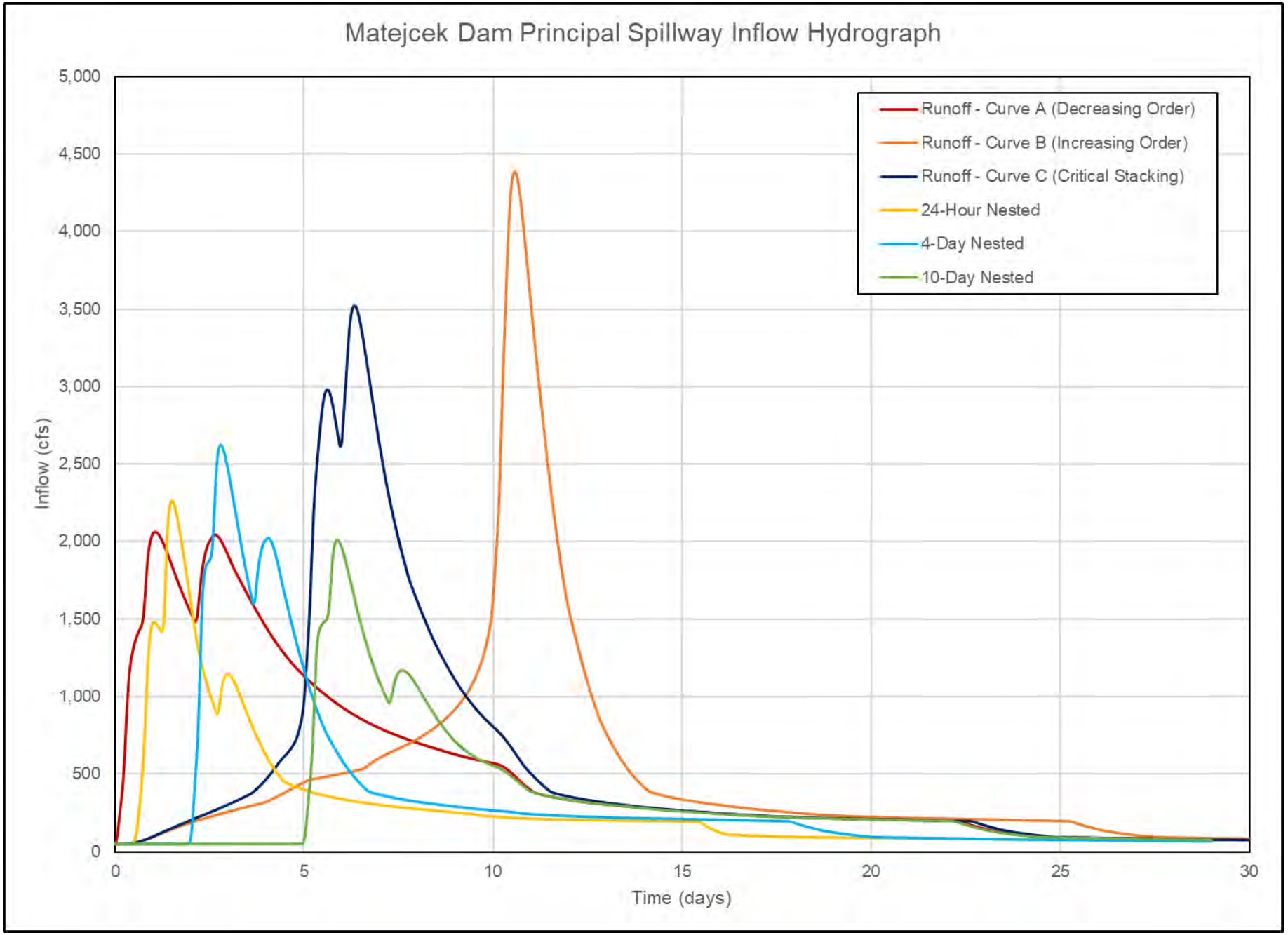


***Figure 3-6**: Auxiliary Spillway Mass Curve*

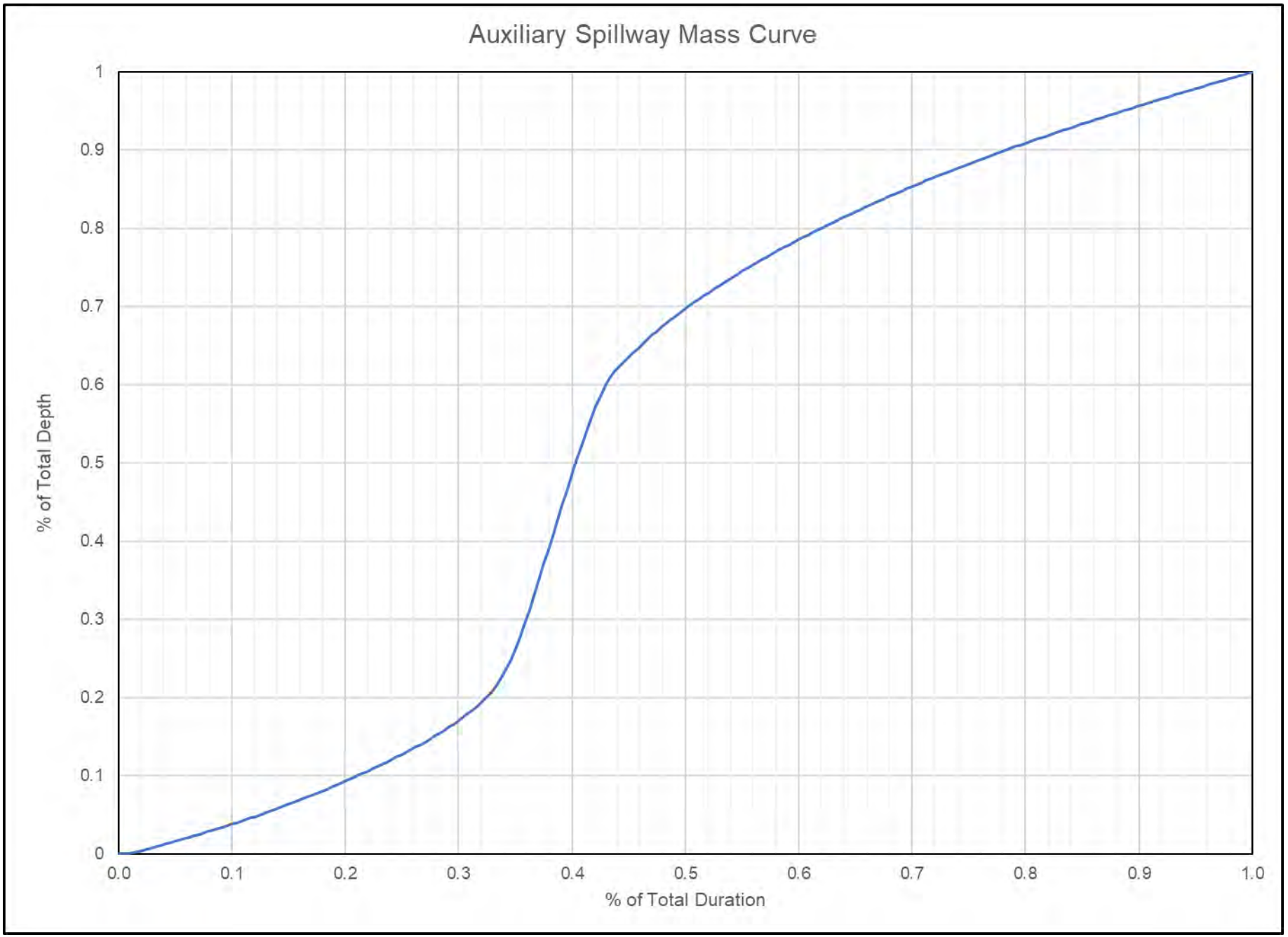


***Figure 3-7**: Auxiliary Spillway Inflow Hydrographs*

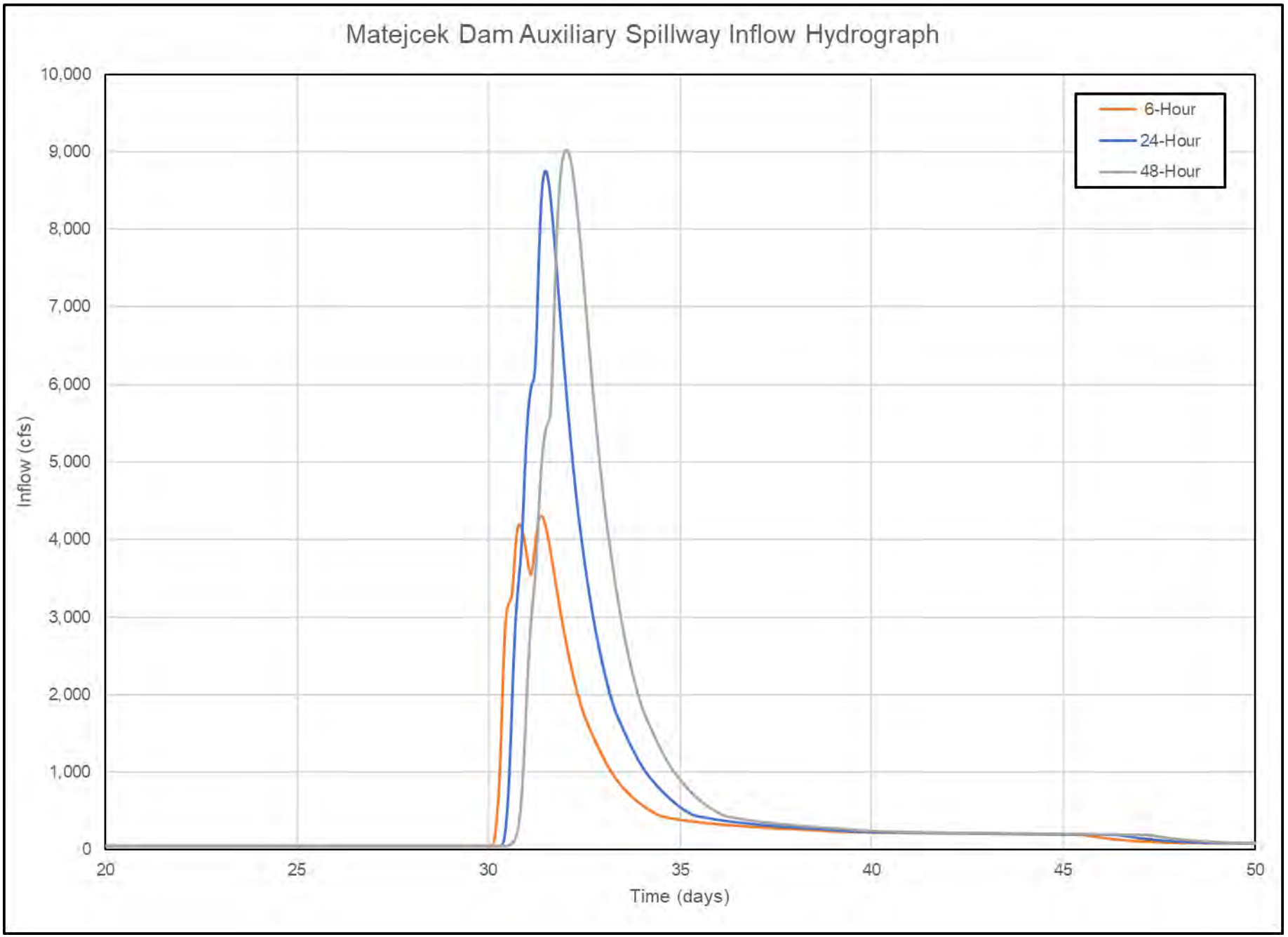


***Figure 3-8**: Freeboard Mass Curves*

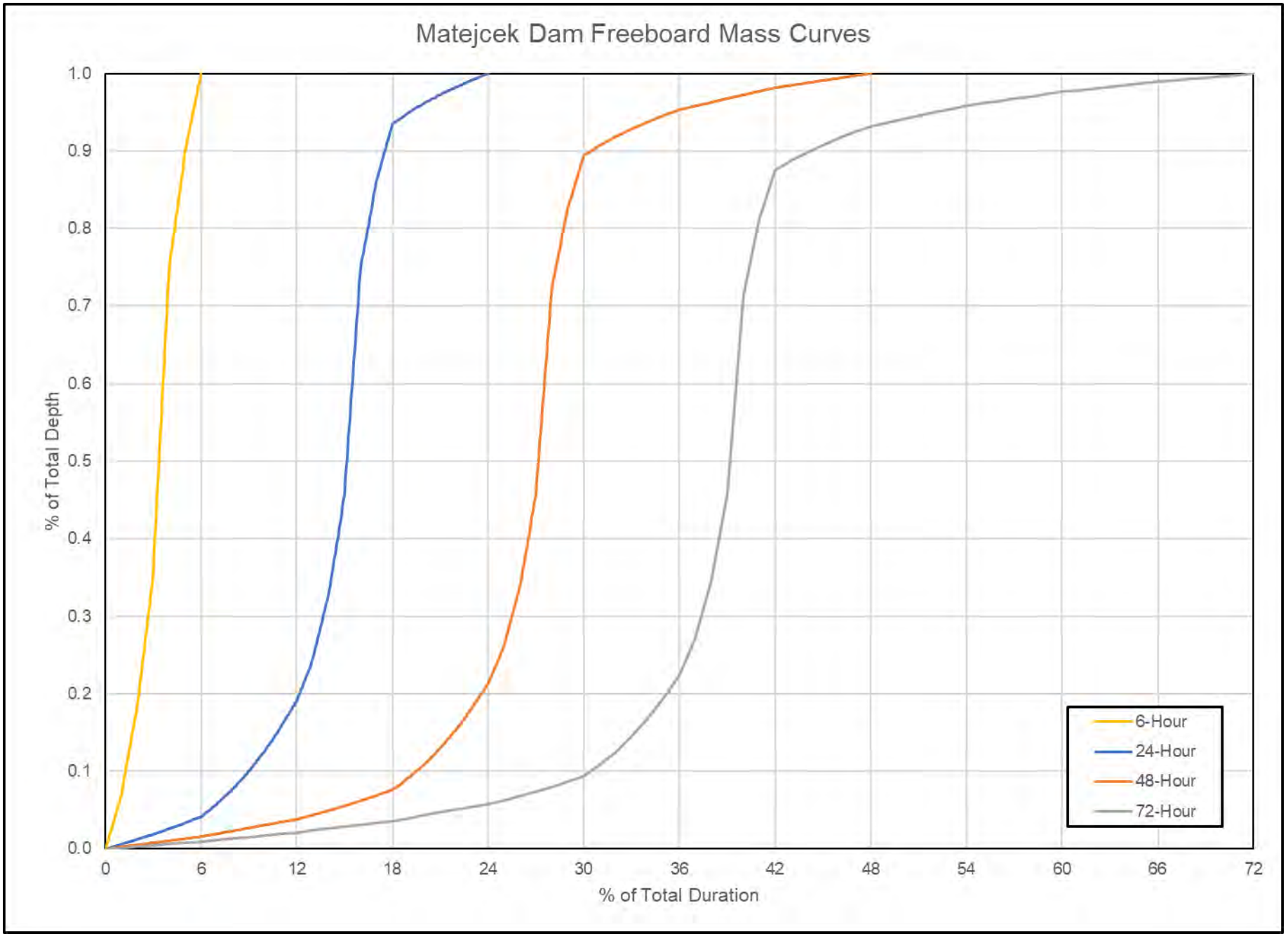


***Figure 3-9**: Freeboard Inflow Hydrographs*

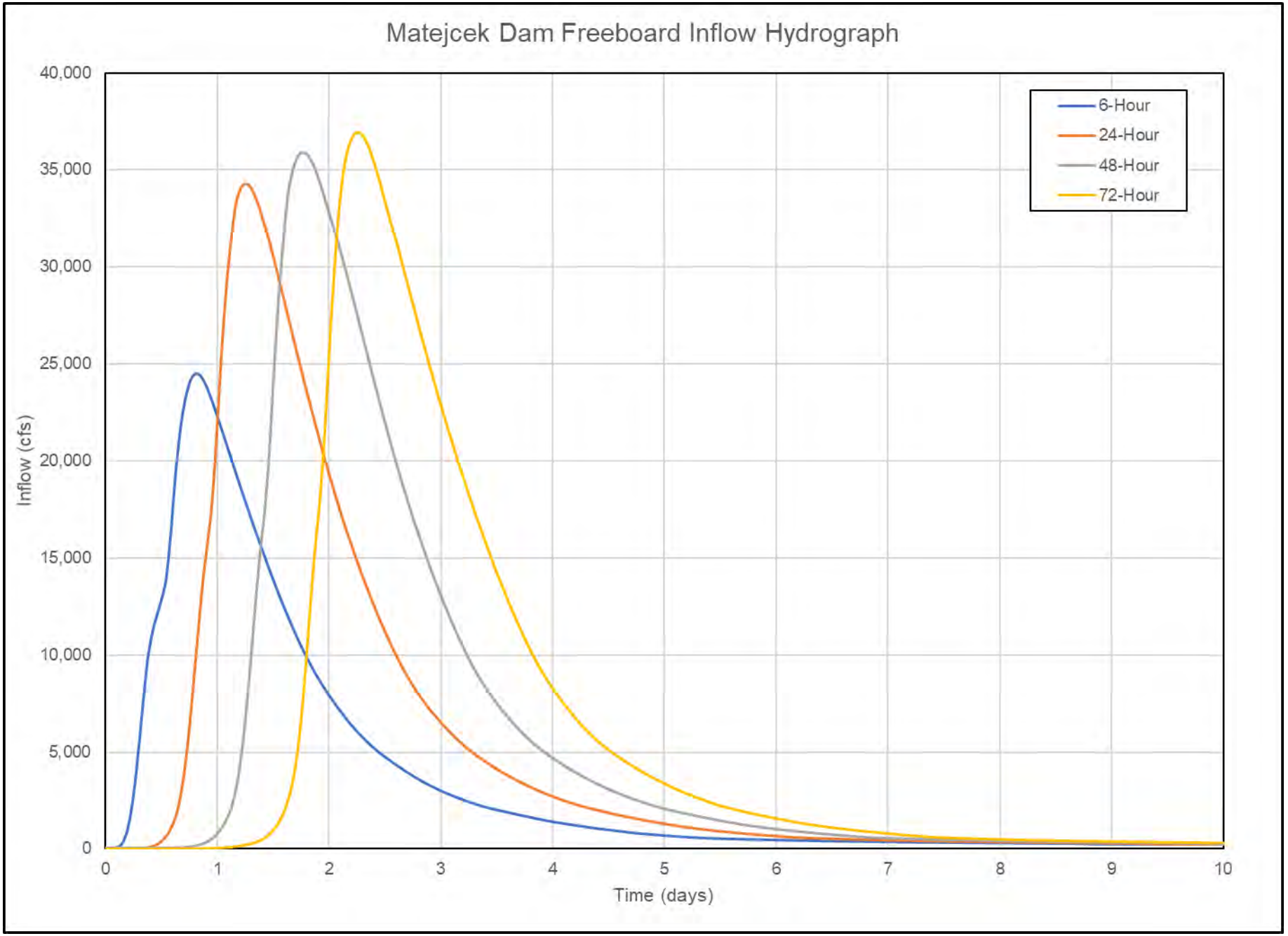


Figure 4-1: *Matejcek Dam Elevation-Storage Relationship*

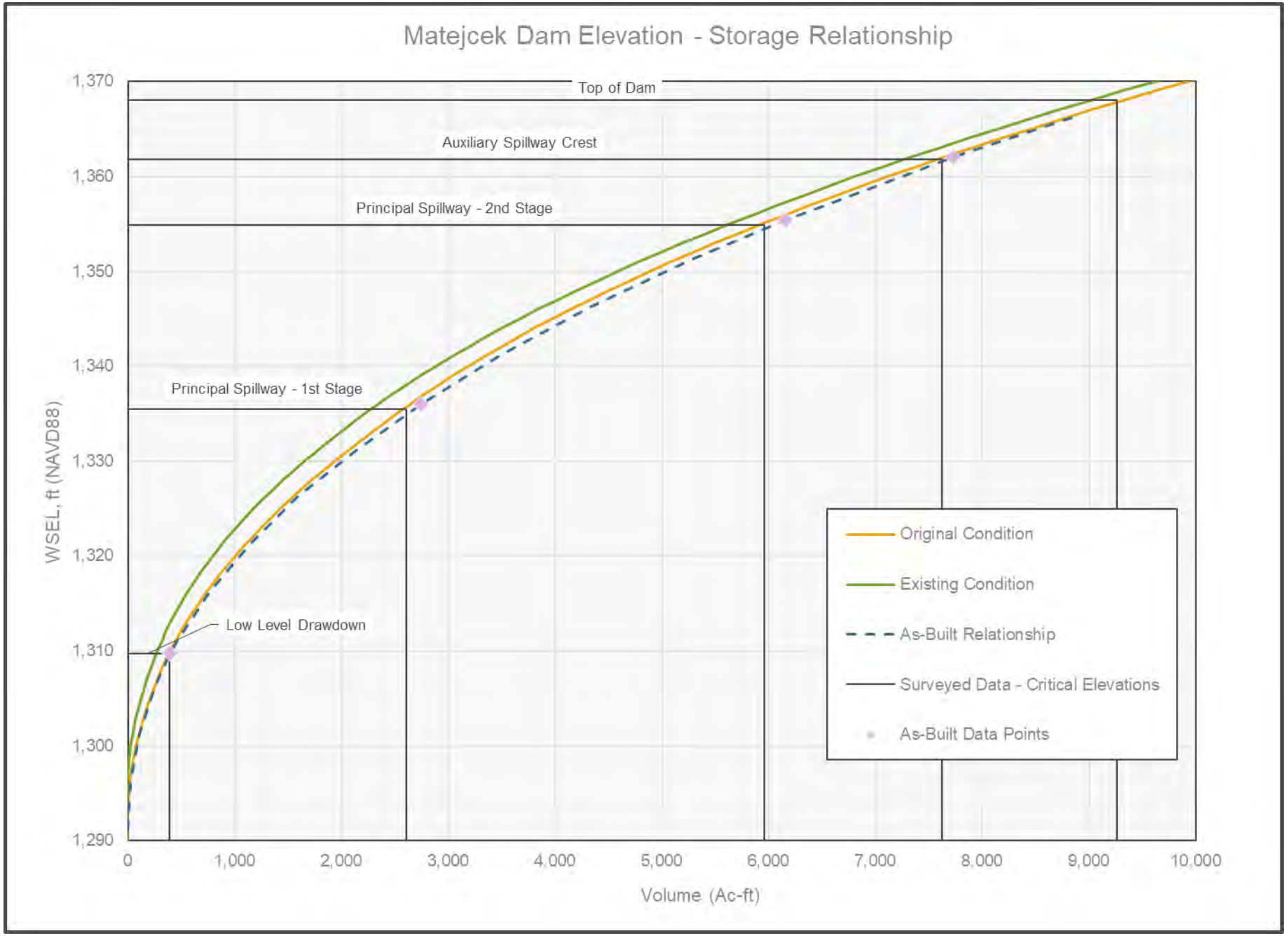
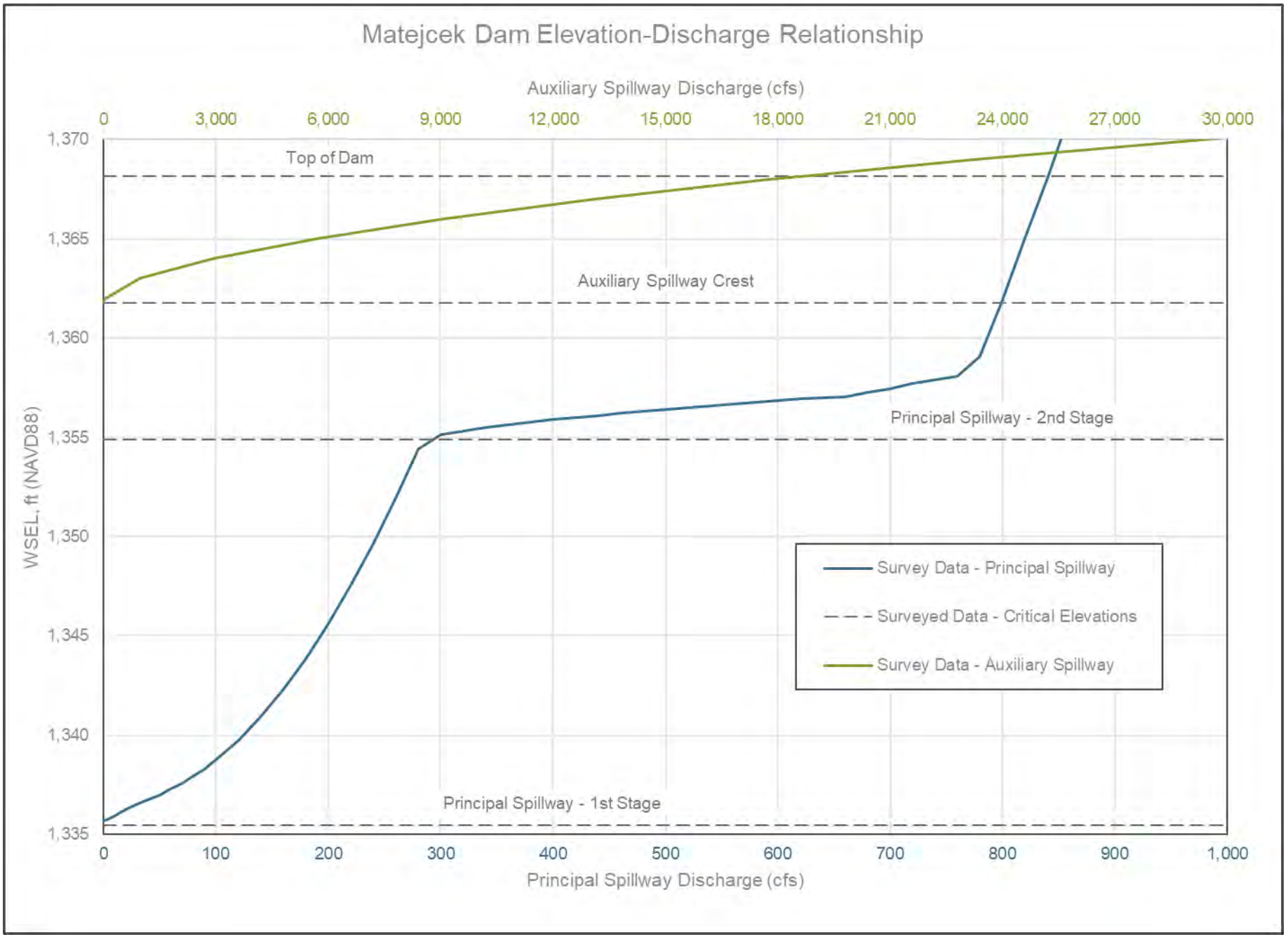
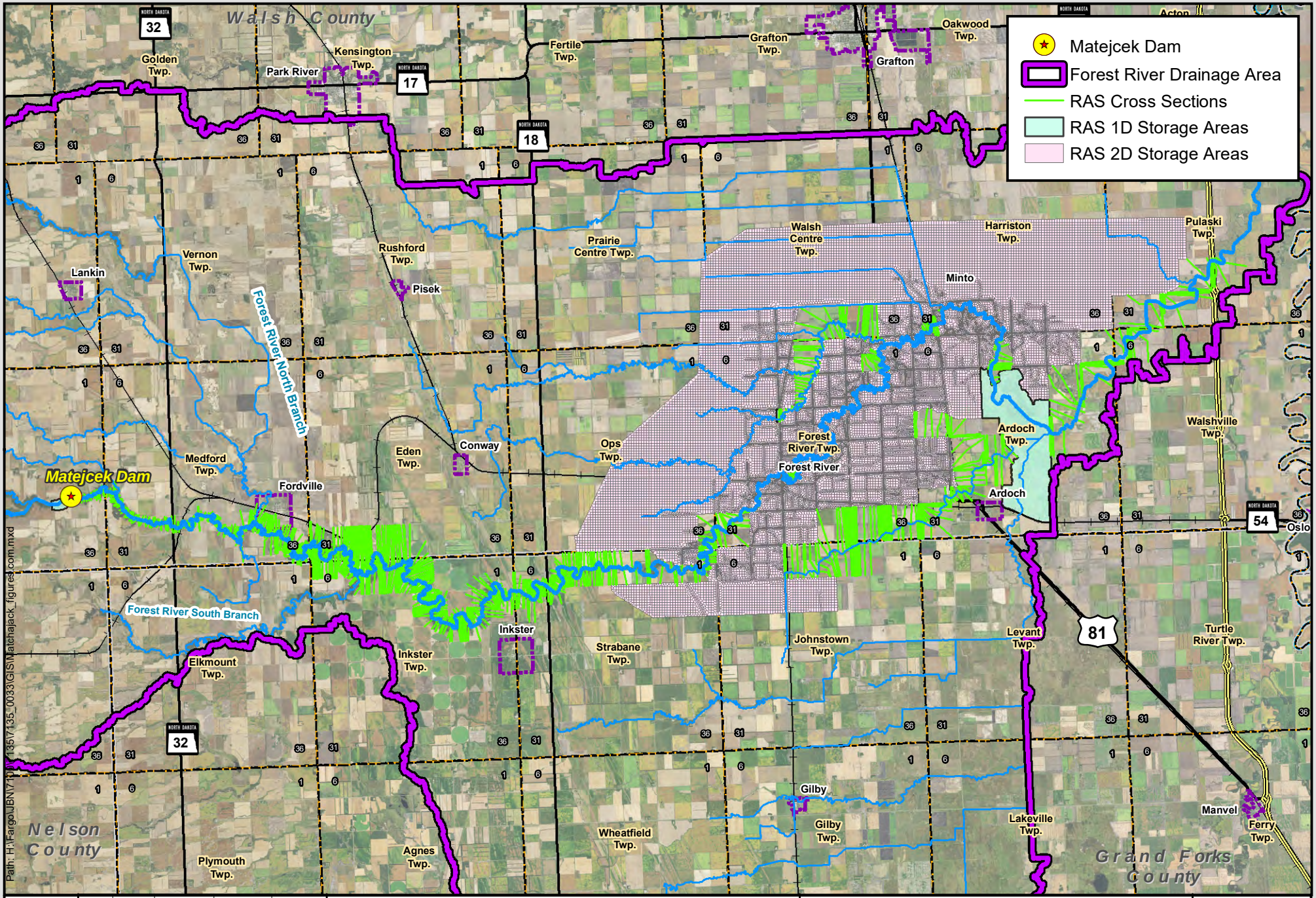


Figure 4-2: *Matejcek Dam Elevation-Discharge Relationship*





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F8-1

Scale:	Drawn by:	Checked by:	Project No.:	Date:
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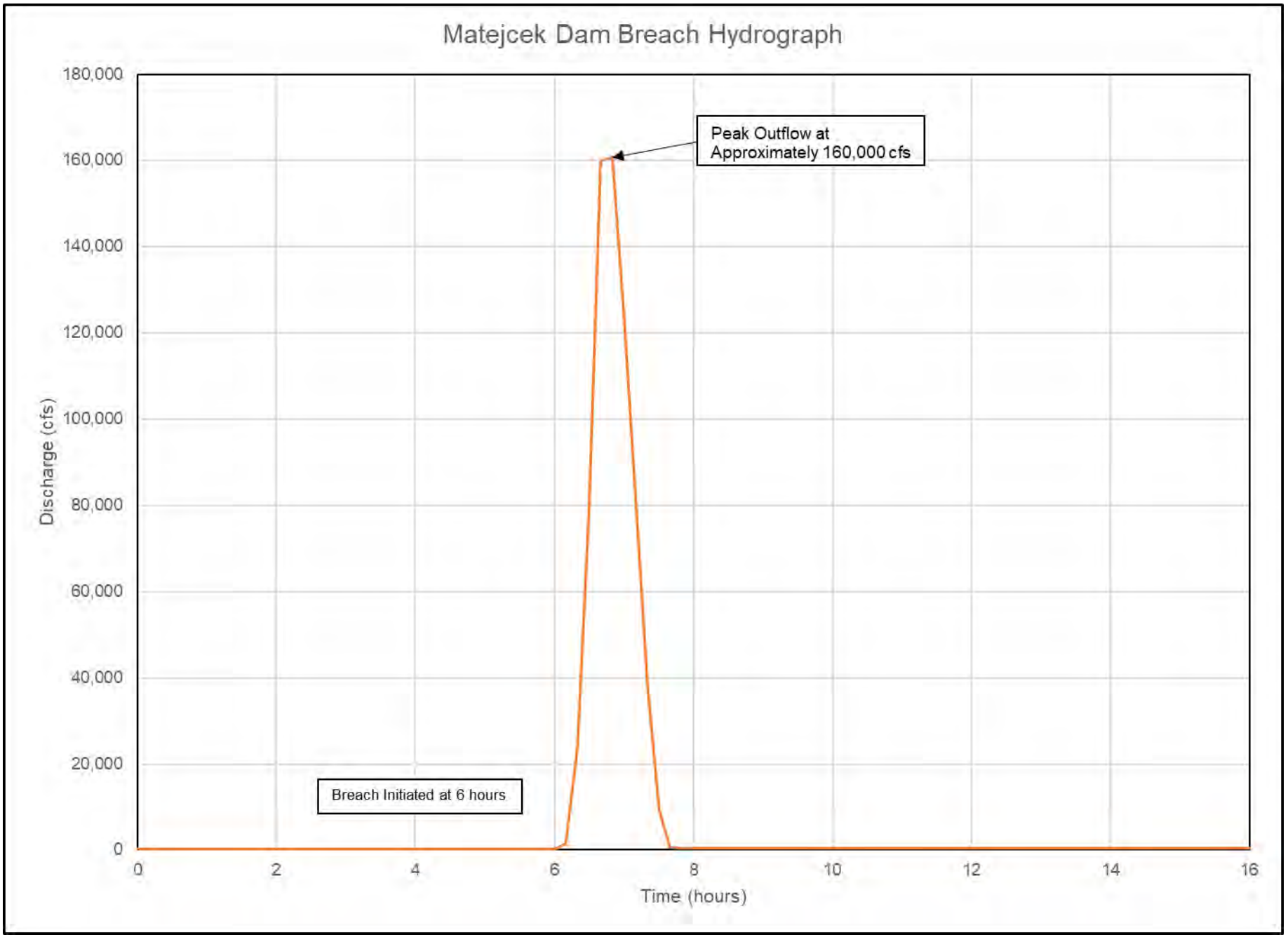
Figure 8-1: HEC-RAS Model Schematic

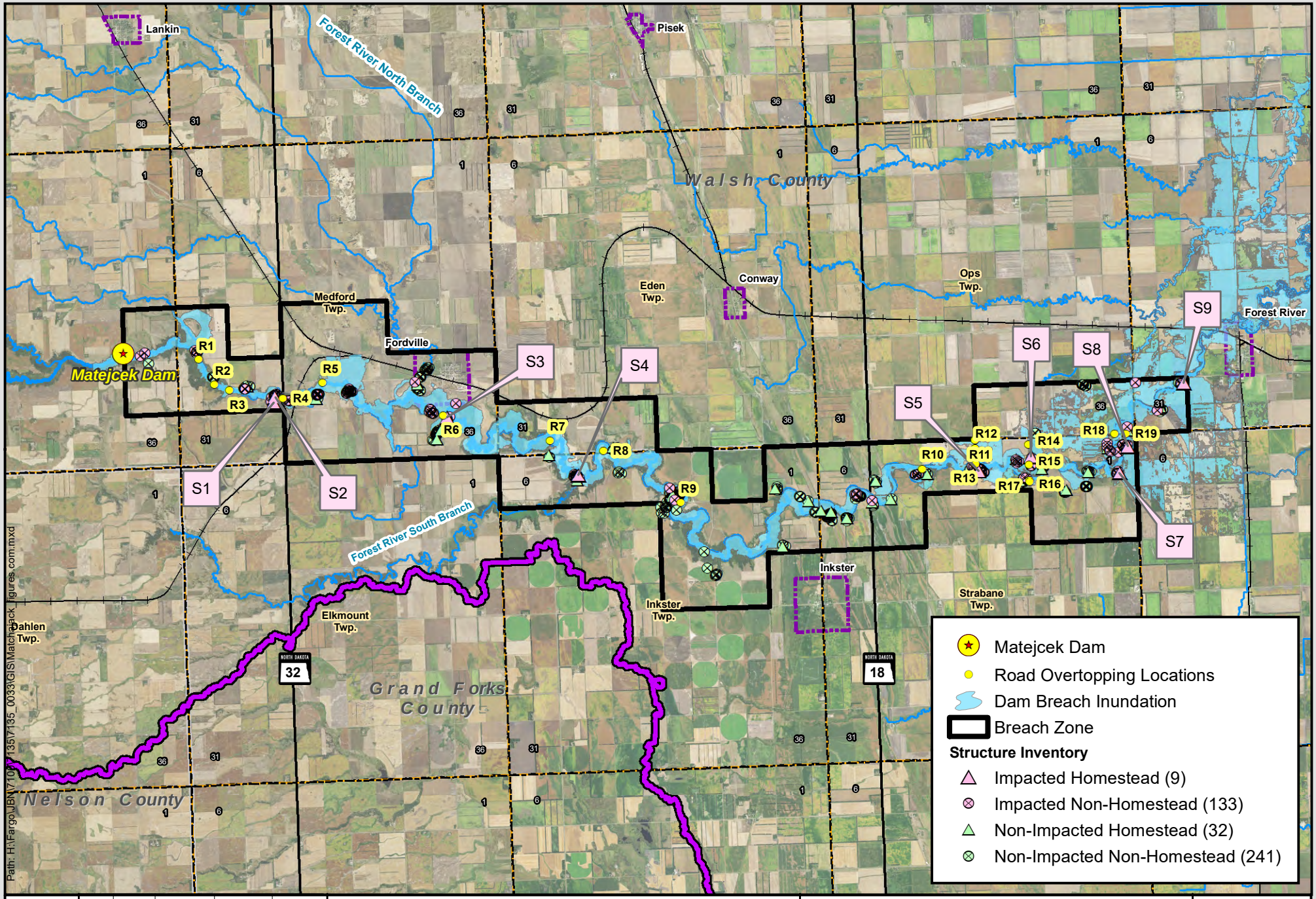
Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 5 10 Miles

N W E S

***Figure 8-2**: Matejcek Dam Breach Hydrograph*





F8-3

Scale:	Drawn by:	Checked by:	Project No.:	Date:
AS SHOWN	NRI	PDL	7135-0033	10/16/2019

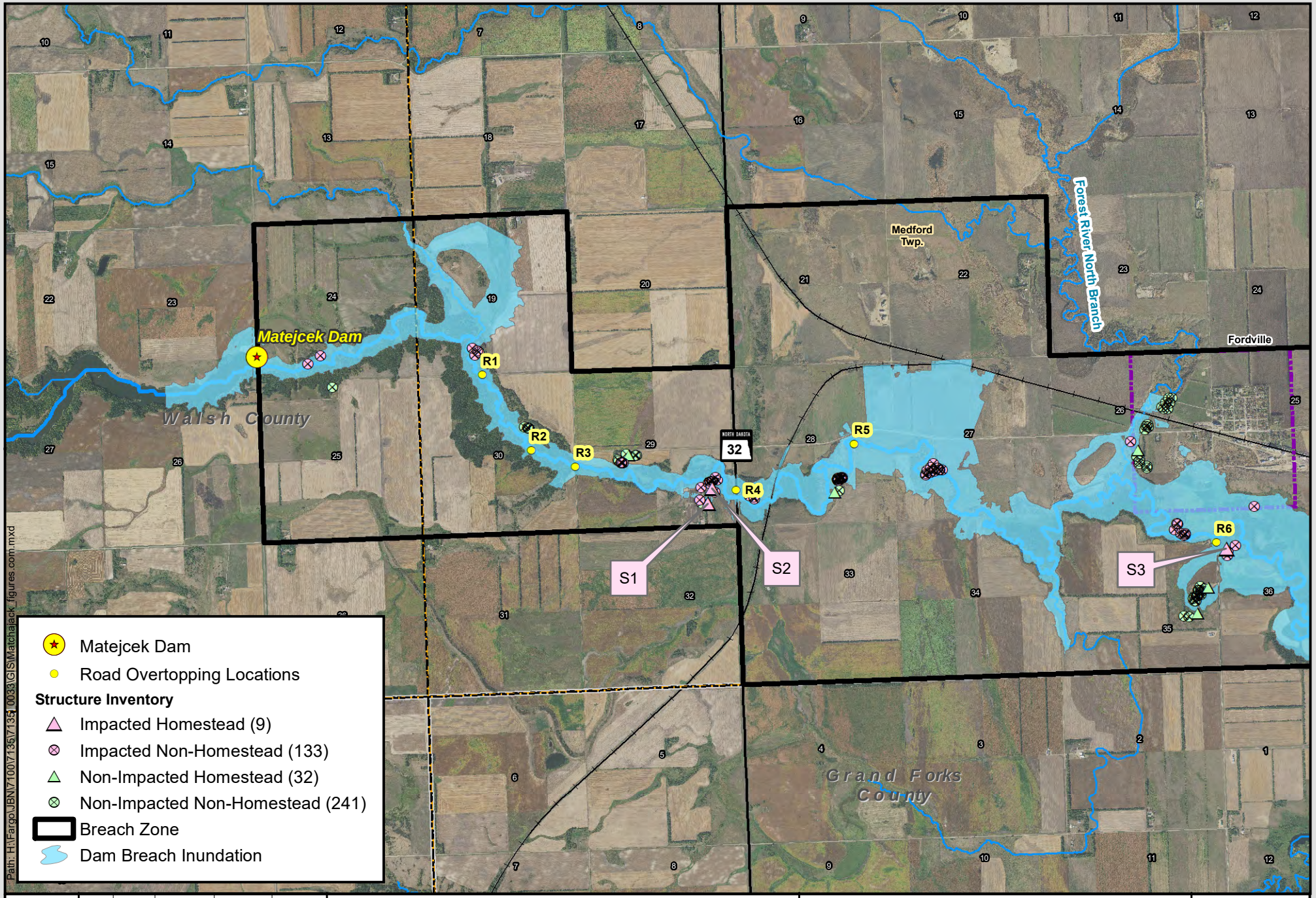
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Fargo, ND 58102
701.237.5065

Figure 8-3: Matejcek Dam Breach Inundation - All

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 3 6 Miles

N W E S



F8-4

Scale:	Drawn by:	Checked by:	Project No.:	Date:
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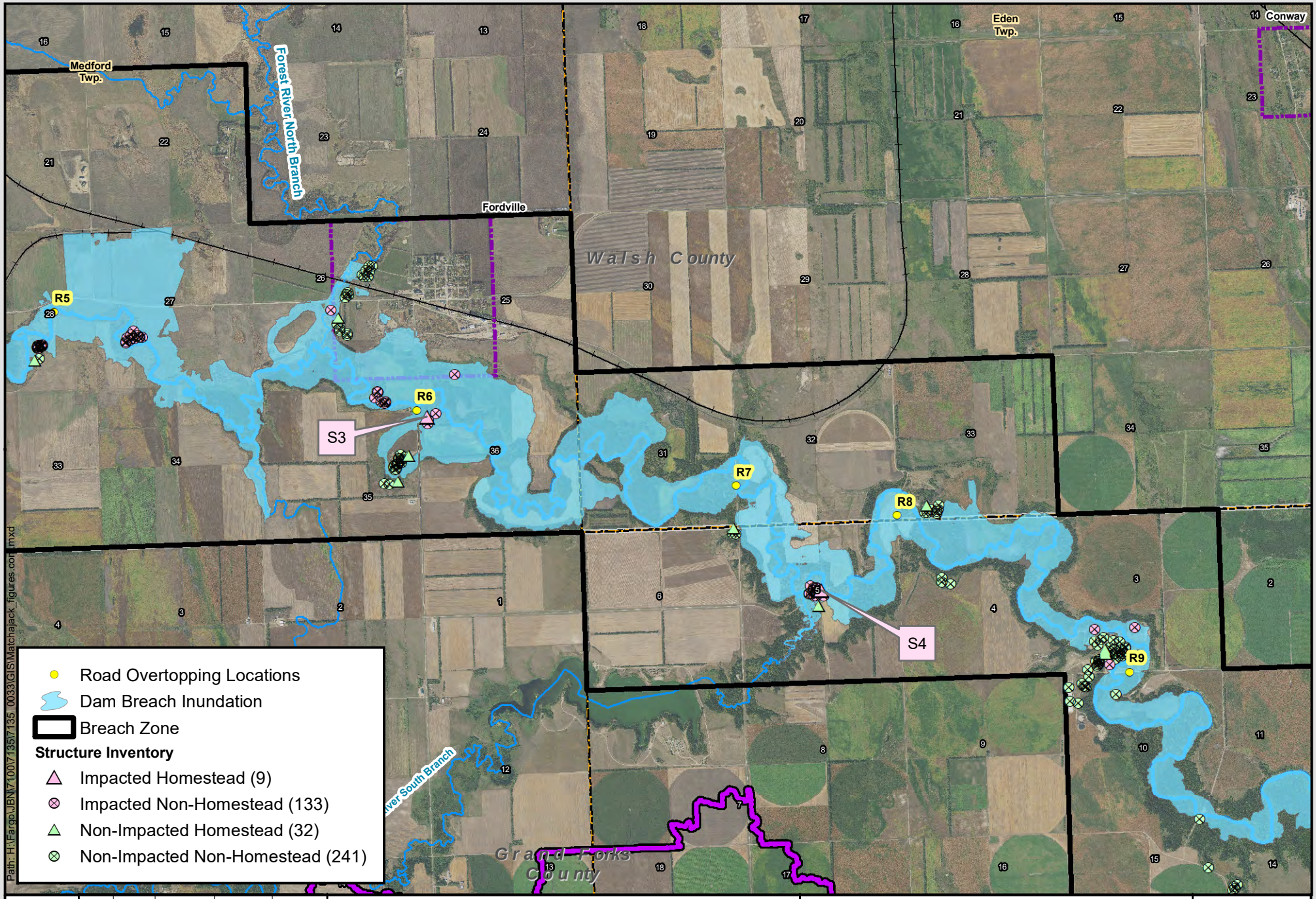
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1401 21st Avenue N
Fargo, ND 58102
701.237.5065

Figure 8-4: Matejcek Dam Breach Inundation - 1

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 1 2 Miles

N W E S



F8-5

Scale:	Drawn by:	Checked by:	Project No.:	Date:
AS SHOWN	NRI	PDL	7135-0033	10/16/2019

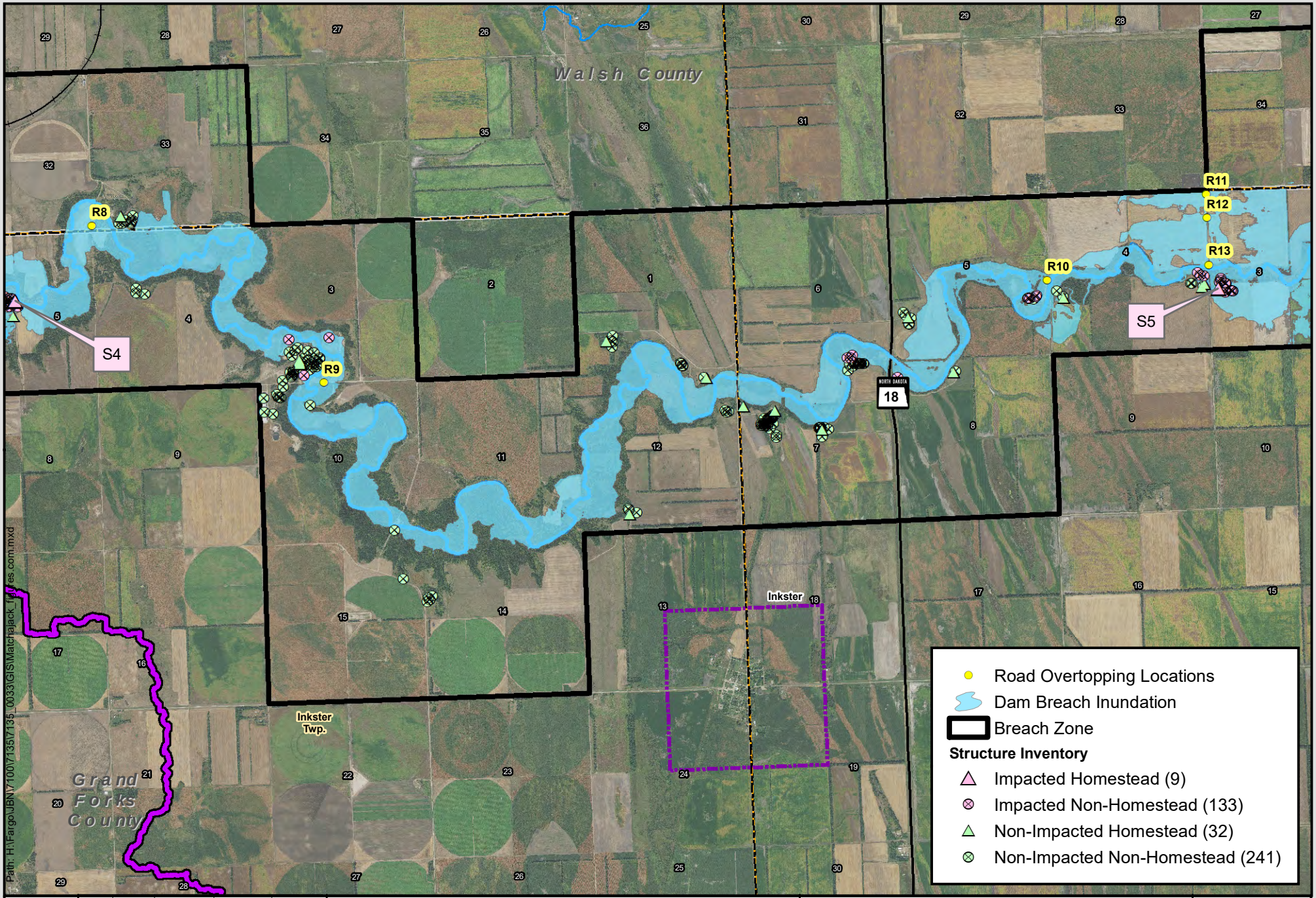
HOUSTON ENGINEERING INC.
1401 21st Avenue N
Fargo, ND 58102
701.237.5065

Figure 8-5: Matejcek Dam Breach Inundation - 2

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 1 2 Miles

N W E S



F8-6

Scale:	Drawn by:	Checked by:	Project No.:	Date:
AS SHOWN	NRI	PDL	7135-0033	10/16/2019

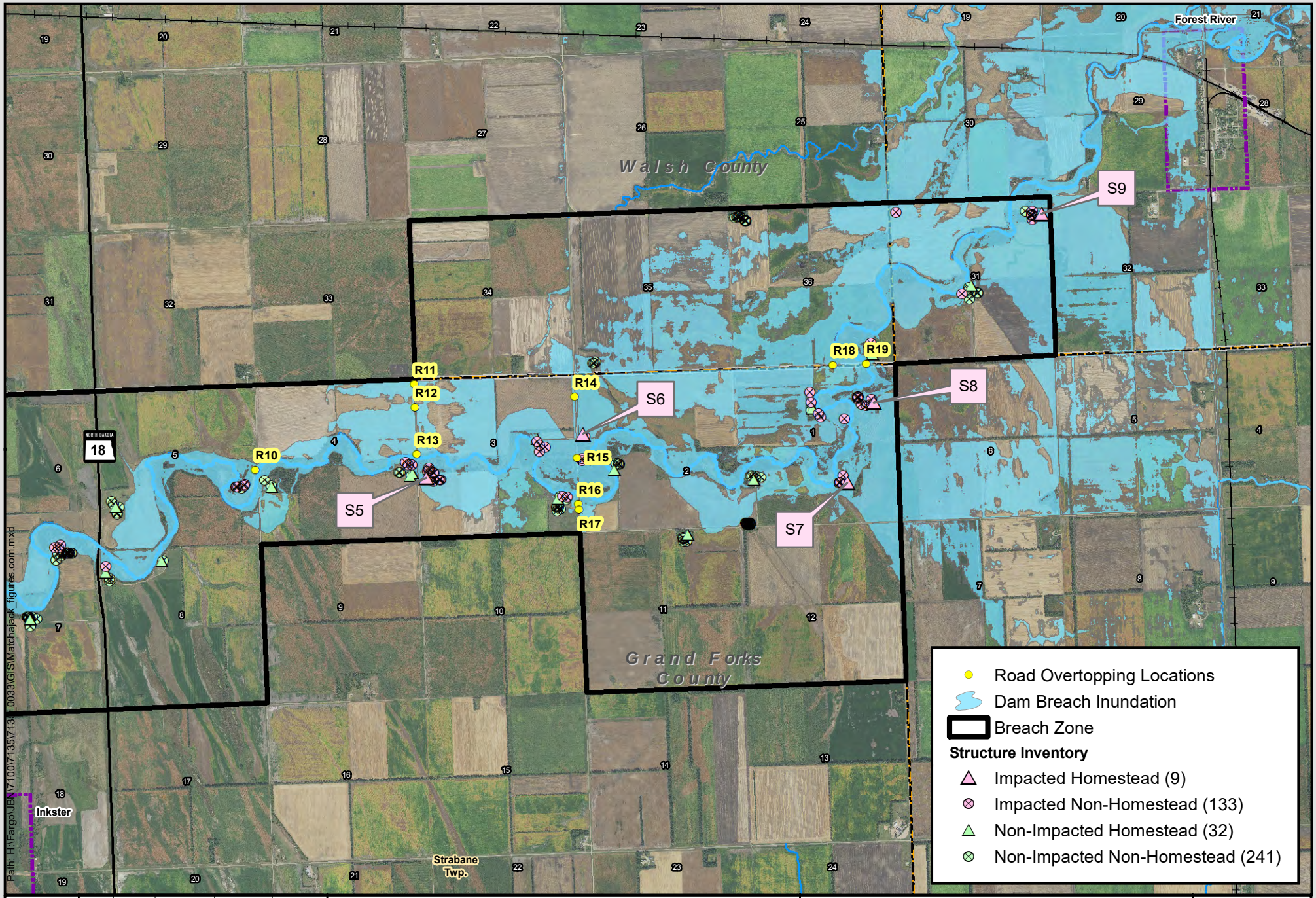
HOUSTON ENGINEERING INC.
1401 21st Avenue N
Fargo, ND 58102
701.237.5065

Figure 8-6: Matejcek Dam Breach Inundation - 3

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 1 2 Miles

N W E S



F8-7

Scale:	Drawn by:	Checked by:	Project No.:	Date:
AS SHOWN	NRI	PDL	7135-0033	10/16/2019

HOUSTON ENGINEERING INC.
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Figure 8-7: Matejcek Dam Breach Inundation - 4

Middle-South Branch Forest River Dam No. 1 (Matejcek Dam)
Existing Conditions Assessment Report
Forest River Joint Water Resource District

0 1 2 Miles

N W E S

APPENDIX A

As-Built Drawings

DRAFT

FLOOD RETARDING
FISH & WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

GRAND FORKS, NELSON, & WALSH COUNTIES, NORTH DAKOTA

SPONSORS

NELSON COUNTY SOIL CONSERVATION DISTRICT
THREE RIVERS SOIL CONSERVATION DISTRICT
WALSH COUNTY SOIL CONSERVATION DISTRICT
WESTERN GRAND FORKS COUNTY SOIL CONSERVATION DISTRICT
EASTERN GRAND FORKS COUNTY SOIL CONSERVATION DISTRICT
WALSH COUNTY WATER MANAGEMENT DISTRICT

CONSTRUCTION DATA:

CONSTRUCTION STARTED: AUGUST 7, 1966
COMPLETED: AUGUST 19, 1966
CONTRACTOR: Wm CLAIRMONT INC., BISMARCK, NO. DAKOTA
PROJECT ENGINEER: WILLIS J. DEMKE
ENGINEER: RICHARD BERGANTINE
PROJECT INSPECTORS: MEL ASKEW
GENE ANDRENS
ELMER BITTNER

BENCH MARK DATA:

BM	ELEVATION	LOCATION
T-13	1365.90	BRASS CAP IN CONCRETE - 75 FEET EAST OF E SOUTH END OF DAM
B-12	1296.00	BRASS CAP IN CONCRETE - 10 FEET SOUTH OF ABUTMENT TOE DRAIN IN SOUTH WALL OF OUTLET CHUTE OF PRINCIPAL SPILLWAY

ELEVATION DATA OF STRUCTURAL ITEMS:

FOUNDATION DRAIN OUTLETS	ELEVATION INSTALLED
NORTH OUTLET	1287.00
SOUTH OUTLET	1296.17
* RISER	
TOP	1354.20
FLOOR	1306.00

* See report and data on conduit settlement recordings on file at Bismarck State office SCS, BISMARCK, NO. DAKOTA

INDEX

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1,2,3	TABLE OF QUANTITIES, LOCATION MAP, TOPOGRAPHIC MAP OF RESERVOIR AREA
4	TOPOGRAPHIC MAP OF DAMSITE & FLUME OUTLET
4A	DELETED FROM CONTRACT
4B	INSTALLATION OF GATE
5	PROFILE ALONG E DAM, LOG OF SOIL BORINGS
6	MAXIMUM SECTION, PROFILE ALONG E OF DAM
7	CROSS SECTION OF DAM ALONG E PRINCIPAL SPILLWAY, PRINCIPAL SPILLWAY DETAILS
8,9,9A,9B	DETAILS - TRANSVERSE DRAINS
10, 11	DRAWDOWN STRUCTURE
12	DETAILS OF INLET
13-18	DETAILS OF STEEL INLET STRUCTURE
19-21	DETAILS OF TRASH RACKS
22-35	STEEL PLACING PRIN. SPWY. & I.M.P. DRAIN
1-4	FLOOD ROUTING

MATECJEK DAM
"AS BUILTS"

FLOOD RETARDING-FISH AND WILDLIFE DAM No.1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

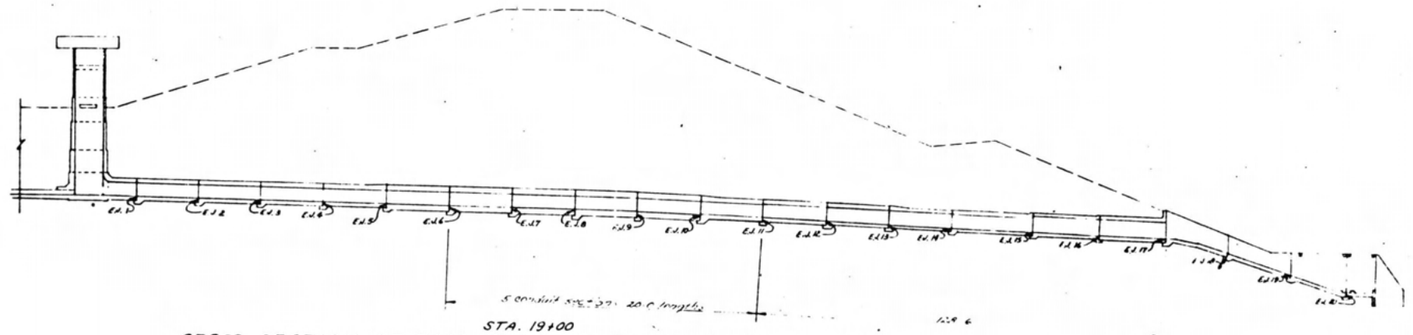
Designed J.M.M. D.E.M. 5-64 Date
Drawn
Traced
Approved by
Title
Date
Title

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-1

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1

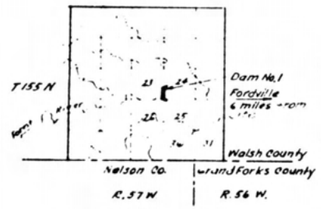
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

WALSH COUNTY. NORTH DAKOTA



STA. 19+00

CROSS SECTION OF DAM ALONG ℄ OF PRINCIPAL SPILLWAY
Scale: 1"=20'



LOCATION MAP
Scale: 1" = 1 mi.

TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
Wrought iron	lb.	35
[illegible]	[illegible]	107.5
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Started Feb 1, 1967
Completed Feb 27, 1967
Contractor Wm. Clairmont Inc.
Bismark, N. Dak.

Proj Eng- Willis J. Danke
Proj Insp. - Elmer Bittner

AS BUILT
INSTALLATION OF COPPER WATERSTOP

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

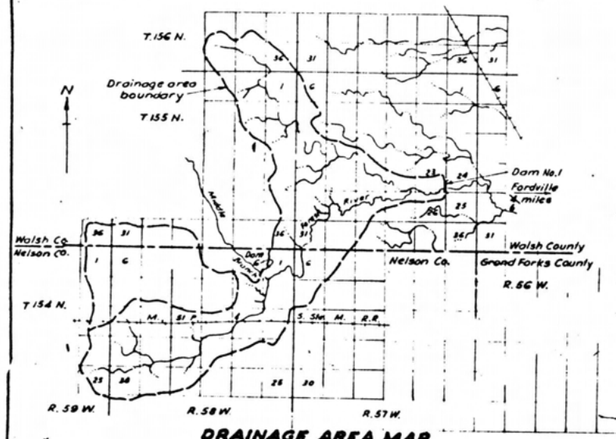
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	A. [illegible]	1/66
Drawn	JRO	8/66
Traced		
Checked		

Approved: [signature] [illegible]
Title: Asst. Regional Conservationist
FHA0 - R&W Project 38-66

AS BUILT

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-2



DRAINAGE AREA MAP
Scale: 1" = 1 Mile
D.A. = 45.9 sq. mi.

TABLE OF QUANTITIES

"AS BUILT"

ITEM	UNIT	QUANTITY
COMPACTED EARTH FILL, CLASS B-I, IN ZONE I OF DAM, CUTOFF TRENCH AND CONDUIT TRENCH	CU.YDS.	~~127,040~~
COMPACTED EARTH FILL, CLASS B-I, IN ZONE II OF DAM	CU.YDS.	~~179,970~~ 530,803
COMPACTED EARTH FILL, CLASS B-I, IN ZONE III OF DAM	CU.YDS.	~~118,000~~
COMPACTED EARTH FILL, CLASS B-I, IN OUTLET CHANNEL AND DIKE, EMERGENCY SPILLWAY AND SPILLWAY DIKE	CU.YDS.	~~55,000~~
EXCAVATION: A. EMERGENCY SPILLWAY	CU.YDS.	350,400
B. OUTLET CHANNEL	CU.YDS.	1,430
C. CONDUIT TRENCH	CU.YDS.	3,040
D. CUTOFF TRENCH	CU.YDS.	14,080
E. FOUNDATION REMOVAL	CU.YDS.	16,470
F. FOUNDATION DRAINS	CU.YDS.	750
G. STRUCTURAL	CU.YDS.	40
CONDUIT TRENCH BACKFILL	CU.YDS.	325
CONCRETE (CLASS A) AIR ENTRAINED	CU.YDS.	~~1,151~~
STEEL BAR REINFORCEMENT	LBS.	~~10,000~~
TRASH RACK (PER DETAILS) 4 REQUIRED	LUMP SUM	
24" DIA. METAL SLIDE GATE WITH SPIGOT BACK AND 39 3/8" HIGH GATE FRAME (ARMCO MODEL 50-10C OR EQUAL) ONE REQUIRED PER DETAILS	LUMP SUM	
GATE LIFTING MECHANISM, CONSISTING OF GATE STEM, OIL RETAINERS, PIPE HOUSING WITH UNION, STEM SLEEVES, STEM COUPLINGS, OIL FILL PIPE, BASE ANGLE, FASTENING STRAPS AND A ¾" DIA. HANDWHEEL LIFT (ARMCO MODEL HB-30 OR EQUAL) WITH BRONZE LIFT NUT	LUMP SUM	
24" DIA., CLASS V (8,000 LBS. PER LIN.FT.) R.C. PIPE WITH B-R JOINTS AND RUBBER GASKETS	LIN.FT.	116
FOUNDATION DRAINS:		
A. PIT-RUN SAND-GRAVEL	CU.YDS.	~~690~~ 781
B. 6" DIA. ASBESTOS CEMENT NONPERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150, OR EQUAL)	LIN.FT.	~~210~~ 241
C. 6" DIA. ASBESTOS CEMENT PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE, CLASS 150, OR EQUAL)	LIN.FT.	~~201~~ 251
ROCK RIPRAP AND FILTER BLANKET (ON FACE OF DAM)	SQ.YDS.	~~5,000~~ 6850
ROCK RIPRAP AND FILTER BLANKET (IN OUTLET CHANNEL)	SQ.YDS.	~~2,000~~
SALVAGING AND PLACING TOPSOIL IN EMERGENCY SPILLWAY	SQ.YDS.	~~91,500~~ 113,992
SOD DRAIN WITH 2% METAL FLUME	~~LUMP SUM~~ = Deleted	
CLEARING AND GRUBBING OF TREES IN DAM SITE AND BORROW AREA	LUMP SUM	
CLEARING OF TREES IN PERMANENT POOL TO ELEV. 1337	LUMP SUM	
STRUCTURE REMOVAL	LUMP SUM	

CONCRETE (CLASS A)
f'c = 4000 p.s.i.
fc = 1800 p.s.i.
fs = 20,000 p.s.i.

RESERVOIR CAPACITY TABLE

ELEV.	AREA-ACRES	STORAGE ACRE FEET	ACCUM. STORAGE ACRE FEET
1290.0	0	0	0
1295.0	11.20	28.00	28.00
1300.0	22.60	89.50	112.50
1305.0	34.61	143.03	255.53
1308.56	45.82	143.17	398.70
1310.0	50.36	69.25	467.95
1315.0	66.62	292.95	760.90
1320.0	82.63	371.13	1131.53
1325.0	100.58	457.92	1589.45
1330.0	118.06	546.50	2137.95
1334.8	134.81	606.89	2744.84
1335.0	135.51	27.03	2771.87
1340.0	154.69	725.53	3497.40
1345.0	177.66	830.88	4328.28
1350.0	200.79	944.12	5272.40
1354.2	221.46	887.17	6161.57
1355.0	225.65	178.92	6340.49
1360.0	248.17	1184.54	7525.01
1360.8	252.78	200.38	7725.41
1365.0	276.95	1112.66	8837.87

DRAWDOWN 44,851

F.L. OF ORIFICE FIRST STAGE 1334.8 — 125,937

CREST OF INLET SECOND STAGE 1354.2

CREST OF EMERG. SPWY. 1360.8

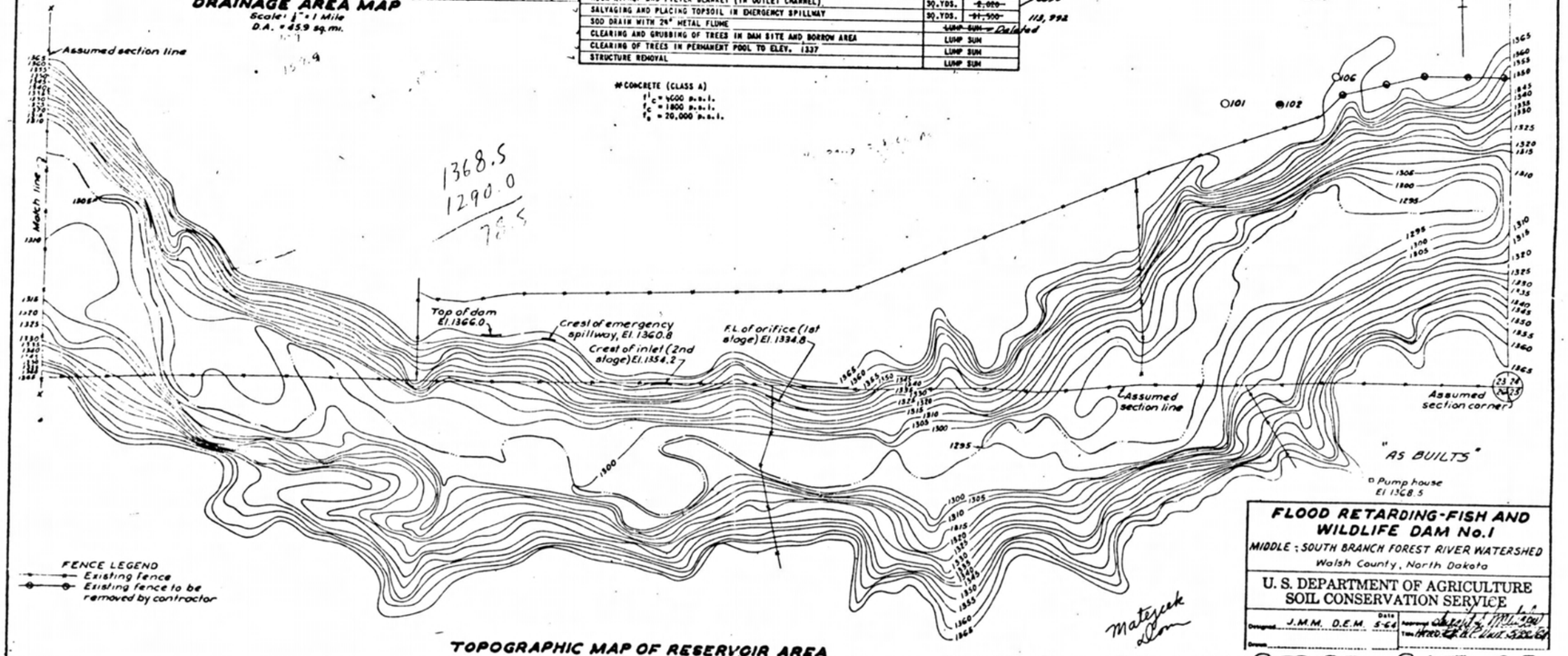
Sta. 5+00

Section 23 Twp. 155 N. Range 57 W

Sec. 24 Twp. 155 N R. 57 W

℄ of dam

N



1368.5
1290.0
78.5

FENCE LEGEND
Existing fence
Existing fence to be removed by contractor

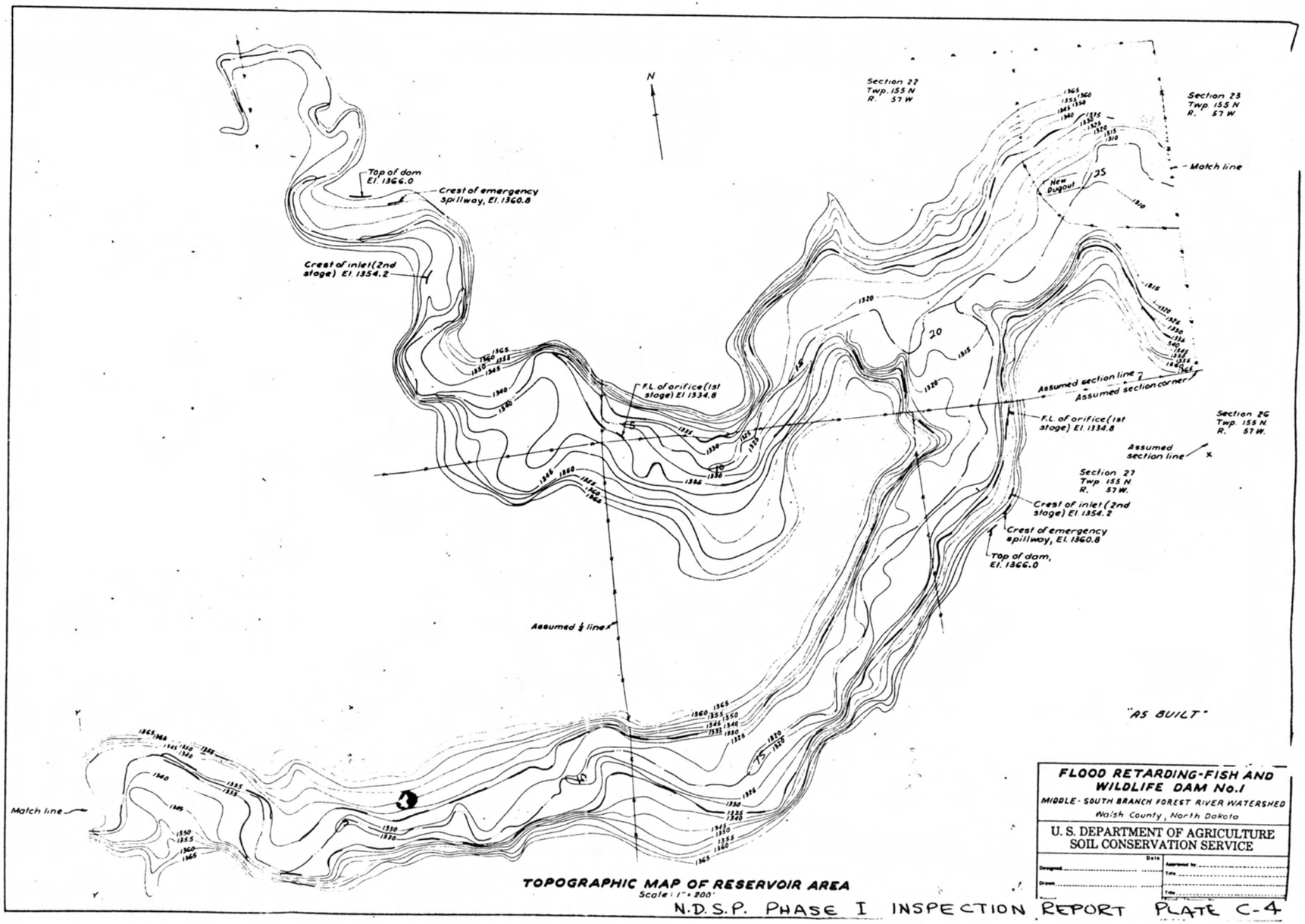
TOPOGRAPHIC MAP OF RESERVOIR AREA
Scale 1" = 200'

FLOOD RETARDING-FISH AND WILDLIFE DAM No.1
MIDDLE ; SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

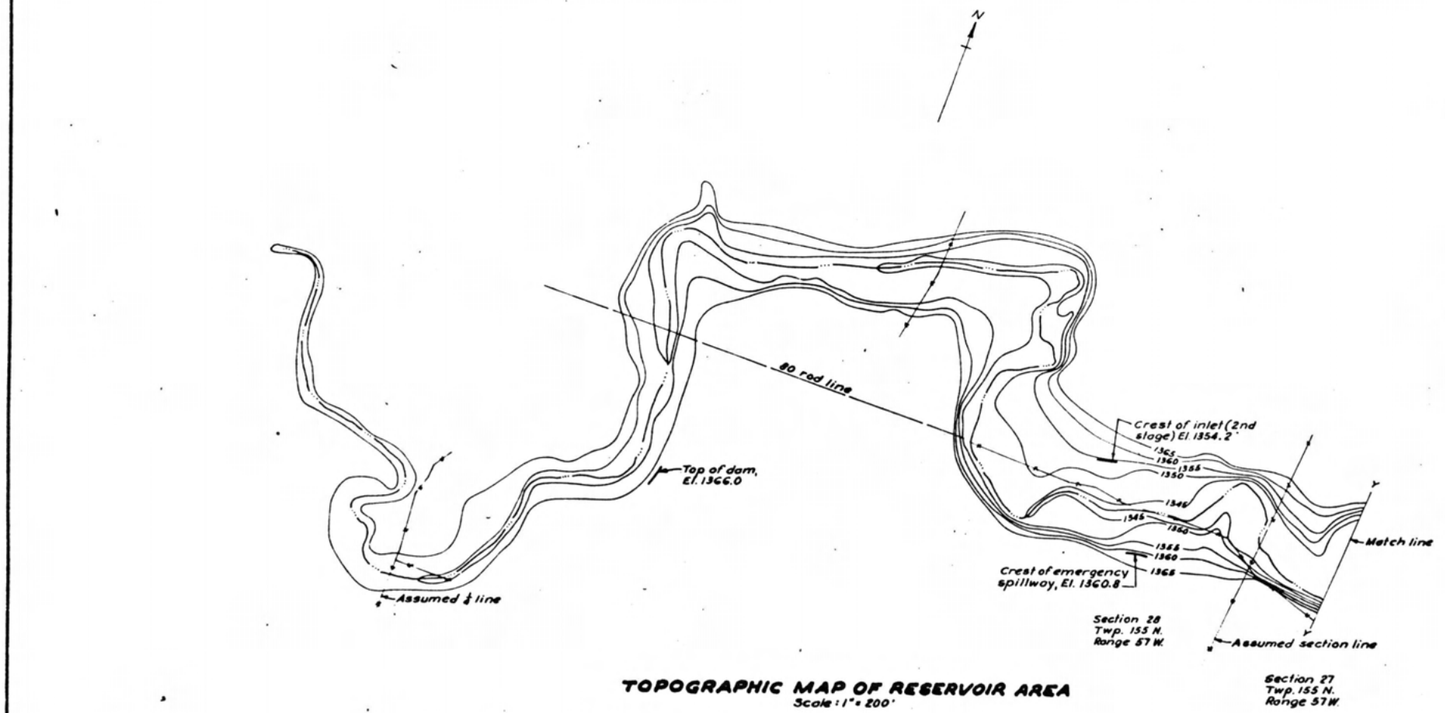
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed J.M.M. D.E.M. Date 5-64 Approved [illegible]
Traced [illegible] Checked [illegible]
Drawn

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-3



N.D.S.P. PHASE I INSPECTION REPORT PLATE C-4



TOPOGRAPHIC MAP OF RESERVOIR AREA
Scale: 1" = 200'

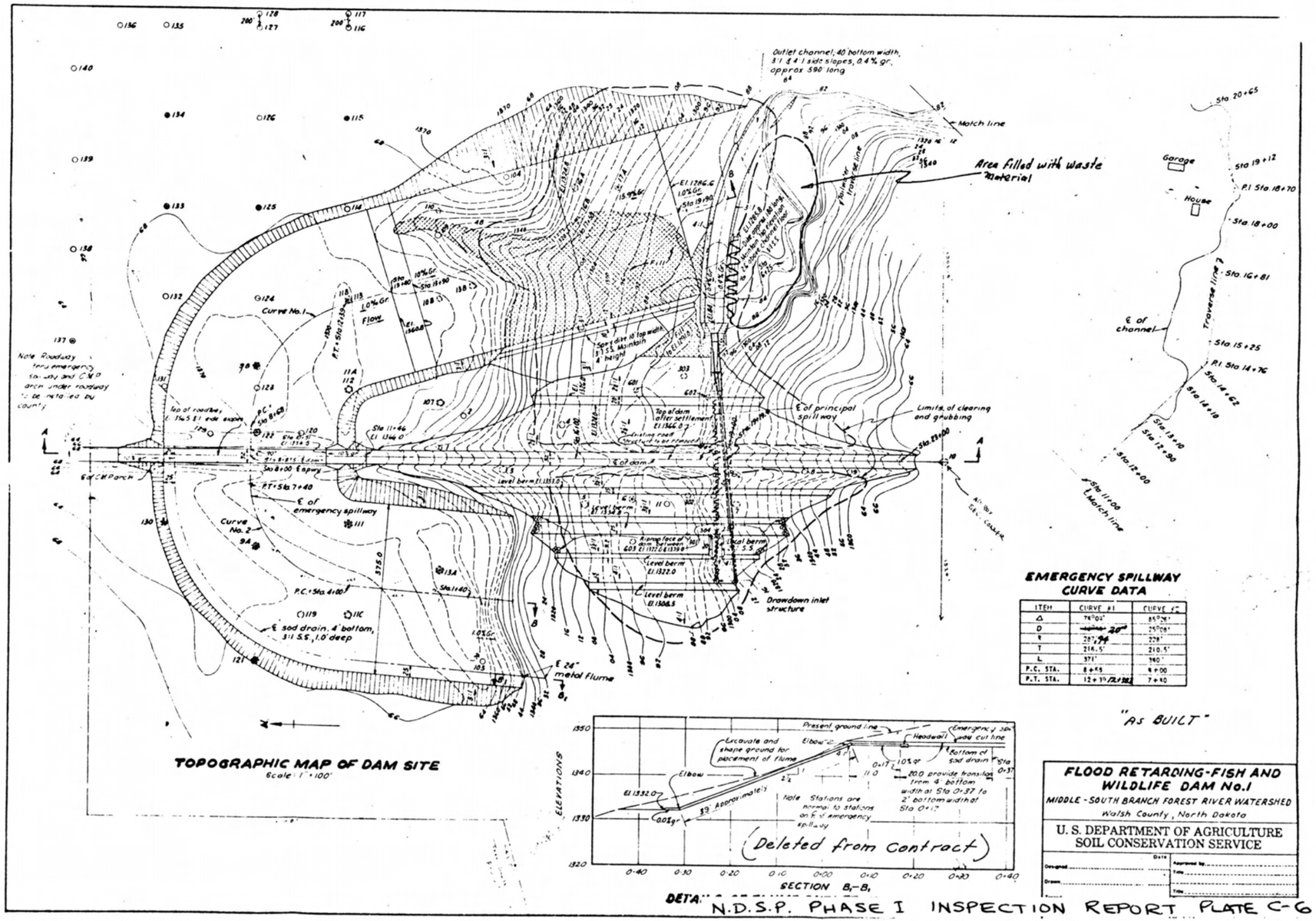
"AS BUILT"

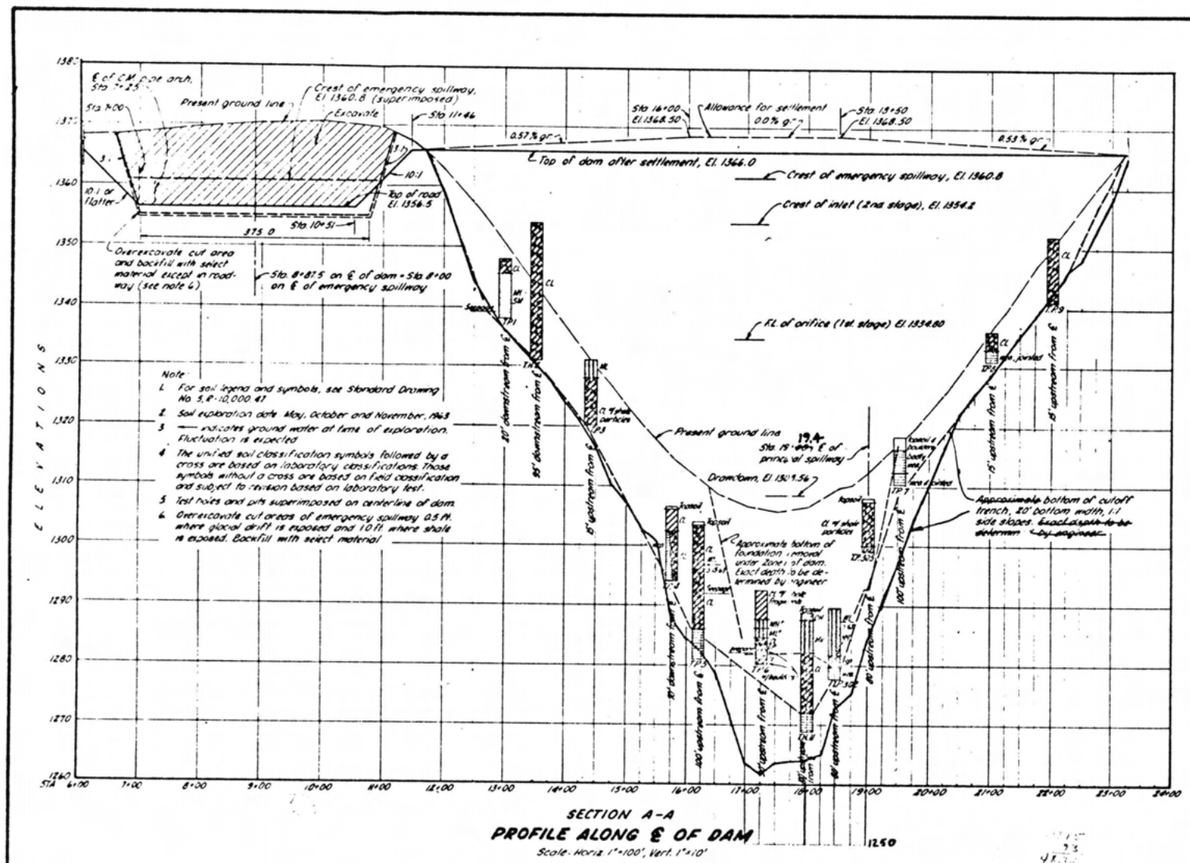
FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed ..... Title .....
Drawn ..... Title .....

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-5


Outlet channel, 40' bottom width, 3:1 & 4:1 side slopes, 0.4% gr., approx 590' long
Notch line
Area filled with waste material
Garage
House
Sta 20+65
Sta 19+12
P.I. Sta 18+70
Sta 18+00
Sta 16+81
Sta 15+25
P.I. Sta 14+76
Sta 14+62
Sta 14+18
Sta 13+40
Sta 12+90
Sta 12+00
Sta 11+00
E. Notch line
Traverse line
℄ of channel
Curve No. 1
Curve No. 2
Flow
Note: Roadway for emergency spillway and CMP arch under roadway to be installed by county
Top of roadway El. 1345.8 (+ side slopes)
℄ of CM Arch
Sta 8+00 ℄ spwy
PT = Sta 7+40
℄ of emergency spillway
P.C. = Sta 4+00
℄ sod drain, 4' bottom, 3:1 S.S., 1.0' deep
℄ 24" metal flume
Sta 11+46 El 1340.0
Sta 19+90
El. 1328.6 10% Gr.
Sta 19+80
El. 1326.0
Sta 19+90
Sta 19+40
El. 1326.0
10% Gr.
Sta 19+90
Sta 19+80
El. 1326.0
Sta 19+90
Sta 19+40
El. 1326.0



SECTION A-A

PROFILE ALONG ℄ OF DAM

Scale: Horiz. 1"=100', Vert. 1"=10'

LOG OF SOIL BORINGS

LOCATION	NORTH ABUTMENT									
TH NO.	9A	9B	11A	11B	11C	13A	13B	14A	14B	17A
ELEVATION	1365.0	1351.0	1370.0	1357.0	1344.0	1372.0	1344.0	1337.0	1316.0	1373.0

DEPTH IN FEET: 0, 10, 20, 30

LOCATION	FOUNDATION				
TH NO.	10	301	303	601	603
ELEVATION		1281.0	1286.8	1287.0	1294.0

DEPTH IN FEET: 0, 10, 20

LOG OF SOIL BORIIIGS

BORROW NORTH ABUTMENT

LOCATION																																						
TH NO.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
ELEV.	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371	1371

DEPTH IN FEET: 0, 10, 20, 30

"AS BUILT"

FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1

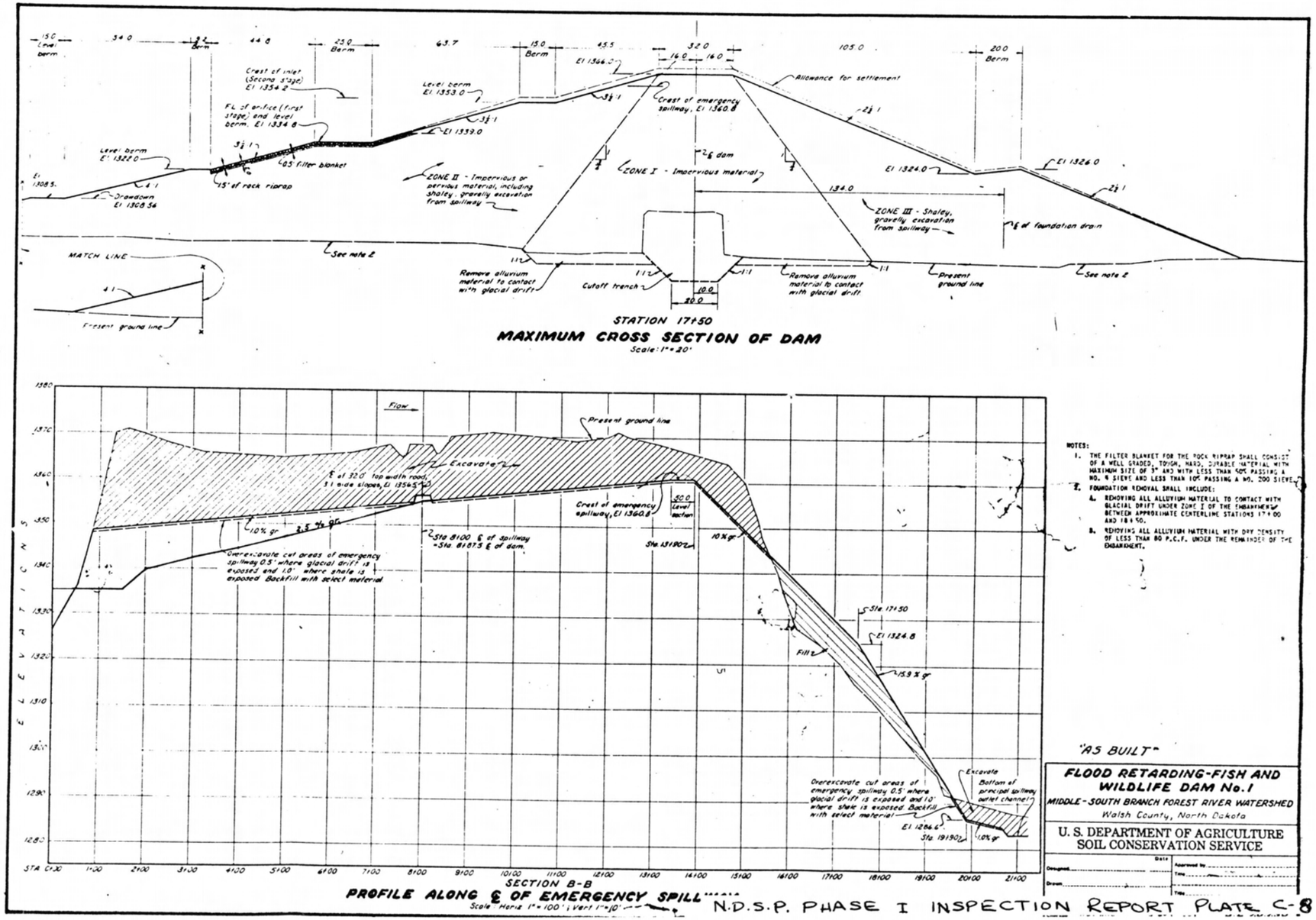
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Nelson County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed E.J.P. J.M.M. Date
Drawn E.J.P.
Traced
Approved by
Title
Scale
Drawing No.

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-7



NOTES:

1. THE FILTER BLANKET FOR THE ROCK RIPRAP SHALL CONSIST OF A WELL GRADED, TOUGH, HARD, DURABLE MATERIAL WITH MAXIMUM SIZE OF 3" AND WITH LESS THAN 50% PASSING A NO. 4 SIEVE AND LESS THAN 10% PASSING A NO. 200 SIEVE.
2. FOUNDATION REMOVAL SHALL INCLUDE:
   A. REMOVING ALL ALLUVIUM MATERIAL TO CONTACT WITH GLACIAL DRIFT UNDER ZONE I OF THE EMBANKMENT BETWEEN APPROXIMATE CENTERLINE STATIONS 17+00 AND 18+50.
   B. REMOVING ALL ALLUVIUM MATERIAL WITH DRY DENSITY OF LESS THAN 80 P.C.F. UNDER THE REMAINDER OF THE EMBANKMENT.

"AS BUILT"

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

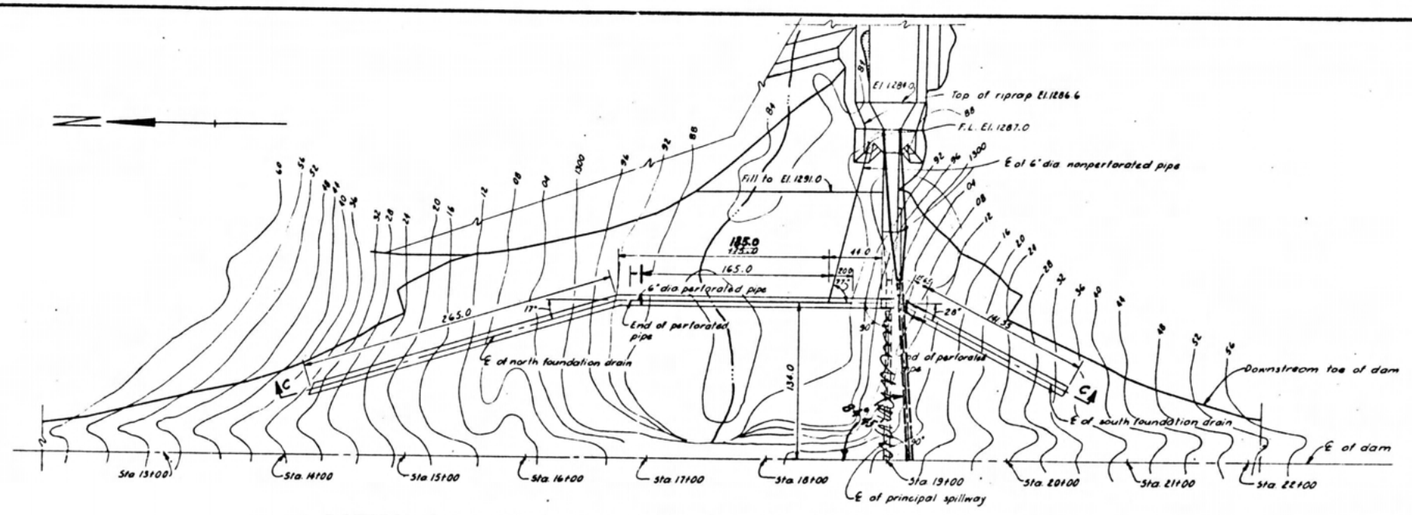
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

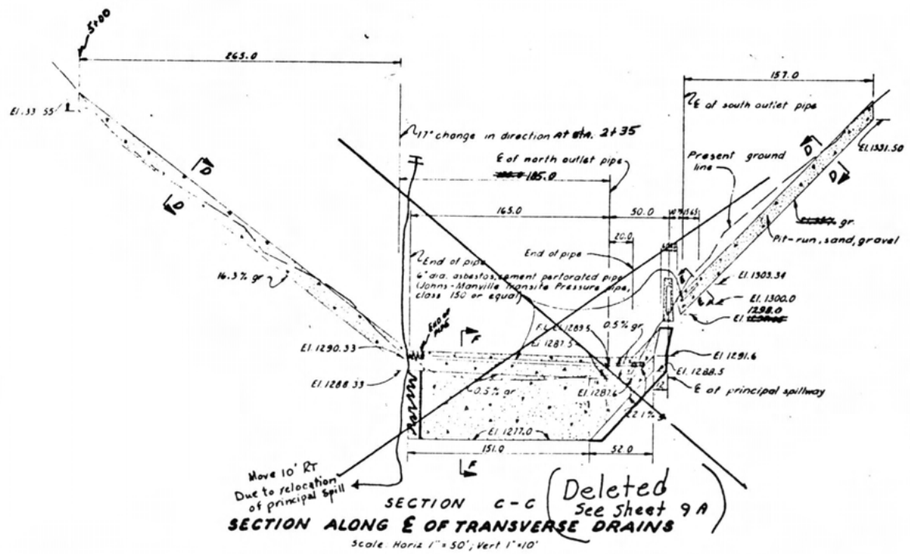
Designed _____ Date _____ Approved by _____
Drawn _____ Title _____
Title _____

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-8



PARTIAL PLAN OF BASE OF DAM SHOWING FOUNLATION DRAINS

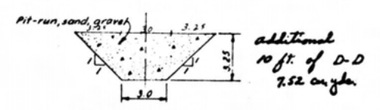
Scale: 1" = 50'



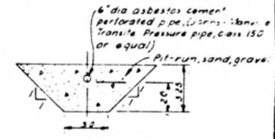
SECTION C-C (Deleted See Sheet 9A)

SECTION ALONG E OF TRANSVERSE DRAINS

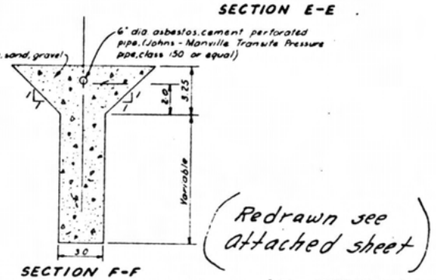
Scale Horiz 1" = 50', Vert 1" = 10'



SECTION D-D



SECTION E-E



SECTION F-F

(Redrawn see attached sheet)

DETAILS OF TRANSVERSE DRAINS AS BUILT PLANS

Scale 1" = 4'

NOTES:

1. PROVIDE END CAP ON OUTLET END OF OUTLET PIPES. FOR DETAILS OF END CAPS, SEE STANDARD DRAWING NO. S-R-10,000.55.
2. PLUG UPPER END OF PIPES WITH 4" OF CONCRETE.
3. THE DEPTH OF FILL OVER THE DRAIN PIPE SHALL BE AT LEAST 2' BEFORE PASSING HEAVY EQUIPMENT OVER THE PIPE.
4. WHERE TRANSVERSE DRAIN TRENCH IS ABOVE THE GROUND LINE, PLACE COMPACTED EARTH FILL TO ELEVATION AT TOP OF DRAINS AND EXCAVATE DRAIN IN COMPACTED FILL.
5. THE PIT-RUN SAND GRAVEL SHALL HAVE A MINIMUM OF 15% LARGER THAN 1/4" WITH A MAXIMUM SIZE OF 3" AND WITH LESS THAN 5% PASSING THE NO. 200 SIEVE.

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed K.J.P., R.M.B. Date

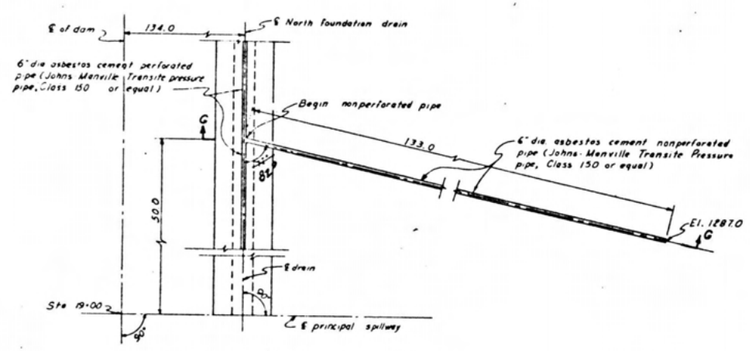
Drawn

Approved by

Title

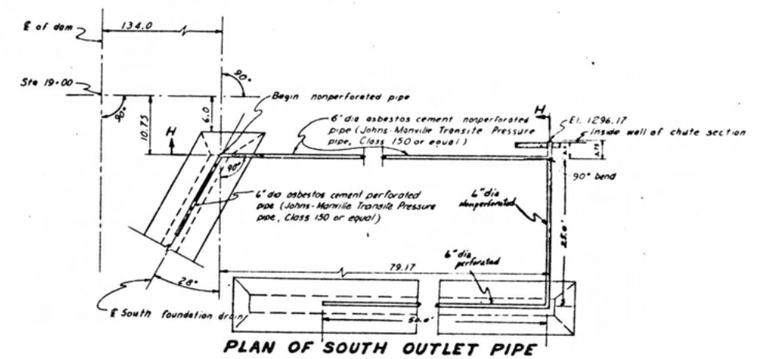
Date

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-9



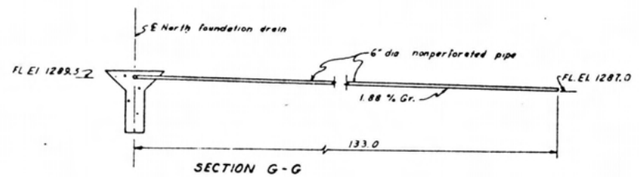
PLAN OF NORTH OUTLET PIPE

Scale 1" = 10'



PLAN OF SOUTH OUTLET PIPE

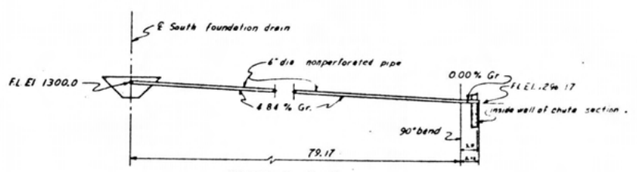
Scale 1" = 10'



SECTION G-G

SECTION ALONG ℄ OF NORTH OUTLET PIPE

Scale 1" = 10'



SECTION H-H

SECTION ALONG ℄ OF SOUTH OUTLET PIPE

Scale 1" = 10'

TABLE OF QUANTITIES FOR FOUNDATION DRAINS

ITEM	UNIT	QUANTITY
EXCAVATION	CU.YDS.	750
PIT-RUN SAND GRAVEL	CU.YDS.	~~500~~ 751
6" DIA. ASBESTOS CEMENT NON-PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150 OR EQUAL)	LIN.FT.	216
6" DIA. ASBESTOS CEMENT PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150 OR EQUAL)	LIN.FT.	201

AS BUILT

FLOOD RETARDING-FISH AND WILDLIFE DAM NO.1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

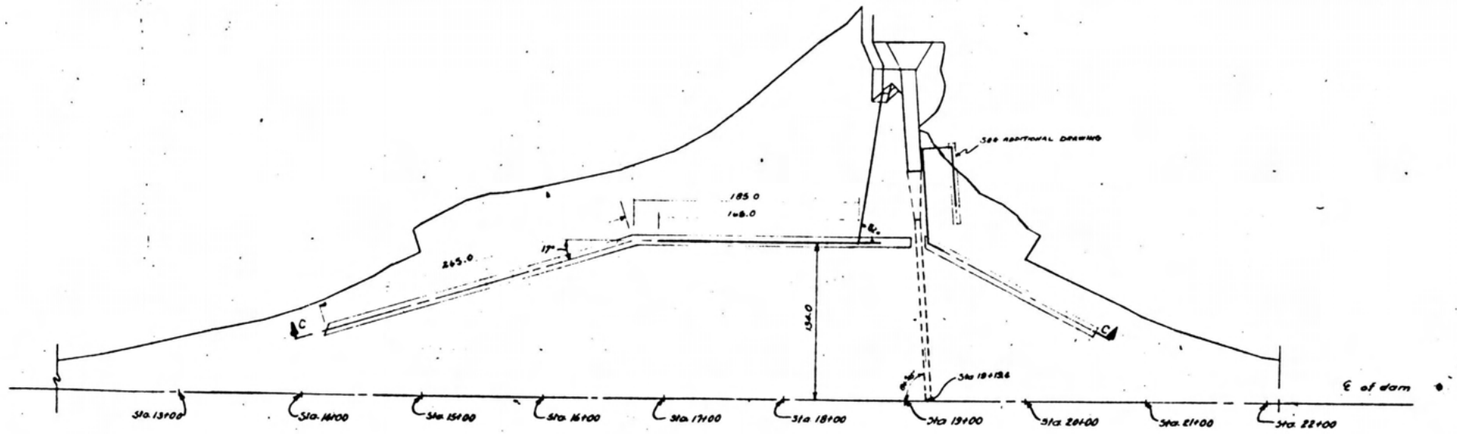
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed P.M.B. Date Approved by

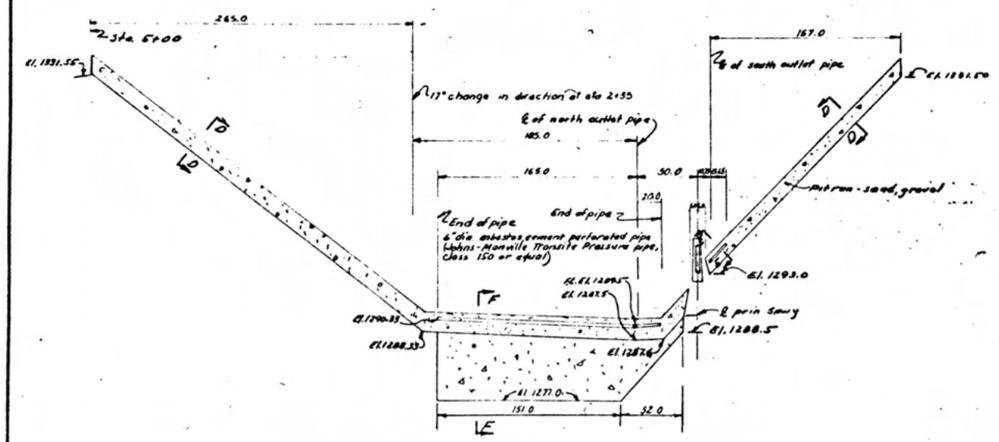
Drawn Title

Traced Checked No.

N.D.S.P. PHASE 1 INSPECTION REPORT PLATE C-10



PLAN FOUNDATION DRAIN
Scale 1" = 50'

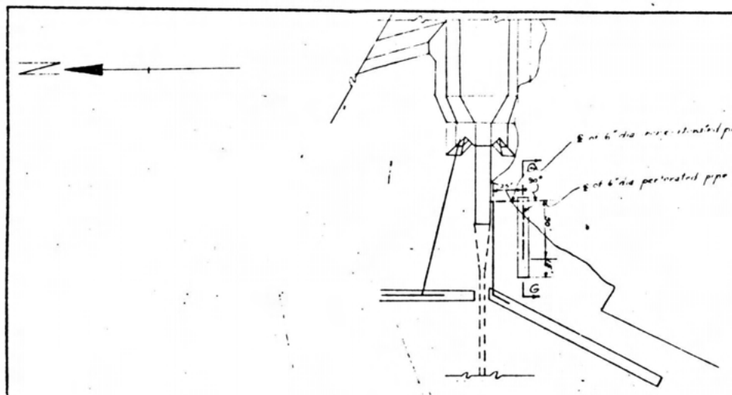


SECTION C-C
SECTION ALONG ℄ OF TRANSVERSE DRAINS
Scale: Horiz. 1" = 50'; Vert. 1" = 10'

"AS BUILT"

FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1
"As Built"
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

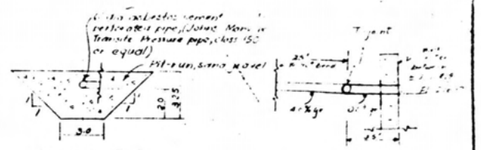
Designed | Date | Approved by
Drawn | Title
Traced | Title



PLAN OF SOUTH OUTLET DRAIN
Scale 1"=50'



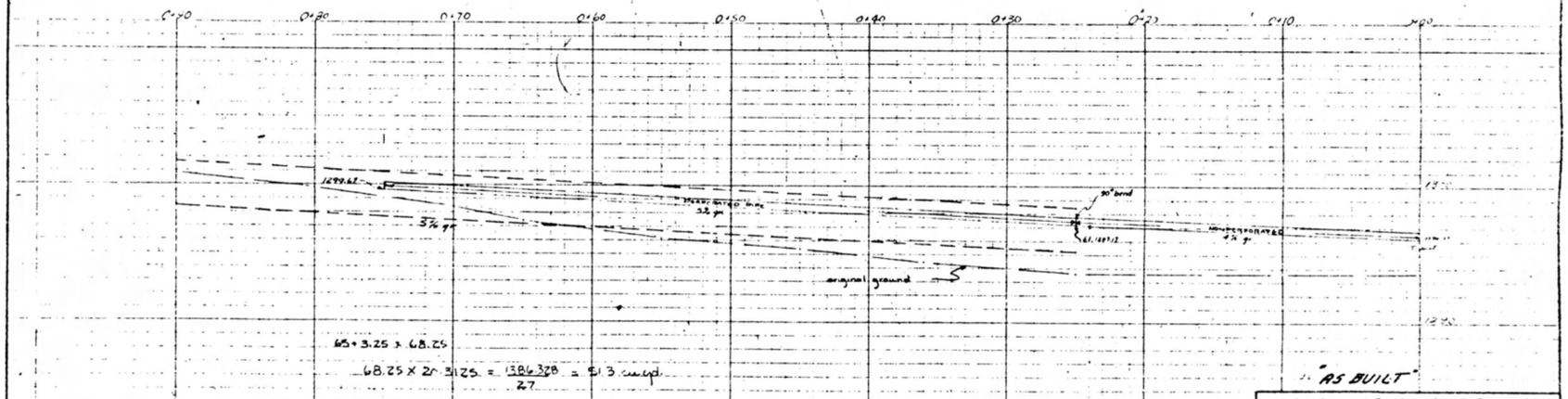
SECTION G-G
SECTION ALONG ℄ OF TRANSVERSE DRAIN
Scale: Horiz. 1"=50'; Vert. 1"=10'



SECTION H-H
DETAILS OF TRANSVERSE DRAIN
Scale: 1"=6'

TABLE OF QUANTITIES FOR FOUNDATION DRAIN

ITEM	UNIT	QUANTITY
PIT-RUN SAND GRAVEL	CU. YDS	53
6" DIA. ASBESTOS CEMENT NON-PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150 OR EQUAL)	LIN FT.	85
6" DIA. ASBESTOS CEMENT PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150 OR EQUAL)	LIN FT.	80



65+3.25 = 68.25

68.25 X 20 3/125 = 1364378 / 27 = 513 cu yd

PROFILE OF FOUNDATION DRAIN

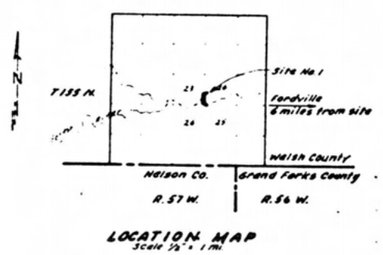
"AS BUILT"

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

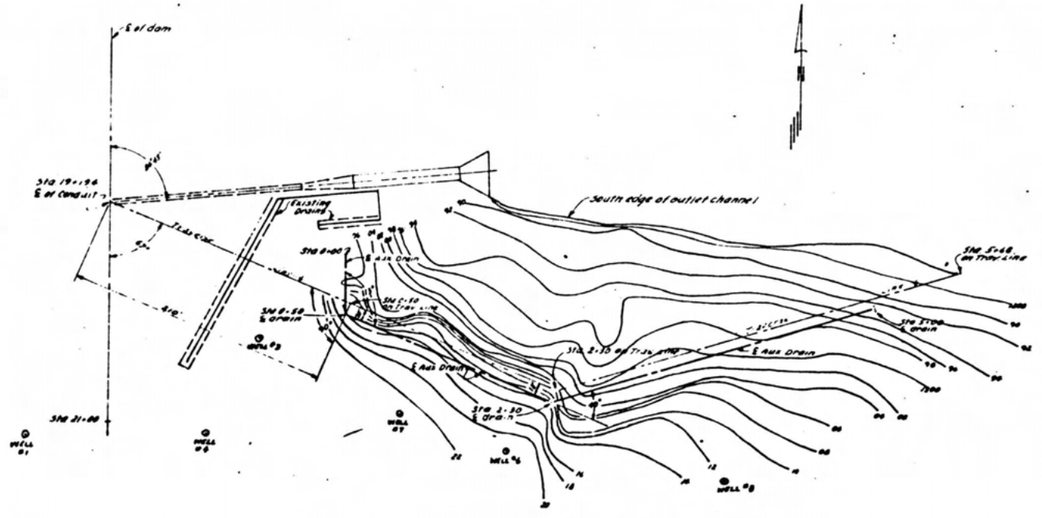
Designed | Date | Approved by
Drawn | Title
Traced | Title

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-12

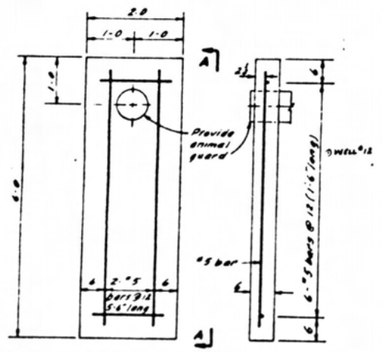
AUXILIARY DRAIN
SITE NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
WALSH COUNTY NORTH DAKOTA



LOCATION MAP
Scale ½" = 1 mi.



PLAN VIEW OF AUXILIARY DRAIN
Scale: 1" = 100'



DOWNSTREAM ELEVATION SIDE ELEVATION A-A
DETAILS OF OUTLET DRAIN PIPE SUPPORT
Scale: ½"=1'-0"

QUANTITIES FOR AUXILIARY DRAIN

ITEM	UNIT	QUANTITY	AS BUILT QUANTITY
Excavation	Cu. Yd.	2631*	
Drain Fill	Cu. Yd.	1188	1054
Concrete (Class 4000 Air entrained)	Cu. Yd.	0.22	0.22
Steel Reinforcement	Lb.	21	21
8" dia. perforated asbestos cement pipe	Lin. Ft.	498	439
45° C.I. Bend Bell x Bell	Ea.	3	3
22½° C.I. Bend Bell x Spigot	Ea.	1	1
Loose rock riprap	Cu. Yd.	14	1

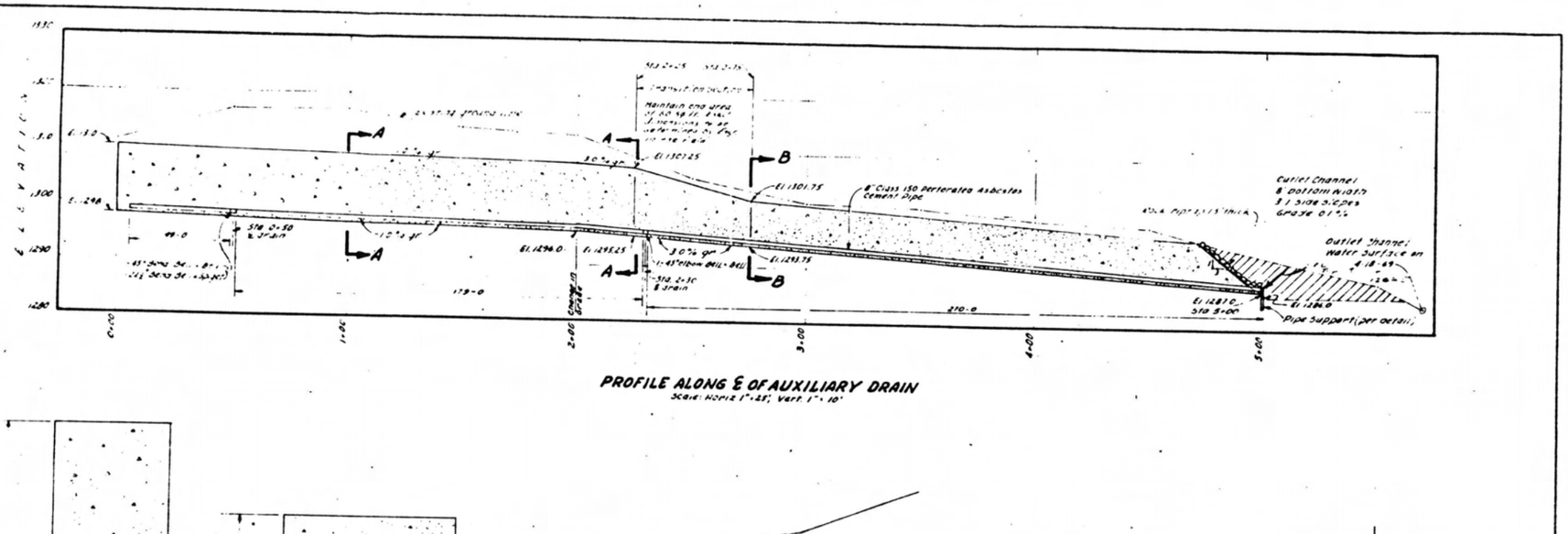
* Estimated.

NOTES:
1. Provide end cap outlet end of pipe. For details of end cap see Std. Drwg. No. S.R.-16-000.56
2. Plug upper end of pipe with 6" of concrete or prefabricated cap.
3. The drain material shall be a poorly graded gravel with all the material being retained on the #4 sieve and maximum size not to exceed 3".
4. The drain material shall extend at least 3' below the bottom of the bentonite layer. Therefore the depths indicated on the plans for the drain are approximate and the exact depths will be determined by the Engineer in the field.
5. Backfill drain a minimum of one foot or to existing ground line which ever is larger.
6. The neat lines on the cross sections indicating excavation above the auxiliary drain are approximate. The contractor shall have the option of increasing or decreasing the slopes as he may deem necessary.
7. At Sta 0+50 and Sta 4+38 the alignment of the pipe can be adjusted by taking up several degrees in the joints between the pipe and the bends.
8. Care shall be taken during construction to protect the observation wells from damage. They are located on the plan view of the auxiliary drain.

AUXILIARY DRAIN

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County North Dakota
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
R.D.S. 6-69

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-13



PROFILE ALONG ℄ OF AUXILIARY DRAIN

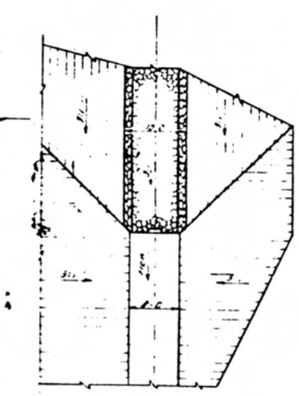
Scale: Horiz 1"=25', Vert. 1"= 10'

SECTION A-A

Scale 1"=2½'

SECTION B-B

Scale 1"=2½'



PLAN OF OUTLET CHANNEL

AUXILIARY DRAIN

FLOOD RETARDING-FISH AND WILDLIFE DAM NO.1

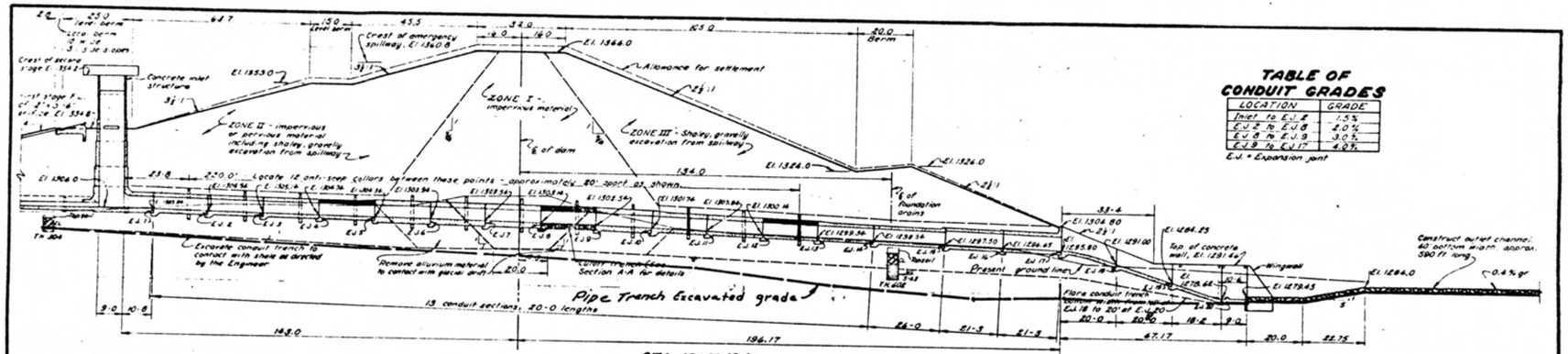
MIDDLE SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

RDS. 6-69

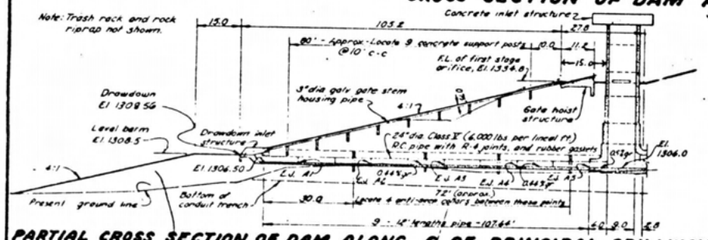
N.D.S.P. PHASE I INSPECTION REPORT PLATE C-4



CROSS SECTION OF DAM ALONG ℄ OF PRINCIPAL SPILLWAY

STA. 19+00 13.4

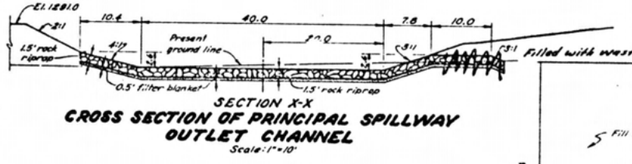
Scale: 1" = 20'



PARTIAL CROSS SECTION OF DAM ALONG ℄ OF PRINCIPAL SPILLWAY

(Rock riprap not shown)

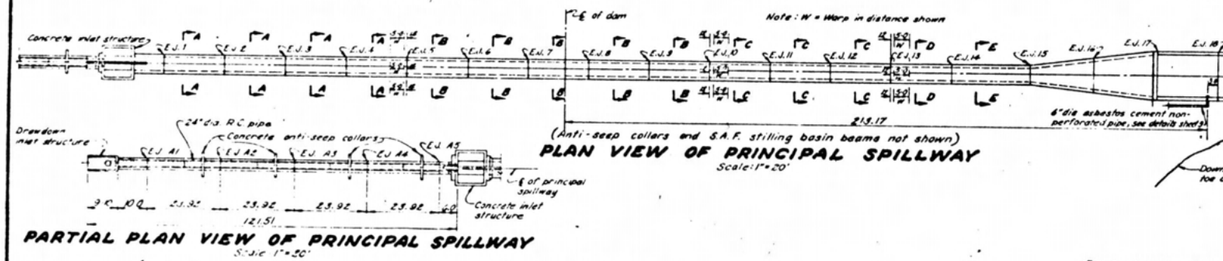
Scale: 1" = 20'



SECTION X-X

CROSS SECTION OF PRINCIPAL SPILLWAY OUTLET CHANNEL

Scale: 1" = 10'

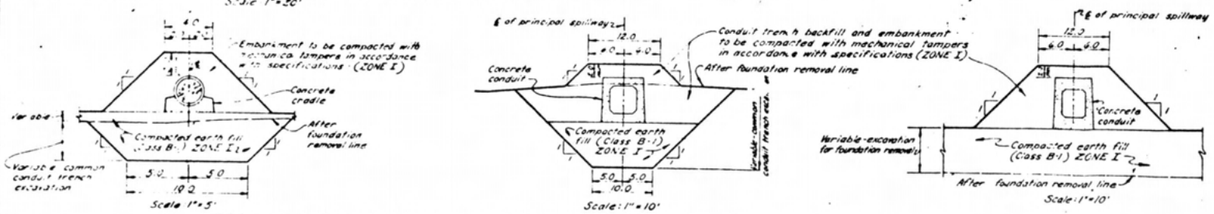


PLAN VIEW OF PRINCIPAL SPILLWAY

Scale: 1" = 20'

PARTIAL PLAN VIEW OF PRINCIPAL SPILLWAY

Scale: 1" = 20'



DIAGRAMS OF CONDUIT TRENCH - EXCAVATION, BACKFILL AND EMBANKMENT

"AS BUILT"

FLOOD RETARDING - FISH AND WILDLIFE DAM No. 1

MIDDLE - SOUTH BRANCH FOREST RIVER WATERSHED

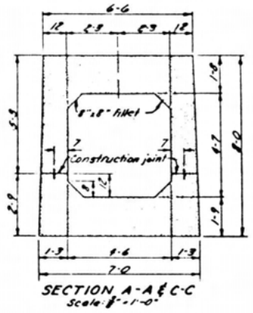
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

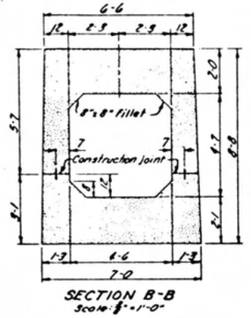
Designed JHM, SEM | Date | Approved by | Title

Drawn | | Title

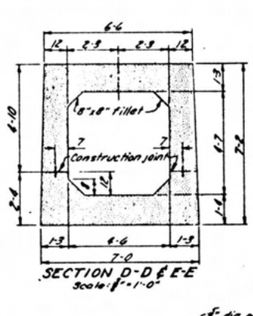
N.D.S.P. PHASE I INSPECTION REPORT PLATE C-15



SECTION A-A & C-C
Scale: 3/8" = 1'-0"



SECTION B-B
Scale: 3/8" = 1'-0"



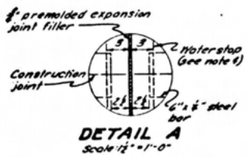
SECTION D-D & E-E
Scale: 3/8" = 1'-0"

TABLE OF QUANTITIES

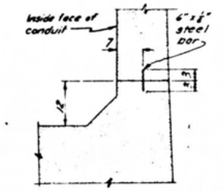
ITEM	CONCRETE (CU. YDS.)	REINFORCING STEEL (LBS)
CONDUIT E.J. 1 TO E.J. 15	160.80	71,501
ANTI-SEEP COLLARS	33.11	1,082

TABLE OF DIMENSIONS FOR EXPANSION JOINTS

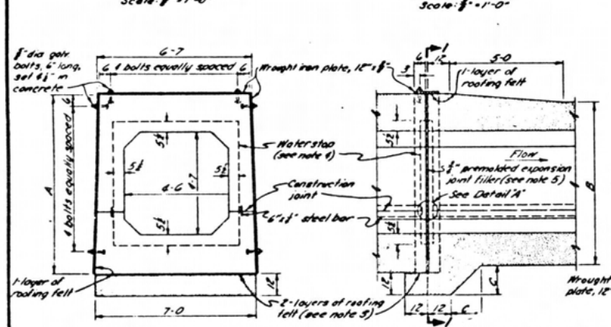
EXPANSION JOINT NO.	A	B	C
1,2,3,4,11 & 12	8-0		
6,7,8 & 9	8-8		
10	8-8	8-0	1-8
13	8-0	7-2	1-5
14	7-2		



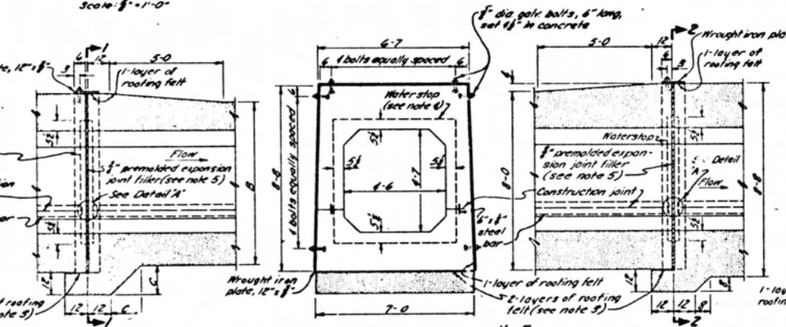
DETAIL A
Scale 12" = 1'-0"



DETAILS OF CONSTRUCTION JOINT
Scale 3/4" = 1'-0"



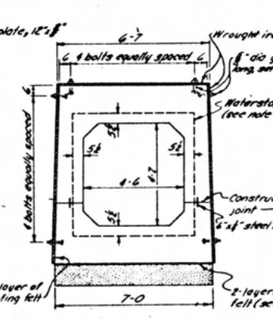
SECTION 1-1



LONGITUDINAL SECTION

SECTION 2-2

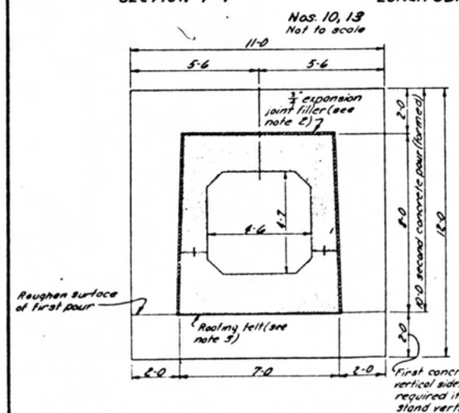
No.5 LONGITUDINAL SECTION
Scale: 3/8" = 1'-0"



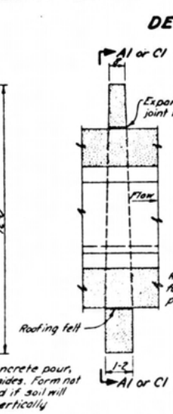
SECTION 3-3

LONGITUDINAL SECTION
Nos. 1, 2, 3, 4, 6, 7, 8, 9, 11, 12 & 14
Not to scale

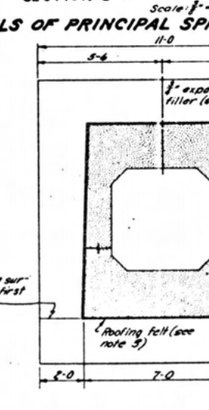
DETAILS OF PRINCIPAL SPILLWAY FROM E.J. 1 TO E.J. 15



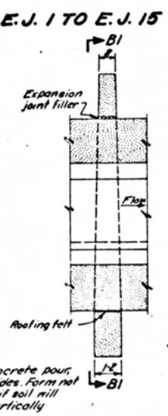
SECTIONAL ELEVATION A1-A1 & C1-C1



LONGITUDINAL SECTION



SECTIONAL ELEVATION B1-B1



LONGITUDINAL SECTION

DETAILS OF ANTI-SEEP COLLARS

Scale: 3/8" = 1'-0"

NOTES:

1. BATTER SIDES OF ANTI-SEEP COLLARS FROM 1'-2" AT TOP OF FIRST POUR JOINT TO 8" AT TOP OF COLLAR. SIDES OF ANTI-SEEP COLLAR TO BE VERTICAL FROM FIRST POUR JOINT TO BOTTOM OF COLLAR.
2. PLACE PREMOLDED EXPANSION JOINT FILLER BETWEEN ANTI-SEEP COLLAR AND CONDUIT (TOP AND SIDES ONLY)
3. PLACE 2 LAYERS OF HEAVY SMOOTH SURFACE ROOFING FELT BETWEEN (A) BOTTOM OF CONDUIT AND ANTI-SEEP COLLAR AND (B) BOTTOM OF CONDUIT AND EXPANSION JOINT "SLEEPER."
4. USE POLYVINYLCHLORIDE WATERSTOP (SIMILAR AND EQUAL TO SEALTIGHT DUO-PVC TYPE NO. 61800) 6" WIDE AT ALL EXPANSION JOINTS PER DETAIL.
5. SECURE PREMOLDED EXPANSION JOINT FILLER TO CONCRETE FACE OF CONDUIT LAST POURED WITH 3" COPPER NAILS @ 12" C-C, COUNTERSINK NAILS 1/8".
6. FOR LOCATION OF SECTIONS AND WARP BETWEEN SECTIONS, SEE SHEET 7.
7. ANTI-SEEP COLLARS SHALL BE INSTALLED IN A VERTICAL POSITION.

"AS BUILT"

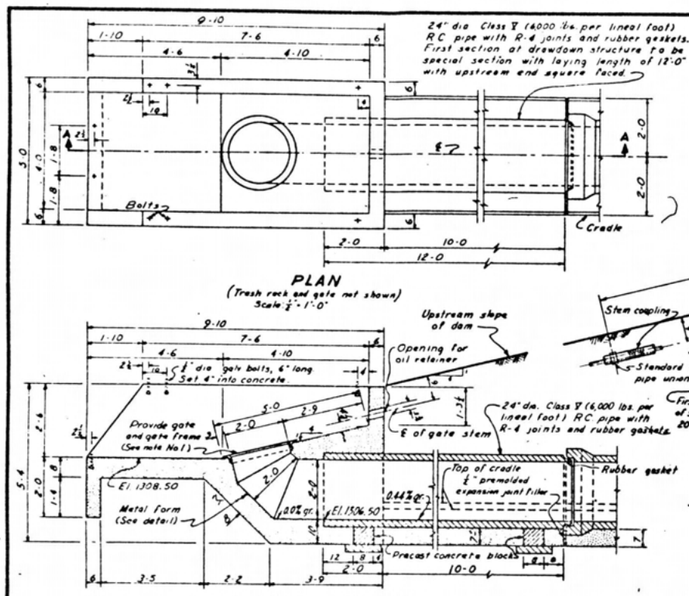
PRINCIPAL SPILLWAY BETWEEN E.J.1 AND E.J.15, 4'-6" x 4'-7" CONDUIT

FLOOD RETARDING-FISH AND WILDLIFE DAM No.1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed CEM Date Approved by
Drawn CEM Title
Checked

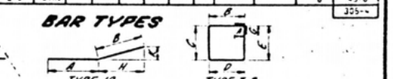
N.D.S.P. PHASE I INSPECTION REPORT PLATE C-16



BAR SCHEDULE FOR GATE HOIST STRUCTURE AND CONCRETE SUPPORTS

Mark	Size	Quantity	Length	Type	A	B	C	D	E	F	H	J	Weight Each Lbs.	Weight Total Lbs.
L1	¾	10	4-6	STR.									15	151-0
L2	¾	9	4-3	STR.									15	33-3
L3	¾	2	5-10	19	1-7	4-3					1-4 1/2	0-4 1/2	-	11-4
L4	¾	4	10-0	2	4-6	1-4							12	48-0
L5	¾	2	9-0	STR.									-	8-0
L6	¾	11	3-4	T-2	0-7	0-8	0-10	0-8	0-10	0-2			12	36-8
L7	¾	4	10-9	STR.									-	43-0
L8	¾	10	1-9	STR.									12	17-6
L9	¾	22	0-9	STR.									12	20-3
L10	¾	18	2-6	STR.									8	45-0
														355-4

BAR TYPES



MATERIAL LIST FOR GATE AND GATE LIFTING MECHANISM

ITEM	UNIT	QUANTITY
GATE STEM 1 1/2" DIA.	LIN. FT.	113-8
PIPE HOUSING 3" DIA. STD. GALV. WITH PIPE UNION AND COUPLINGS	LIN. FT.	127-0
STEM COUPLINGS	EACH	4
STEM SLEEVES	EACH	5
OIL RETAINER (STANDARD ARMCO OR EQUAL)	EACH	2
30" DIA. HANDWHEEL LIFT (EQUAL TO ARMCO HB-30) WITH BRONZE NUT	EACH	1
24" DIA. STEEL SLIDE GATE, WITH SPIGOT BACK AND 37-9 9/16" RISE (ARMCO MODEL 50-100F OR EQUAL)	EACH	1

QUANTITIES FOR GATE HOIST INLET STRUCTURE AND APPURTENANCES

ITEM	UNIT	QUANTITY
CONCRETE (CLASS A)	CU.YDS.	41.72
REINFORCING STEEL	LBS.	1,770
STRUCTURAL STEEL	LBS.	967

NOTES:

1. PROVIDE 24" DIA. STEEL SLIDE GATE WITH SPIGOT BACK AND 37 9/16" RISE GATE FRAME EQUAL TO ARMCO MODEL 50-100C. (SET GATE FRAME AND ANCHOR BOLTS ACCORDING TO MANUFACTURER'S SPECIFICATIONS).
2. AT EXPANSION JOINTS FILL SPACE BETWEEN PIPE SECTIONS ABOVE TOP OF CRADLE WITH A RUBBER TYPE JOINT SEALING COMPOUND SIMILAR TO SERVICISED BLACK "VENTISEAL".
3. FILL GATE STEM HOUSING WITH 600 W. OR EQUAL CYLINDER OIL TO WITHIN 4" OF THE TOP OF THE OIL FILL PIPE.
4. TRASH RACK ANGLES, BARS AND PLATES TO BE SECURELY WELDED AT JUNCTIONS.
5. TRASH RACK TO BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS.
6. PROVIDE 5/8" DIAMETER HOLES IN TRASH RACK MEMBERS (A), (B) AND (C) FOR 1/2" DIA. BOLTS.
7. ALL BOLTS AND NUTS TO BE GALVANIZED.
8. RADIUS OF BENDS OF REINFORCING BARS = 4 TIMES THE DIAMETER OF THE BAR.
9. LENGTH OF THE GATE STEM IS MEASURED FROM THE CENTER OF THE GATE TO THE BASE OF THE HANDWHEEL LIFT.

MATERIAL LIST FOR TRASH RACK

MARK	ITEM	QUANTITY
A	∠ 3 ½" X 3" X 1/4", 7'-0" LONG	2
B	BARS 6" X 1/4", 6'-10" LONG	6
C	BARS 6" X 1/2", 11'-9 1/2" LONG	10
D	BARS 6" X 1/4", 2'-0" LONG	1
E	SL@67°, 5'-0" LONG	1
F	BARS 6" X 1/4", 11'-4 1/8" LONG	1
G	∠ 5 1/2" X 3 1/2" X 1/4", 5'-0" LONG	1
	TOTAL WEIGHT OF STRUCTURAL STEEL	119 LBS.

"AS BUILT"

DRAWDOWN STRUCTURE

DETAILS OF DRAWDOWN INLET, GATE HOIST TRASH RACK AND APPURTENANCES

FLOOD RETARDING-FISH AND WILDLIFE DAM No.1

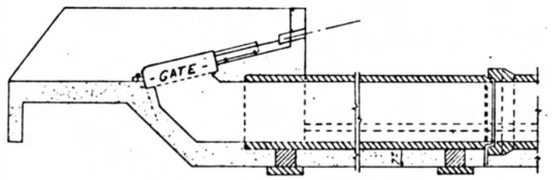
MIDDLE - SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed V.H.W. Date
Drawn
Traced
Approved by
Title
Date
Sheet No. Drawing No.

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-17



SECTIONAL ELEVATION A-A
Scale 1/4" = 1'-0"

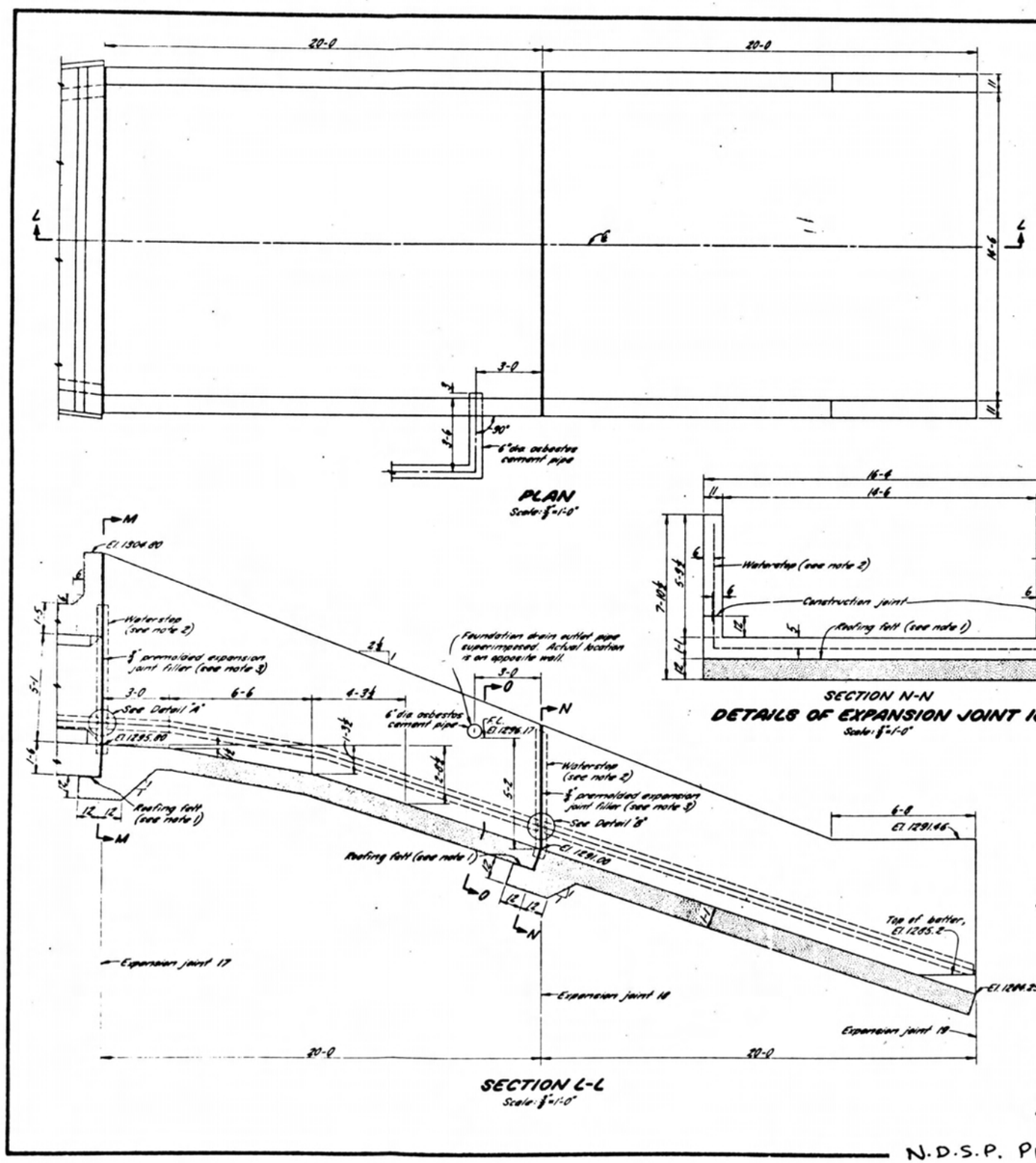
"AS Built" installation of Gate

FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1
MI. - SO. BR. FOREST RIVER WATERSHED
Walsh County North Dakota

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
Drawn		Title
Traced		Title

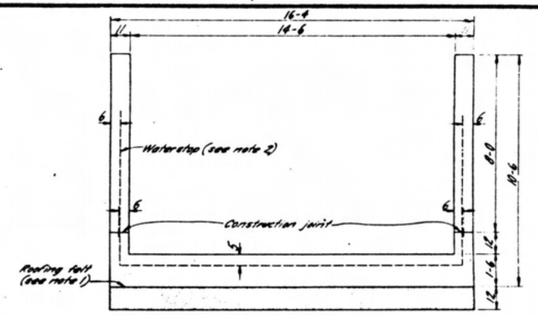
N.D.S.P. PHASE I INSPECTION REPORT PLATE C-18



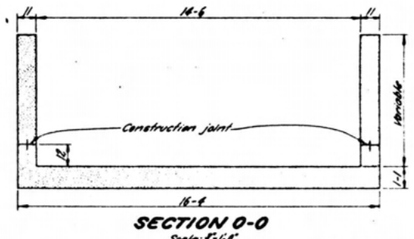
SECTION L-L
Scale: ⅛"=1'-0"

PLAN
Scale: ⅛"=1'-0"

SECTION N-N
DETAILS OF EXPANSION JOINT 18
Scale: ⅛"=1'-0"



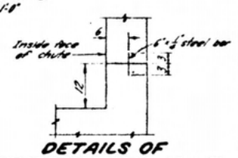
SECTION M-M
DETAILS OF EXPANSION JOINT 17
Scale: ⅛"=1'-0"



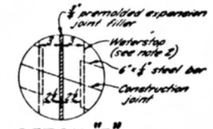
SECTION O-O
Scale: ⅛"=1'-0"

TABLE OF QUANTITIES

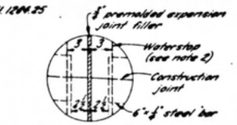
ITEM	UNIT	QUANTITY
Concrete (Class A)	Cu.yds.	47.78
Reinforcing steel	Lbs.	9,554



DETAILS OF CONSTRUCTION JOINT
Scale: ½"=1'-0"



DETAIL "B"
Scale: 1½"=1'-0"



DETAIL "A"
Scale: 1½"=1'-0"

NOTES:
1. PLACE 2 LAYERS OF HEAVY SMOOTH SURFACE ROOFING FELT BETWEEN BOTTOM OF STRUCTURE AND EXPANSION JOINT SLEEPER AND BETWEEN OUTSIDE SURFACE OF ASBESTOS CEMENT PIPE AND SIDEWALLS.
2. USE POLYVINYLCHLORIDE WATERSTOP (SIMILAR AND EQUAL TO SEALTIGHT DUO-PVC TYPE NO. 6100) 6" WIDE AT ALL EXPANSION JOINTS PER DETAIL.
3. SECURE PREMOLDED EXPANSION JOINT FILLER TO CONCRETE FACE LAST PLACED WITH 3" COPPER NAILS @ 12" C-C. COUNTERSINK NAILS 1/8".
4. PROVIDE END CAP ON OUTLET END OF OUTLET PIPE. FOR DETAILS OF END CAP, SEE STANDARD DRAWING NO. S.R-10.000-55.

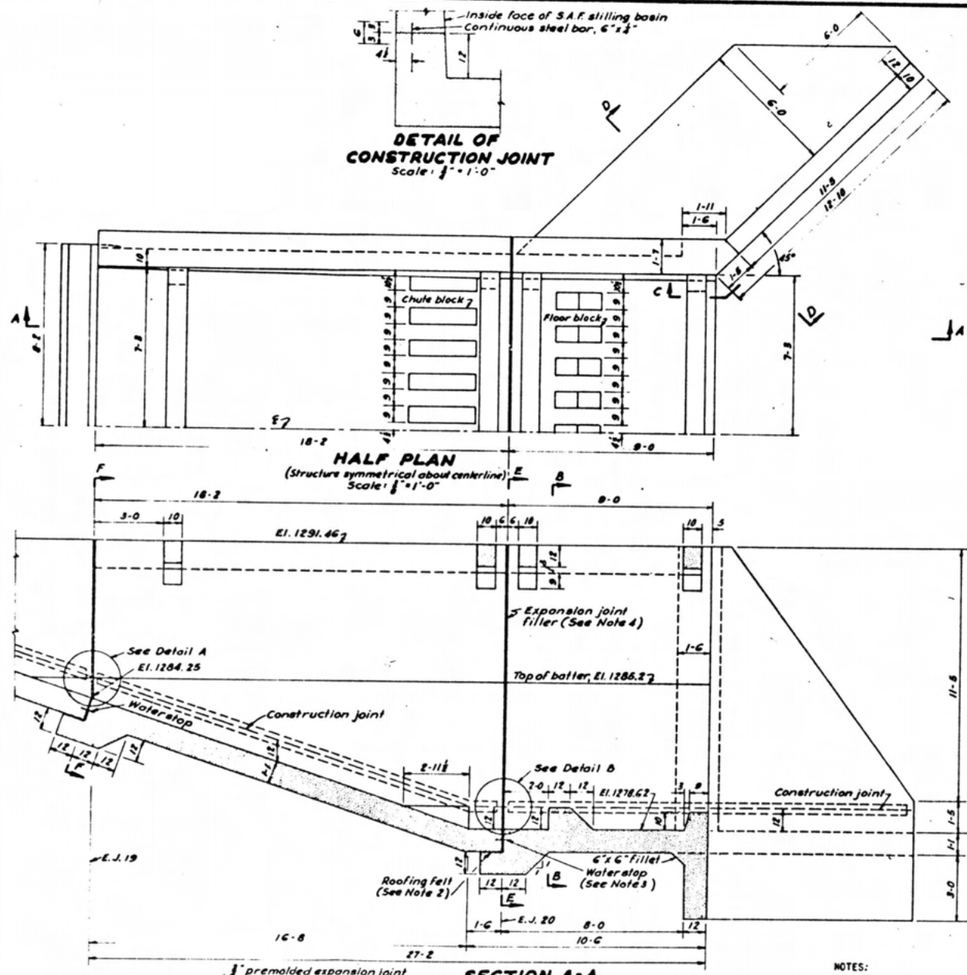
"AS BUILT"

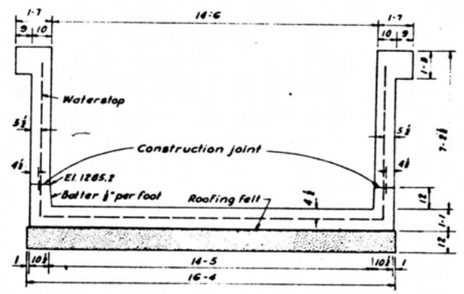
PRINCIPAL SPILLWAY DETAILS OF CHUTE SECTIONS E.J. 17 TO E.J. 19

FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed: R.E.M. — Approved by: — Date:
Drawn: V.E.S. C.E.M. — Title:
Traced: — Title:
Scale: — Drawing No.
No. 28





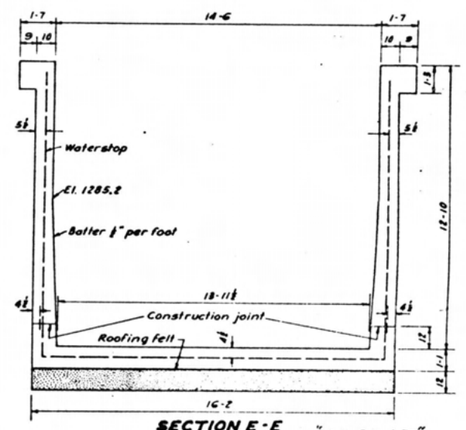


TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
CONCRETE (CLASS A)	CU.YD.	64.39
REINFORCING STEEL	LBS.	13,606

NOTES:
1. E.J. = EXPANSION JOINT.
2. PLACE TWO LAYERS OF HEAVY, SMOOTH SURFACE, ROOFING FELT BETWEEN BOTTOM OF STRUCTURE AND EXPANSION JOINT, AND BETWEEN SEAMS AND SUPPORTS.
3. USE POLYVINYLCHLORIDE WATERSTOP (SIMILAR AND EQUAL TO SEALTIGHT BUD-PVC TYPE NO. 61800) 6" WIDE AT EXPANSION JOINTS, PER DETAILS.
4. SECURE PREMOLDED EXPANSION JOINT FILLER TO CONCRETE FACE OF THE SECTION LAST PLACED WITH 3" COPPER NAILS @ 12" C-C. COUNTERSINK NAILS 1/8".

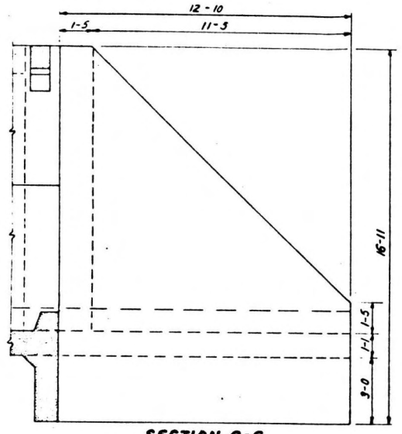
PRINCIPAL SPILLWAY
DETAILS OF S.A.F. STILLING BASIN

FLOOD RETARDING-FISH AND WILDLIFE DAM No.1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

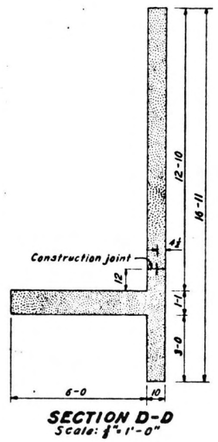
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed WRE D.E.M. Date
Drawn Approved by
Title
Title

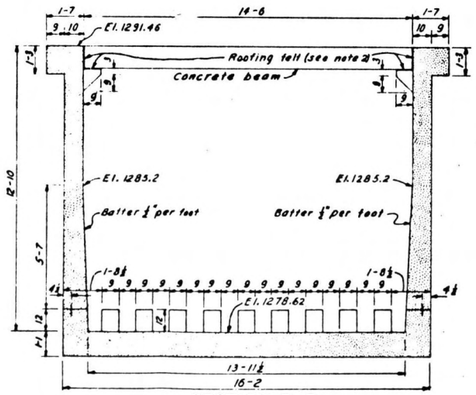
N.D.S.P. PHASE I INSPECTION REPORT PLATE C-20



SECTION C-C
Scale: $\frac{3}{8}$" = 1'-0"



SECTION D-D
Scale: $\frac{3}{8}$" = 1'-0"



SECTION B-B
(concrete beam superimposed)
Scale: $\frac{3}{8}$" = 1'-0"

"AS BUILT"

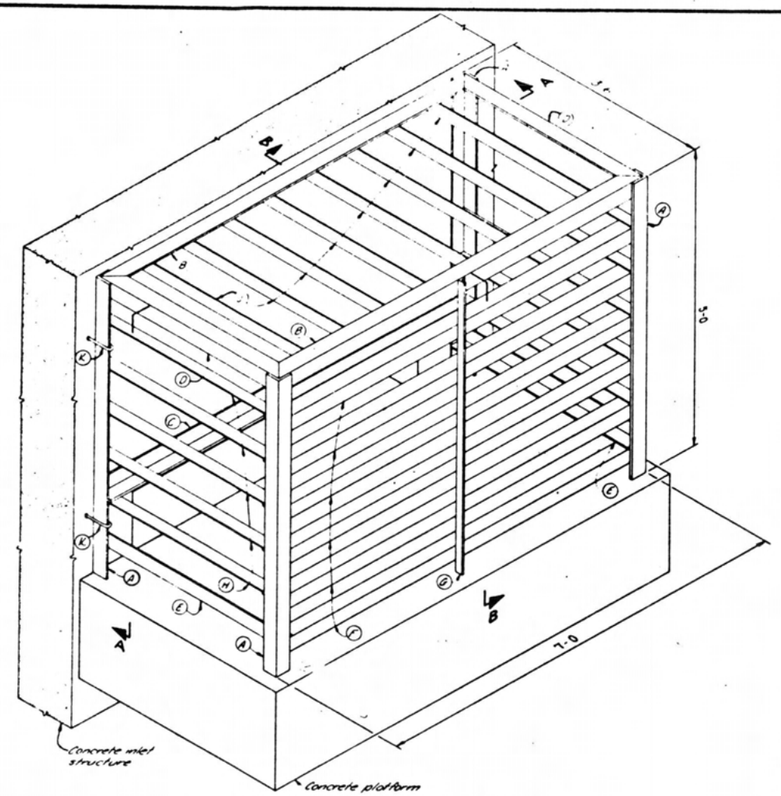
PRINCIPAL SPILLWAY
DETAILS OF S.A.F. STILLING BASIN

FLOOD RETARDING-FISH AND WILDLIFE DAM No.1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

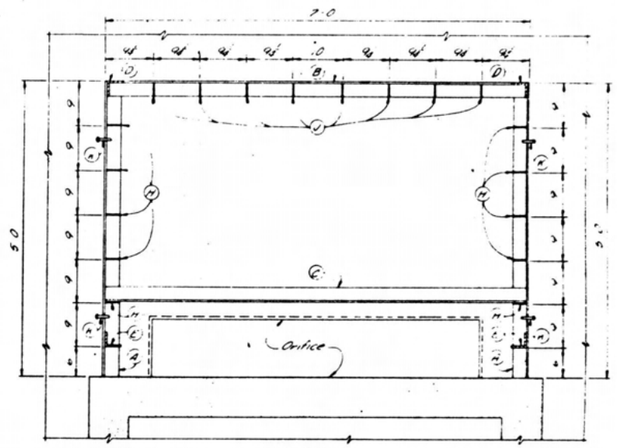
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed O.E.M.		Approved by	
Drawn O.E.M.		Title	
Traced		Title	
R.W.R. W.R.F. C-44		Sheet No. 52	Drawing No. SE-7A-93A

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-21



ISOMETRIC VIEW OF TRASH RACK
scale 1"-1'-0"
(two required)

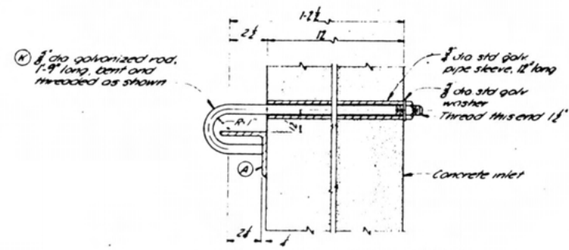


SECTIONAL ELEVATION A-A
SCALE 1"-1'-0"

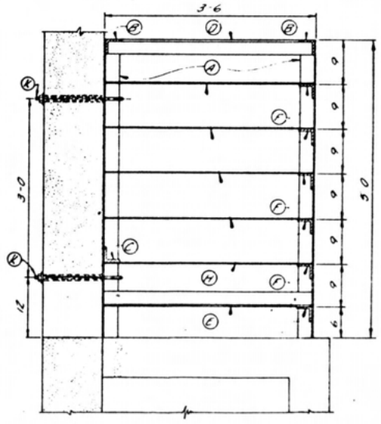
MATERIAL LIST FOR ONE TRASH RACK

MARK	ITEM	QUANTITY
A	∠ 3" X 3" X 1/2" 5'-0" LONG	4
B	∠ 3" X 3" X 1/2" 4'-11" LONG	2
C	∠ 3" X 3" X 1/2" 4'-11" LONG	1
D	∠ 3" X 3" X 1/2" 3'-5" LONG	2
E	∠ 3" X 3" X 1/2" 3'-5" LONG	2
F	∠ 3" X 3" X 3/8" 4'-11" LONG	6
G	∠ 1 1/2" X 1 1/2" X 1/4" 4'-11" LONG	1
H	BAR 2 1/2" X 1/4" 3'-5" LONG	10
J	BAR 2 1/2" X 1/4" 3'-6" LONG	8
K	5/8" DIA. J BOLT WITH WASHER AND NUT (GALV.) PER DETAIL	4
TOTAL WEIGHT OF ONE RACK		953 LBS.
TOTAL WEIGHT OF 2 RACKS		1906 LBS

1. CLIP MARK (3) AND (3) ANGLES AS SHOWN.
2. ALL ANGLES AND BARS TO BE SECURELY WELDED AT JUNCTIONS.
3. TRASH RACK TO BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS.



DETAIL OF FASTENING BOLT
SECTIONAL PLAN
Scale 3"-1'-0"



SECTIONAL ELEVATION B-B
Scale 1"-1'-0"

AS BUILT

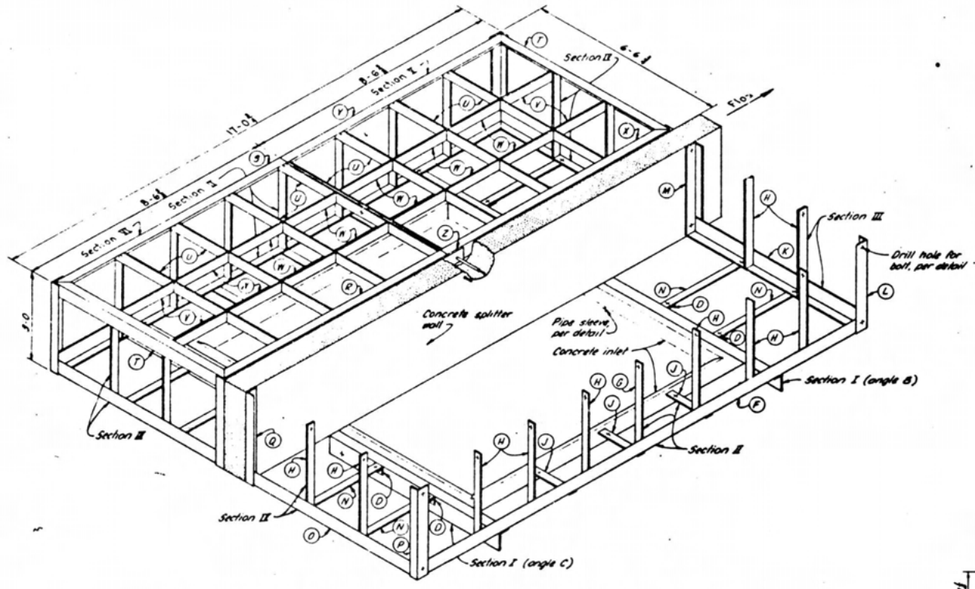
DETAILS OF ORIFICE TRASH RACK FOR CONCRETE INLET STRUCTURE (2 REQ'D)

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

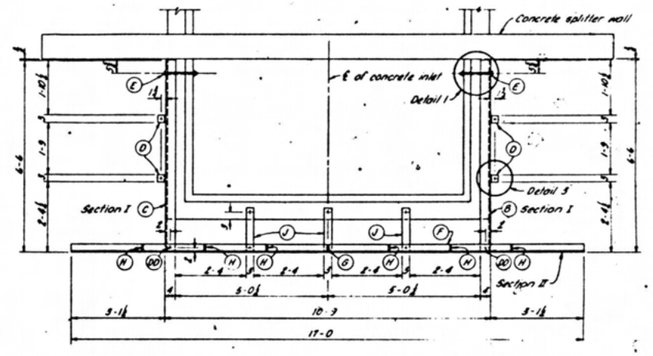
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed J.M.M. Date
Approved by
Title
Drawn
Title

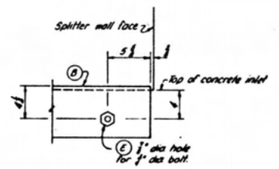
N.D.S.P. PHASE I INSPECTION REPORT PLATE C-22



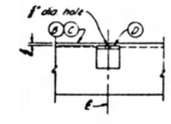
ISOMETRIC VIEW OF TRASH RACK FOR TOP OF INLET
Scale: ½" = 1'-0"



PLAN OF SECTION I AND II
scale: ½"=1'-0"



DETAIL 1
(Detail of Ⓒ would be similar)
Scale: ½" = 1'-0"



DETAIL 3
Scale: 1½" = 1'-0"

* MATERIAL LIST FOR TRASH RACK

MARK	ITEM	QUANTITY
B	∠5 ½" x 3½" x 11/32", 4'-4½" LONG	2
C	∠5 ½" x 3½" x 11/32", 8'-4½" LONG	2
D	∠5 ½" x 3½" x 3/8", 0'-3" LONG	8
E	BOLT ¾" DIA., GALV., 11 ½" LONG	10
F	∠5 ½" x 3½" x ½", 17'-0" LONG	2
G	BAR ½" x 1½", 0'-11" LONG	2
H	BAR ½" x 1½", 0'-11" LONG	20
J	BAR ½" x 1½", 1'-4½" LONG	6
K	∠5 ½" x 3½" x ½", 8'-4½" LONG	2
L	∠5 ½" x 3½" x ½", 11'-0" LONG	2
M	∠5 ½" x 3½" x ½", 11'-0" LONG	2
N	BAR ½" x 1½", 11'-1 1/2" LONG	8
O	∠5 ½" x 3½" x ½", 8'-4½" LONG	2
P	∠5 ½" x 3½" x ½", 11'-0" LONG	2
Q	∠5 ½" x 3½" x ½", 11'-0" LONG	2
R	∠5 ½" x 3½" x ½", 8'-4½" LONG	2
S	∠5 ½" x 3½" x ½", 8'-4½" LONG	2
T	∠5 ½" x 3½" x ½", 8'-4½" LONG	4
U	BAR ½" x 1½", 8'-0" LONG	14
V	BAR ½" x 1½", 0'-11" LONG	8
W	BAR ½" x 1½", 0'-0" LONG	34
X	∠5 ½" x 3½" x ½", 8'-4½" LONG	2
Y	∠5 ½" x 3½" x ½", 8'-4½" LONG	2
Z	BAR ½" x ½", 11'-1" LONG (SPACER)	2
AA	BAR ½" x 1½", 0'-4½" LONG (SPACER)	2
BB	BOLT ½" DIA. GALV., 0'-3" LONG	4
CC	BOLT ½" DIA. GALV., 0'-1 1/2" LONG	44
DD	BOLT ½" DIA. GALV., 0'-2" LONG	4
	TOTAL WEIGHT OF STRUCTURAL STEEL 3663 LBS.	

* TOTAL FOR BOTH HALVES OF TRASH RACK

NOTES:
1. CLIP ANGLES AS SHOWN.
2. ANGLES AND BARS ARE TO BE SECURELY WELDED AT JUNCTIONS AS SHOWN ON EACH SECTION. SECTIONS ARE BOLTED TOGETHER TO FORM A COMPLETE TRASH RACK.
3. TRASH RACK TO BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS.
4. PROVIDE WASHER WHEN REQUIRED TO PREVENT DIRECT CONTACT BETWEEN BOLT HEAD OR NUT AND CONCRETE SURFACE.

"AS BUILT"

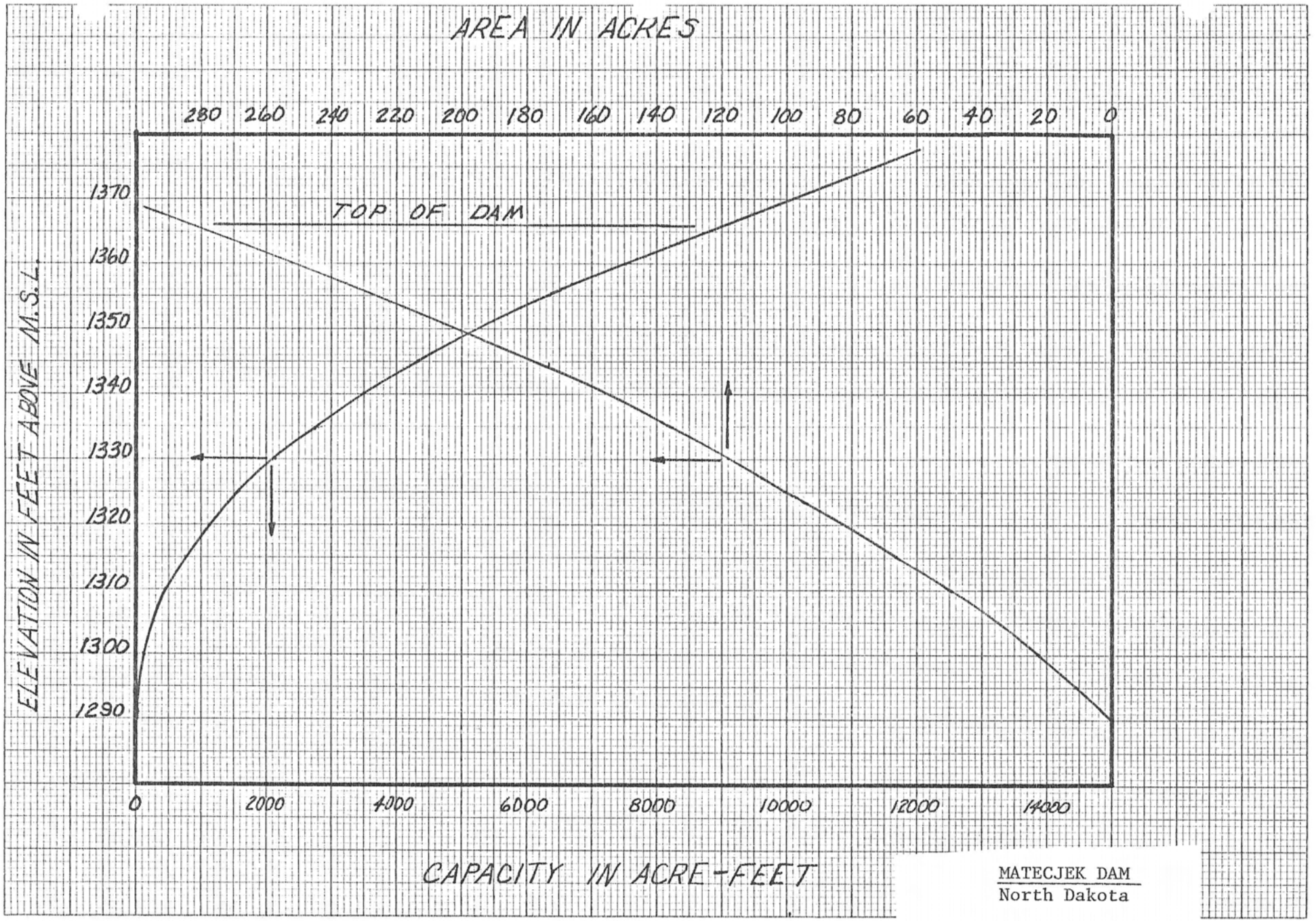
DETAILS FOR TRASH RACK FOR TOP OF INLET

FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1
MIDDLE SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed DCH, JMH — Date — Approved by
Drawn RAF — Title
Traced — Title — Sheet — Drawing No.

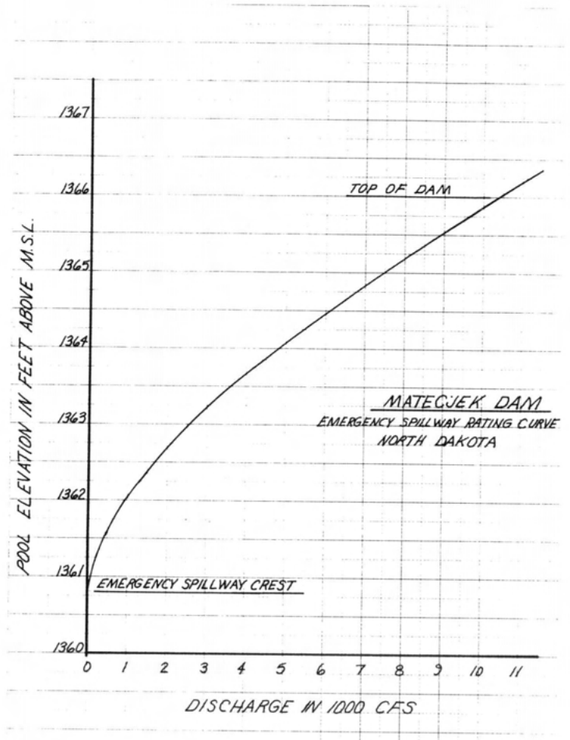
N.D.S.P. PHASE I INSPECTION REPORT PLATE C-23

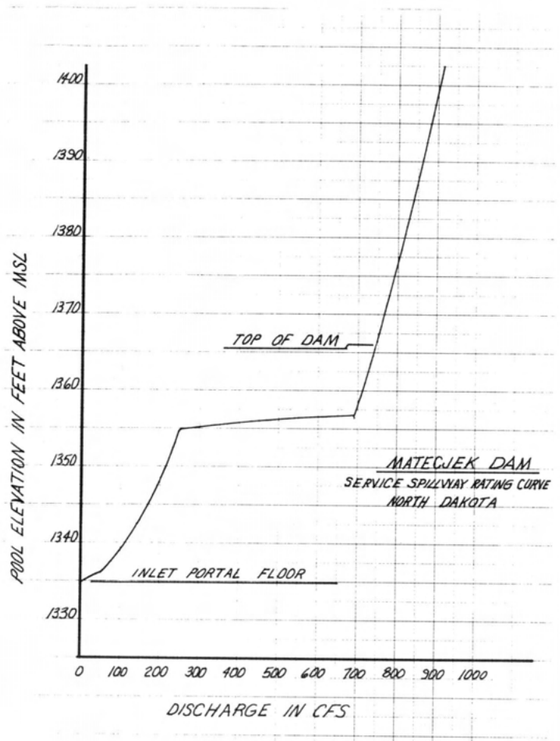


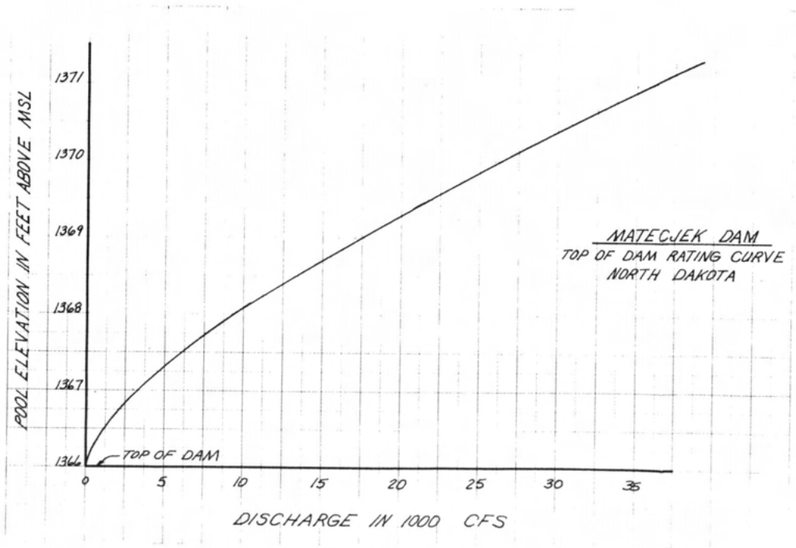
MATECJEK DAM
North Dakota

AREA-CAPACITY CURVES

N.D.S.P. Phase I Inspection Report MAY 72 '71





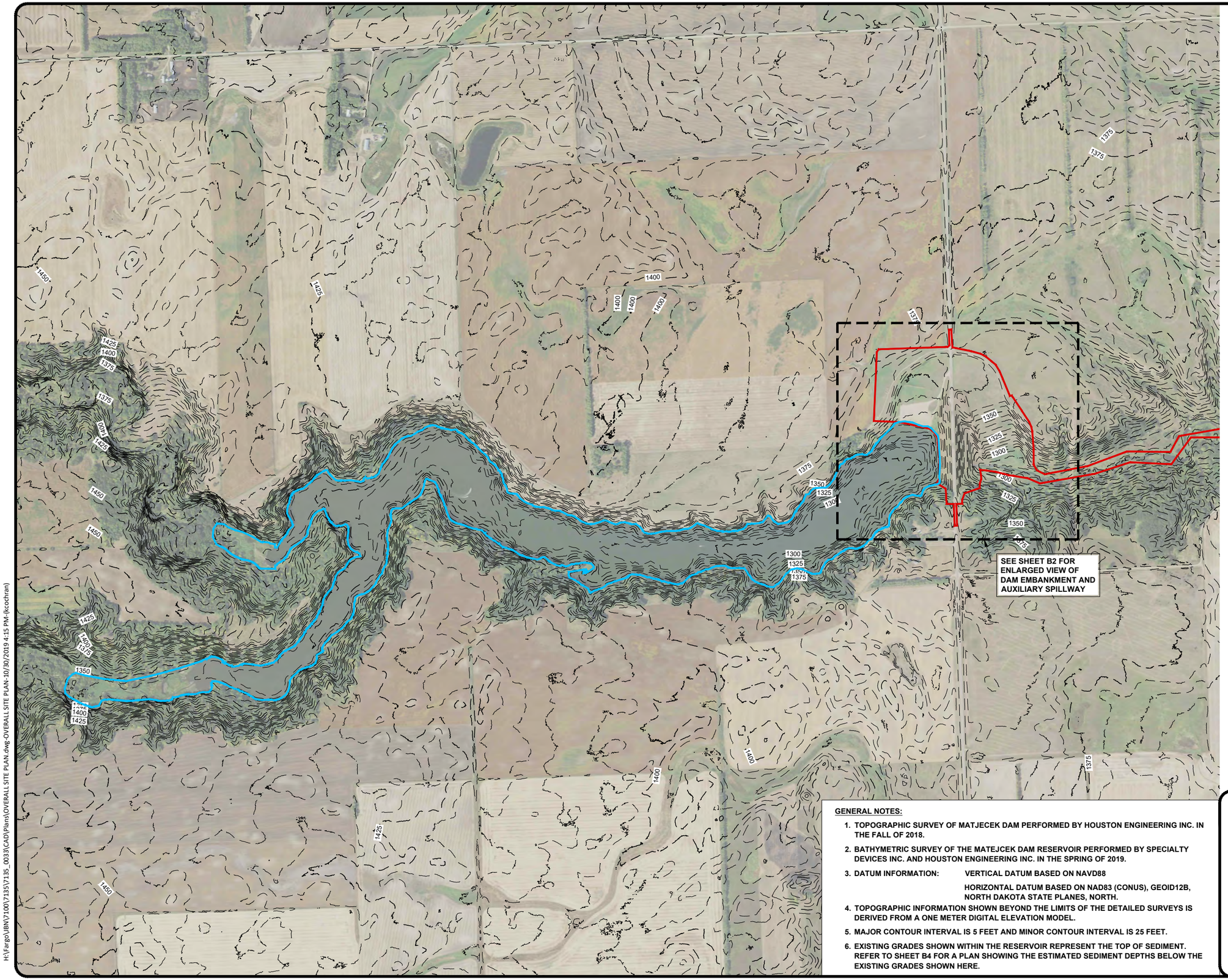


MATECJEK DAM
I. D. No. ND 00043
EMERGENCY SPILLWAY RATING CURVE,
SERVICE SPILLWAY RATING CURVE,
AND TOP OF DAM RATING CURVE.

APPENDIX B

Field Survey Maps

DRAFT



GENERAL NOTES:

1. TOPOGRAPHIC SURVEY OF MATJECEK DAM PERFORMED BY HOUSTON ENGINEERING INC. IN THE FALL OF 2018.
2. BATHYMETRIC SURVEY OF THE MATEJCEK DAM RESERVOIR PERFORMED BY SPECIALTY DEVICES INC. AND HOUSTON ENGINEERING INC. IN THE SPRING OF 2019.
3. DATUM INFORMATION: VERTICAL DATUM BASED ON NAVD88
   HORIZONTAL DATUM BASED ON NAD83 (CONUS), GEOID12B, NORTH DAKOTA STATE PLANES, NORTH.
4. TOPOGRAPHIC INFORMATION SHOWN BEYOND THE LIMITS OF THE DETAILED SURVEYS IS DERIVED FROM A ONE METER DIGITAL ELEVATION MODEL.
5. MAJOR CONTOUR INTERVAL IS 5 FEET AND MINOR CONTOUR INTERVAL IS 25 FEET.
6. EXISTING GRADES SHOWN WITHIN THE RESERVOIR REPRESENT THE TOP OF SEDIMENT. REFER TO SHEET B4 FOR A PLAN SHOWING THE ESTIMATED SEDIMENT DEPTHS BELOW THE EXISTING GRADES SHOWN HERE.

PRELIMINARY
NOT FOR CONSTRUCTION

MATEJCEK DAM
WALSH COUNTY WATER RESOURCE DISTRICT
GRAFTON, NORTH DAKOTA

OVERALL SITE PLAN

DRAFTED BY	KHC
REVIEWED BY	JMW
DATE	7-22-2019
PROJECT NUMBER	7135-033

B1

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CONTROL POINT TABLE				
Point #	Description	Elevation	Northing	Easting
1	CONTROL POINT	1366.714	458192.8800	2596616.1020
2	CONTROL POINT	1364.114	458742.2370	2595951.8600
3	CONTROL POINT	1363.086	458506.8100	2595469.0830
4	CONTROL POINT	1370.236	457097.6750	2596033.5360

CP# 2
458742.24
2595951.86
ELEV. 1364.11

24 x 61' RCP
W INV. 1355.48
E INV. 1356.06

CP# 3
458506.81
2595469.08
ELEV. 1363.09

EX DITCH

CENTERLINE OF AUXILIARY SPILLWAY

18 x 24' RCP
NW INV. 1360.99
SE INV. 1359.33

EX DITCH

BORING 1 (NOT DRILLED)
ELEV. 1356.74 (GROUND)

CENTERLINE OF AUXILIARY SPILLWAY

CP# 1
458192.88
2596616.10
ELEV. 1366.71

EX DITCH

BORING 3
ELEV. 1362.22 (GROUND)

AUXILLARY SPILLWAY CREST
ELEV. 1361.88

EX DITCH

18 x 26' CMP
N INV. 1338.07
S INV. 1337.80

BORING 2
ELEV. 1361.88 (GROUND)

CENTERLINE OF AUXILIARY SPILLWAY

EX EARTH DAM
TOP OF DAM
ELEV. 1368.16

CENTERLINE OF AUXILIARY SPILLWAY

EX GUARD RAIL

BORING 5
ELEV. 1326.96 (GROUND)

BORING 4
ELEV. 1368.73 (GROUND)

SAF - STILLING BASIN

CONDUIT

PRINCIPAL SPILWAY RISER

PRINCIPLE SPILWAY CONDUIT

BORING 6
ELEV. 1326.39 (GROUND)

NORMAL POOL
ELEV. 1335.43

CP# 4
457097.68
2596033.54
ELEV. 1370.24

N

100 0 100 200
Scale Feet

LEGEND

- MAJOR CONTOURS — 1360
- MINOR CONTOURS
- GROUND SURVEY LIMITS
- BATHYMETRIC SURVEY LIMITS
- SOIL BORING
- CONTROL POINT
- TOPO SURVEY POINT +
- ASPHALT
- GRAVEL
- RIPRAP
- DRAINAGE DIRECTION

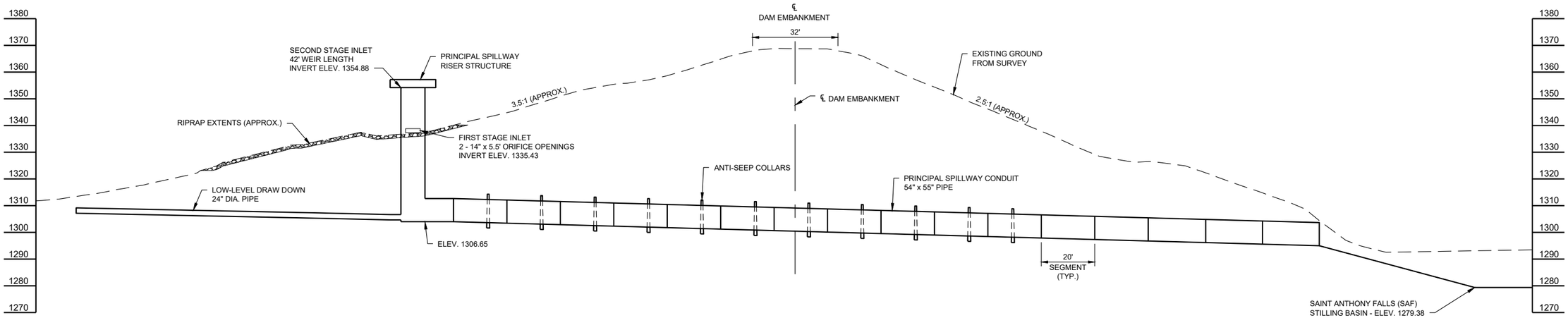
MATEICEK DAM
WALSH COUNTY WATER RESOURCE DISTRICT
GRAFTON, NORTH DAKOTA

EXISTING CONDITIONS PLAN

PRELIMINARY
NOT FOR CONSTRUCTION

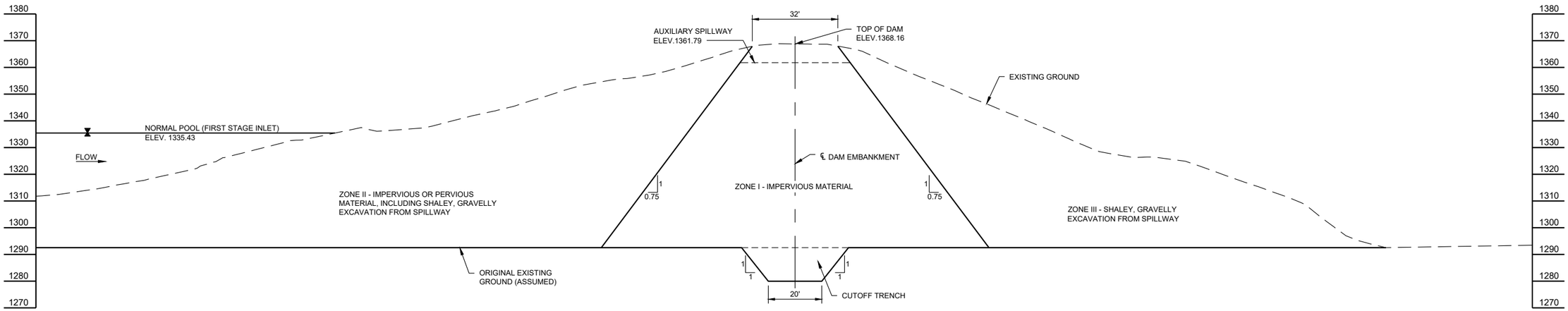
DRAFTED BY	KHC
REVIEWED BY	JMW
DATE	7-22-2019
PROJECT NUMBER	7135-033
	B2

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CROSS SECTION THROUGH PRINCIPAL SPILLWAY STRUCTURE

NOT TO SCALE



TYPICAL CROSS SECTION THROUGH EMBANKMENT

NOT TO SCALE

NOTE:
1. TYPICAL CROSS SECTIONS BASED ON FIELD SURVEY INFORMATION AND AS-BUILT DRAWINGS.

PRELIMINARY
NOT FOR CONSTRUCTION

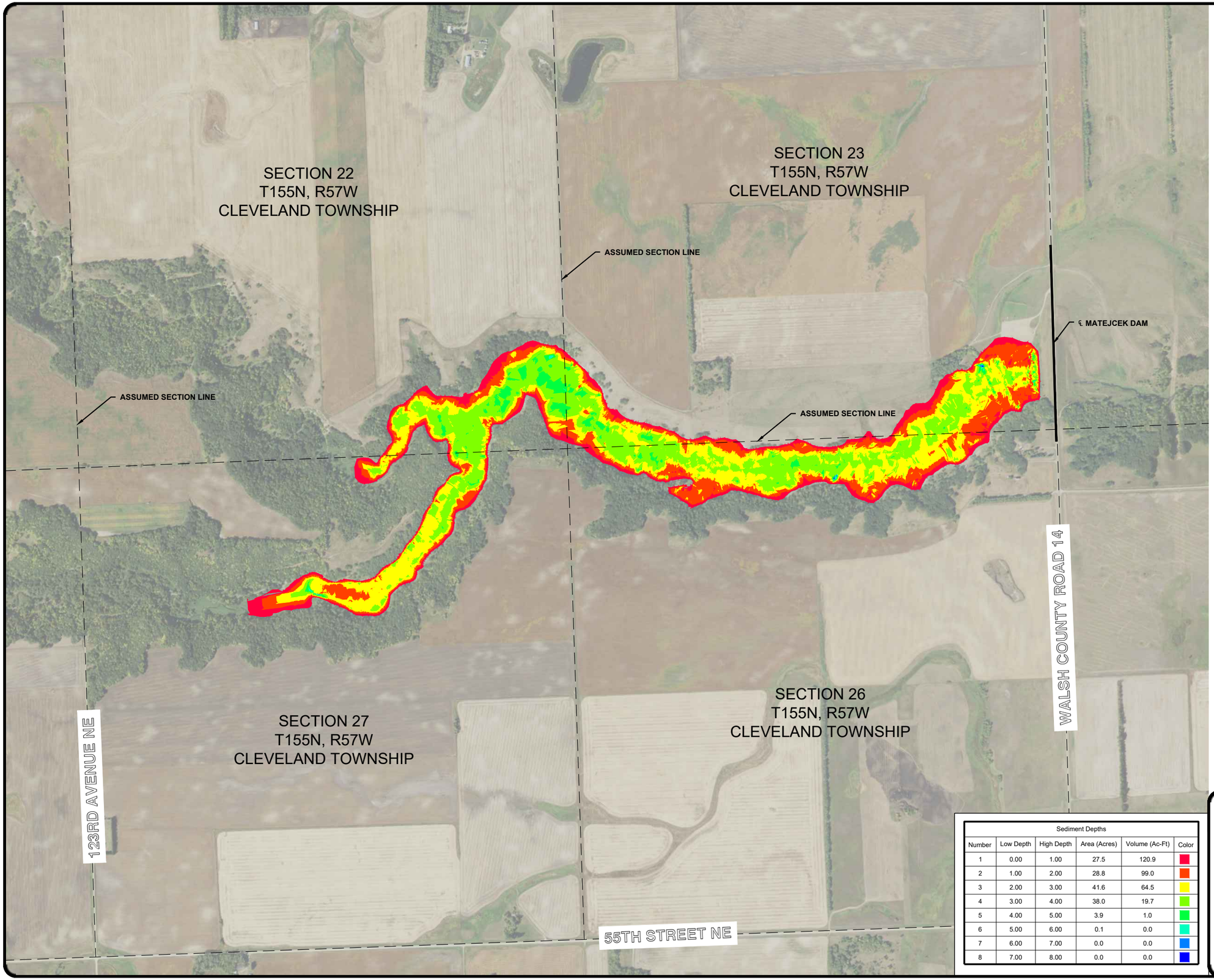
MATEICEK DAM
WALSH COUNTY WATER RESOURCE DISTRICT
GRAFTON, NORTH DAKOTA

CROSS SECTION AT SPILLWAY

DRAFTED BY	KHC
REVIEWED BY	JMW
DATE	7-22-2019
PROJECT NUMBER	7135-033

B3

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N

1000 0 500 1000
Scale Feet

NOTE:
1. SEE SHEET B1 FOR GENERAL NOTES.

Sediment Depths					
Number	Low Depth	High Depth	Area (Acres)	Volume (Ac-Ft)	Color
1	0.00	1.00	27.5	120.9	
2	1.00	2.00	28.8	99.0	
3	2.00	3.00	41.6	64.5	
4	3.00	4.00	38.0	19.7	
5	4.00	5.00	3.9	1.0	
6	5.00	6.00	0.1	0.0	
7	6.00	7.00	0.0	0.0	
8	7.00	8.00	0.0	0.0	

PRELIMINARY
NOT FOR CONSTRUCTION

MATEJCEK DAM
WALSH COUNTY WATER RESOURCE DISTRICT
GRAFTON, NORTH DAKOTA

SEDIMENT SURVEY PLAN

DRAFTED BY
KHC
REVIEWED BY
JMW
DATE
7-22-2019
PROJECT NUMBER
7135-033

B4

H:\Fargo\JBN\7100\7135\7135_0033\CAD\Engr\Surface Comparison - Matejcek Reservoir.dwg-SEDIMENT SURVEY PLAN-11/7/2019 10:11 AM-(pleclaire)

APPENDIX C

Supporting Survey Information

- Survey Field Notes
- Survey Processing Information
- HEI Survey Feature Code List
- Survey Points Collected

DRAFT

SURVEY FIELD NOTES

DRAFT

11-26-18
D. SUNRA
C. GOLAN

7135-0033

MATEJCEK DAM REHAB

N.D. STATE PLANE NORTH

U.S. SURVEY FEET

GEOID 2012B

TABLET 1

- CHECKED ON PT # 479 (BRIDGE DECK CORNER) FROM JOB # 7135-021
- SET HECP # 1 W/ MIDSTATES VRS

11-27-18
D. SUNRA
C. GOLAN

- TT SET ON HECP #1 HT. = 5.625
- SET HECP # 2-4
- LEVEL CIRCUIT THROUGH HECP # 1-4
- PROFILE DAM + SPILLWAY TT #2 B.S. #3
- CROSS SECTION DAM + SPILLWAY

TABLET 1 / PT # 1000 - 1108

TSC3-12 / PT # 5000 - 5425

LEVEL CIRCUIT HECP #1-4

	+	⊼	−	ELEV.	W/CFS
B.M.					1366.71
	7.30				
		1374.01			
T.P. 1			4.52	1369.49	
	4.16	1373.65			
HECP 2			9.54	1364.11	1364.11
	2.62	1366.73			
HECP 3			3.65	1363.08	1363.09
	1.66	1364.74			
T.P. 2			8.46	1356.28	
	15.16	1371.44			
T.P. 3			2.22	1369.22	
	5.35	1374.57			
T.P. 4			5.89	1368.69	
	5.13	1373.82			
HECP 4			3.62	1370.20	1370.24
	3.45	1373.65			
T.P. 4			4.96	1368.69	
	5.80	1374.49			
T.P. 3			5.28	1369.21	
	1.08	1370.29			
T.P. 2			14.02	1356.27	
	9.07	1365.34			
HECP 3			2.26	1363.08	1363.09

HECP #1 SHOT W/ MIDSTATE 3 VRS

NAIL W/RIBBON ON S. SIDE OF ENTRANCE ROAD E SIDE OF DAM

SHOT W/GPS BASE ON HECP 1

SHOT W/GPS BASE ON HECP 1

NAIL W/RIBON ON NORTH MOST GUARDPOST S. SIDE OF ENTRANCE W. SIDE OF DAM

NAIL W/RIBBON ON W. SIDE OF GUARDPOST W. SIDE RD.

NAIL W/RIBBON ON W. SIDE OF GUARDPOST W. SIDE RD

SHOT W/GPS BASE ON HECP 1

Level Circuit HECP 4-4

	+	HI	−	Elev.	w/GPS
HECP 3				1363.08	1363.09
	3.97	1367.05			
HECP 2			2.94	1364.11	1364.11
	9.17	1373.28			
T.P. 1			3.79	1369.49	
	4.28	1373.77			
HECP 1			7.06	1366.71	1366.71

11-28-18
D. SOWRAN
C. GULAN

T SET ON HECP #1 HT. = 5.85
- CROSS SECTION DAM AND SPILLWAY
- PROFILE DAM AND SPILLWAY
SET RP 999 - 996 W/GPS
T 999 BS 2 PT # 1108 - 1146
T 998 BS 4 PT # 1147 - 1191
T 996 BS 997 PT # 1192 - 1207

TABLET 1 / 1208 - 1490
TSC3-12 / 5426 - 6620

11-29-18
D. SOWRAN
C. GULAN

T SET ON HECP #1 HT. = 5.89
- EXTEND CROSS SECTIONS ON W. SIDE OF SPILLWAY, W. SIDE DAM
- TOPO GRAVEL ENTRANCE RMD + PARKING LOT
- TOPO DRAINAGE DITCH IN SPILLWAY ON W. SIDE
- SET HECP # 5, N. OF STRUCTURE, W. SIDE HWY 32
TABLET 1 / PT # 1491 - 1614

12-3-18
D. SUNRA
C. GULAN

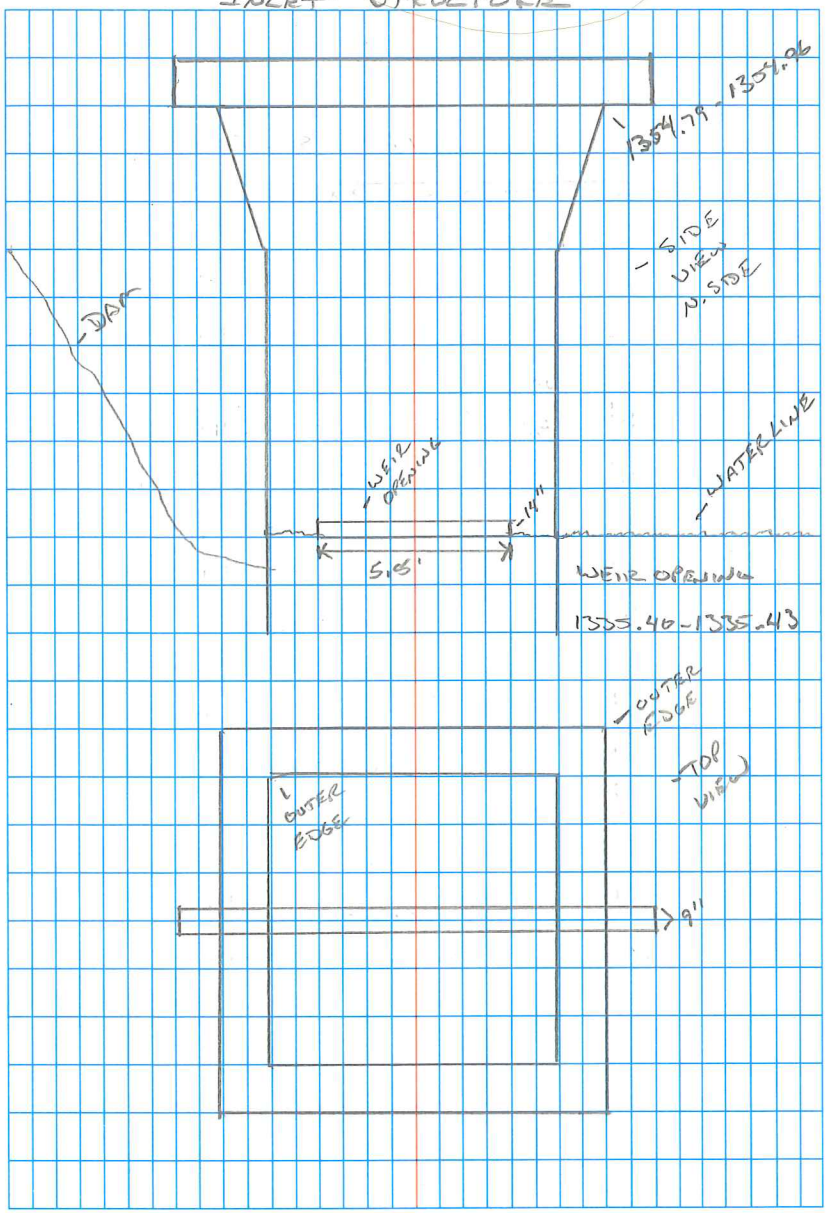
- ROBOTIC SET ON Pt# 999 B.S. 2
  - CHECKED ON Pt# 998

- GPS SET ON HUB #1 Ht. = 5.91
  - TOPO INLET + OUTLET STRUCTURES AT DAM
  - SET Pt# 995 - 992 FOR ROBOTIC W/GPS

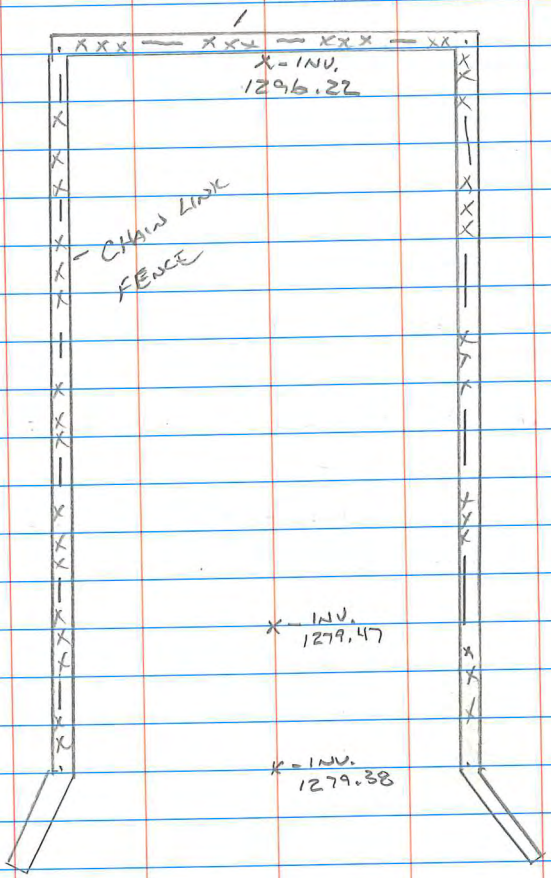
- ROBOTIC SET ON 995 B.S. 994
  - SHOT INLET STRUCTURE Pt# 1617 - 1625
- ROBOTIC SET ON 994 B.S. 995
  - INLET STRUCTURE Pt# 1627 - 1634
  - ICE COVERING INLET PIPE
- ROBOTIC SET ON 993 B.S. 992
  - SHOT OUTLET STRUCTURE Pt# 1635 - 1659

- PICS OF STRUCTURES IN ARCGIS

Inlet Structure



OUTLET STRUCTURE



12-4-18
D. SUNRA
C. GULAN

GPS BASE SET ON HECP #1 Ht.= 5.88
- RIVER CROSS SECTIONS
T5C3-12 Pt# 6840 - 7344

12-5-18
D. SUNRA
C. GULAN

GPS BASE SET ON HECP #5 Ht.= 5.98
- SET HECP #6
GPS BASE SET ON HECP #6 Ht.= 6.04
- SET HECP #7
BASE SET ON HECP #7 Ht.= 6.01
- SET HECP #8

12-6-18
D. SUNRA
C. GULAN

BASE SET ON HECP #8 Ht.= 6.15
- SET HECP #9
BASE SET ON HECP #9 Ht.= 6.22
- SHOT STRUCTURE ON 39TH ST. NE
T5C3-12 Pt# 7345 - 7535

1-8-19
D. SUNPA
C. GULAN
R. HARING
C. DEVINE

⊼ GPS BASE SET ON HUB #5 H.I.= 5.98
- RIVER CROSS SECTIONS
TSC3-12 PT# 7536- BASE ISSUES

1-9-19
D. SUNPA
C. GULAN
R. HARING
C. DEVINE

⊼ GPS BASE SET ON HUB #5 H.I.= 5.91
- STAKE BORINGS BY DAM
- RIVER CROSS SECTIONS
TSC3-12 PT# 7536 - 7682
TSC7-3 PT# 10000 - 10264

1-10-19
D. SUNPA
C. GULAN
R. HARING
C. DEVINE

⊼ GPS BASE SET ON HUB #5 H.I.= 5.89
- RIVER CROSS SECTIONS
TSC3-12 PT# 7683- 7854
TSC7-3 PT# 10265 - 10289

1-14-19
D. SUNDA
R. HARING
C. DEVINE
C. GOLAN

TT BASE SET ON HEC# 5 H.I.= 6.25
- RIVER CROSS SECTIONS
TSC3-12 Pt# 7855-8005
TSC7-3 Pt# 10290-10383

1-15-19
D. SUNDA
R. HARING
C. DEVINE
C. GOLAN

TT BASE SET ON HEC# 5 H.I.= 6.25
- RIVER CROSS SECTIONS
TSC3-12 Pt# 8001-8237
TSC7-3 Pt# 10384-10611

1-16-19
D. SUNDA
R. HARING
C. DEVINE
C. GOLAN

TT BASE SET ON HEC# 6 H.I.= 5.82
- RIVER CROSS SECTIONS
TSC3-12 Pt# 8238-8471 TSC7-3 Pt# 10612-10730

1-17-19
D. SUNRA
R. HARWG
C. GULAN
C. DEVINE

T BASE SET ON HECP #6 H.I.= 6.01
- RIVER CROSS SECTIONS
TSC 7-3 PT# 10731 - 10930

1-21-19
D. SUNRA
C. GULAN

T BASE SET ON HECP #6 H.I. = 5.47
- RIVER CROSS SECTIONS
TSC3-12 PT# 8472 - 8688

1-22-19
D. SUNRA
R. HARWG
C. DEVINE
C. GULAN

T BASE SET ON HECP #6 H.I.= 5.79
- RIVER CROSS SECTIONS
TSC7-4 PT# 8689 - 8828

1-23-19
D. SUNRA
R. HARWG
C. DEVINE
C. GULAN

T HECP #6 H.I.= 5.95 PT# 8829 - 9113

2-19-19
D. SUNRA
C. GULAN

T BASE SET ON HECP #9 H.I. = 5.77
- STRUCTURES ON EAST END OF PROJECT
TSC7-4 Pt# 9114-9165

4-29-19
D. SUNRA
J. ANDERSON
C. GULAN

T BASE SET ON HECP #2 H.I = 5.50
- SHOT SOIL BORINGS
Pt # 1300-1305

T BASE SET ON HECP #9 H.I. = 5.86
- STRUCTURES ON EAST END OF PROJECT
Pt # 9166-9330

4-30-19
D. SUNRA
J. ANDERSON
C. GULAN

T BASE SET ON HECP #9 H.I = 5.78
TSC7-4 Pt# 9331-9866 TSC3-16 Pt # 15000-15217

5-1-19
D. SUNRA
J. ANDERSON
C. GULAN

T BASE SET ON HECP #9 H.I. = 5.80
- CROSS SECTIONS
TSC7-4 Pt # 9667-9869 TSC3-16 Pt # 15218-15618

5-2-19
D. SUNRA
J. ANDERSON
C. GULAN

T BASE SET ON HECP #9 H.I. = 5.93
- CROSS SECTIONS
TSC7-4 Pt # 9870-9934 TSC3-16 Pt # 15619-15662

T BASE SET ON HECP #8 H.I. = 5.67
TSC7-4 Pt # 9935-9999, 20000-20012
TSC3-16 Pt # 15663-16002

5-6-19
D. SUNRA — C. GULAN
J. ANDERSON — D. SPILLMAN

T BASE SET ON HECP #8 H.I. = 5.50
TSC7-4 Pt # 20013-20142
TSC3-16 Pt # 16003-16354

5-7-19
D. SUNDAR
J. ANDERSON
C. GULAN
D. SPECKMAN

π BASE SET ON HECP # 8 H.I. = 5.33

- CROSS SECTIONS

TSC7-4 Pt # 20143 - 20437

TSC3-16 Pt # 16355 - 16617

5-8-19
D. SUNDAR
J. ANDERSON
C. GULAN
D. SPECKMAN

π BASE SET ON HECP # 7 H.I. = 5.59

- CROSS SECTIONS

TSC7-4 Pt # 20438 - 20781

TSC3-16 Pt # 16618 - 16913

5-9-19
D. SUNDAR C. GULAN
J. ANDERSON D. SPECKMAN

π BASE SET ON HECP # 7 H.I. = 5.76

- CROSS SECTIONS

TSC7-4 Pt # 20782 - 21010

TSC3-16 Pt # 16914 - 17098

5-10-19
D. SUNRA — C. GULAN
J. ANDERSON — D. SPELLMAN

T BASE SET ON HEC-RAS #7 H.I. = 5.43
- CROSS SECTIONS
TSC7-4 Pt # 21077 - 21133
TSC3-16 Pt # 17099 - 17194

5-13-19
D. SUNRA —
J. ANDERSON
C. GULAN

T BASE SET ON HEC-RAS #7 H.I. = 5.81
- CROSS SECTIONS
TSC7-4 Pt # 21134 - 21227
TSC3-16 Pt # 17195 - 17252

5-15-19
D. SUNRA —
J. ANDERSON
C. GULAN

T BASE SET ON HEC-RAS #7 H.I. = 5.86
- CROSS SECTIONS
TSC7-4 Pt # 21228 - 21408
TSC3-16 Pt # 17253 - 17470

SURVEY PROCESSING INFORMATION

DRAFT

Matejcek Dam	**Preliminary Survey**
Houston Engineering Inc.	Phone: 701-237-5065
1401 21st Avenue North	Fax: 701-237-5101
	www.houstoneng.com
Fargo, ND 58102	
USA	

Project file data		**User information**		**Coordinate System**	
Name:	H:\Fargo\Dept\Survey\TBC\2018\7100\7135-0033 Matejcek Dam.vce	Field operator:	Dan Sunram	Name:	United States/State Plane 1983
Size:	4 MB	Office operator:	Chuck Rebsch	Datum:	NAD 1983 (Conus)
Modified:	5/23/2019 9:12:26 AM (UTC:-5)			Zone:	North Dakota North 3301
Time zone:	Central Standard Time			Geoid:	GEOID12B (Conus)
Reference number:	7135-0033			Vertical datum:	NAVD 1988
Description:	Preliminary Survey			Calibrated site:	
Comment 1:					
Comment 2:					
Comment 3:					

HEI SURVEY FEATURE CODE LIST

DRAFT

Description	Feature Code
Abutment	ABUT
AerialTarget	ATRGT
Air Con Unit	ACU
Air Release Valve	ARV
Anode	ANODE
Approach	APPR
Asphalt Area	AREAASP
Asphalt Edge	ASP
Azmuth Mark	AZI
Ballast Retainer	BRET
Beehive Center Inlet	BH
Beehive Rim (R-I)	BHRIM
BM	BM
Box Culvert Concrete	BXC
Brace Pole	BP
Breakline	BRK
Bridge	BR
Building	BLDG
Building Height	BLDGHT
Building Polygon	BLDGP
Bulkhead	BULKHEAD
Calculated Point	CALC
Canopy	CAN
Cast Iron Pipe	CIP
Catch Basin	CB
Cattails	CATTAIL
Cattle Guard	CTGD
Catwalk	CATWALK
Center of Sec Calc	CORCOSCALC
Center of Sec Found	CORCOSFD
Center of Sec Set	CORCOSSET
Check Shot	CHK
Column - Line	COL
Column - Point	COLUMN
CON JOINT	JNT
Concrete Area	AREACON
Concrete Edge	CON
Control Point	CP
Cor Metal Pipe	CMP
Cor Metal Pipe Arch	CMPA
Cor Plastic Pipe	CPP
COR16CALC	COR16CALC
COR16FD	COR16FD
COR16SET	COR16SET
Corner Tie	CORTIE
Crack	CRACK
Crushed Concrete	CC
Curb Gutter Line	GUT
Curb Top Back	TC
Dam	DAM
Deck	DECK
Deck Plate Girder	DPG
Depth Shots	DEPTH
Ditch Toe	TOE
Drain Tile	DRNTILE
Drainage Ditch	DRN
Dumpster Area	AREADUMP
Earth DIKE	DIKE
Edge of Field	EOF
Edge of Water	EOW
Elec Transformer	ELT
Elec. Vault	EVLT
Electric Box	ELBX
Electric Fence	FNEL
Electric Meter	ELM
Electric Plug in	ELPI
Evergreen Row	EVERGREENROW
Fence Barb Wire	FNB
Fence Chainlink	FNC
Fence Iron	FNI
Fence Silt	FNS
Fence Vinyl	FNV
Fence Wood	FNW
Fence Woven Wire	FNWW
Fiber Optic	UGFO
Fiber Optic Ped	FOP
Finished Floor	FINFLR
Flag Pole	FGP
Flood Light	FLDLT
FO Vault	FOVLT
Gas Filler Pipe	GFP
Gas Line	UGG
Gas Meter	GM

Description	Feature Code
Gate	GATE
Gate Valve Gas	GVG
Gate Valve Storm	GVST
Gate Valve Water	GVW
Gate Well Sanitary	SSGW
Gate Well Storm	STGW
GRAIN BIN	GB
Grass Area	AREAGRASS
Gravel Area	AREAGRV
Gravel Edge	GRV
Guard Post	GP
Guard Rail	GDR
Guy Pole	GYP
Guywire	GUY
Hand Rail	HDRAIL
Handicap Parking	HPKG
Handicap Ramp	HCR
Handicap Sign	HPKGSGN
Hedge Row	HEDGEROW
HEI Control Point	HECP
High Water	HW
Hydrant	HYD
Lamp Post	LPL
LandScape	LS
Landscape Area	AREALS
Landscape Block	LSBLOCK
Landscape Curb	LSCURB
Lift Station	LFST
Light Pole Concrete	LPC
Light Pole Steel	LPS
Light Pole Traf Sig	LPTS
Light Pole Wood	LPW
Loading DOCK	DOCK
Low Beam	LB
MailBox	MB
Manhole Electric	MHE
Manhole ForceMain	MHFS
Manhole Gas	MHG
Manhole Sanitary	MHS
Manhole Storm	MHST
Manhole Telephone	MHT
Manhole Unidentified	MHU
Manhole Water	MHW
Meander Cor Calc	CORMCCALC
Meander Cor Found	CORMCFD
Meander Cor Set	CORMCSET
Metal Grate	MG
Mile Post	MP
Misc. Tower	TWR
MNDOT Monument	MNDOT
Monitor Well	MWELL
NGS Monument	NGS
Oil Pipeline	UGO
Overhead Lines	OHL
Parapet	PARAPET
Park Bench	BENCH
Parking Bumper	BBLK
Parking Stripe	PKGS
PC	PC
Pergola	PERGOLA
PI	PI
Pier	PIER
Planter	PLTR
Point On Curve	OC
Point on Line	POL
Post Indicator Valve	PIV
Power Pole	PP
PowerPole Structure	PPS
PowerPole w Light	PPL
Property Cor Calc	CORPROPCALC
Property Cor FD	CORPROPFD
Property Cor Set	CORPROPSET
PT	PT
Push to walk	PTW
PVC Pipe	PVC
Quarter Cor Calc	CORQTRCALC
Quarter Cor FD	CORQTRFD
Quarter Cor Set	CORQTRSET
Radius Point	RADPT
Railroad	RAIL
RailRoad CL	RRCL
Random Point	RP
RCP Pipe	RCP

Description	Feature Code
Rein Conc Pipe Arch	RCPA
Retaining Wall	RTW
Right of Way Marker	RWM
RipRap Edge	RIP
River Centerline	RIVER
Road Centerline	RD
Road Shoulder Edge	SHLDR
Roof Drain	RFD
RR BALLAST	BLST
RR Crossing Concrete	RRXC
RR Crossing Rubber	RRXR
RR Crossing Timber	RRXT
RR Heater Vent Pipe	RRHTRVP
RR High Rail	RRHIR
RR Last Long Tie	RRLLT
RR Point of Frog	RRPOF
RR Point of Switch	RRPOS
RR Signal	RRSIG
RR Signal Hut	RRHUT
RR Switch	RRSWT
RR Switch Heater	RRHTR
RW Monument Calc	RWMONCALC
RW Monument FD	RWMONFD
RW Monument Set	RWMONSET
Sanitary Cleanout	SSCLN
Sanitary Locate	SSL
Section Cor Calc	CORSECCALC
Section Cor FD	CORSECFD
Section Cor Set	CORSECSET
SHRUB	SHRUB
Shrub Row	SHRUBROW
Sign	SGN
Sign multi posts	SGNS
Sign Overhang	SGNOH
Slough or Sluff	SLUFF
Soil Boring	SB
Spillway	SPL
SPOT	SPOT
Sprinkler	SPK
Sprinkler Valve	SPKV
Steps	STEPS
Stockpile	STOCKPILE
Storm Locate	STL
Stringer	STRINGER
Struc Plat Pipe Arch	SPPA
Swale	SWALE
Tank Above Grnd	TNKA
Tank Below Grnd	TNKU
Tele. Vault	TVLT
Telephone Ped	TPC
Telephone Pole	TP
Top of Water	TOW
Tower Legs	TWRS
Traffic Control Box	TSCB
Traffic Signal	TSG
Tree Deciduous	TREE
Tree Evergreen	EVERGREEN
Tree Row	TREEROW
Trench Drain	TDR
TV Ped	TVP
Undergr Missle Cable	UMC
Underground CableTV	UGCTV
Underground Electric	UGE
Underground Tele	UGT
Utility Marker	UMK
Utility Marker Elec.	UME
Utility Marker FO	UMFO
Utility Marker Gas	UMG
Utility Marker H2O	UMW
Utility Marker Oil	UMO
Utility Marker Tele	UMT
Vault Outline	VLT
Wall (Brick/Block)	WALL
Water Service Valve	WSV
WaterMain	WM
Weigh Scale	SCALE
WEIR Opening	WEIR
Well	WELL
Wetland Edge	WET
Wing Wall	WING
Witness Cor	CORWT
Woods Edge	WOODS

SURVEY POINTS COLLECTED

DRAFT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
1	458192.88	2596616.102	1366.714	HECP
2	458742.237	2595951.86	1364.114	HECP
3	458506.81	2595469.083	1363.086	HECP
4	457097.675	2596033.536	1370.236	HECP
5	453607.27	2611873.041	1210.314	HECP
6	453779.045	2627728.955	1103.852	HECP
7	444664.358	2643877.714	1135.159	HECP
8	435160.289	2654875.57	1104.733	HECP
9	443596.388	2664986.094	994.347	HECP
10	?	?	?	0
11	458356.856	2596060.312	1000	SB
12	458147.116	2596243.613	1000	SB
13	458249.431	2596557.825	1000	SB
14	457586.284	2596059.004	1000	SB
15	457589.642	2596172.98	1000	SB
16	457415.852	2596218.13	1000	SB
207	?	?	?	0
332	?	?	?	0
992	457537.572	2596684.742	1288.726	RP NAIL
993	457512.352	2596335.744	1292.46	RP NAIL
994	457359.061	2595947.159	1347.945	RP PK NAIL
995	457537.78	2595916.063	1340.69	RP NAIL
996	457928.725	2596656.104	1335.82	RP PK NAIL
997	458161.528	2596470.878	1361.839	RP PK NAIL
998	457497.163	2596055.137	1368.594	RP PK NAIL
999	458142.68	2595999.323	1366.761	RP PK NAIL
1000	457192.861	2603419.535	1249.033	CHK
1001	457929.597	2595613.407	1336.191	SPL B
1002	457916.702	2595606.291	1335.617	TOW
1003	457978.108	2595615.901	1337.968	SPL
1004	458020.758	2595623.802	1339.488	SPL
1005	458062.63	2595634.363	1340.9	SPL
1006	458104.903	2595644.706	1342.136	SPL
1007	458145.955	2595661.31	1343.018	SPL
1008	458186.825	2595678.312	1343.592	SPL
1009	458229.253	2595700.308	1344.7	SPL
1010	458270.92	2595721.722	1346.442	SPL
1011	458289.302	2595735.083	1346.869	SPL
1012	458295.737	2595738.93	1347.533	SPL
1013	458303.378	2595743.868	1347.048	SPL
1014	458340.095	2595770.763	1348.286	SPL
1015	458376.49	2595794.841	1349.353	SPL
1016	458409.923	2595822.536	1350.603	SPL
1017	458446.818	2595858.288	1351.754	SPL
1018	458478.051	2595887.663	1352.469	SPL
1019	458504.771	2595930.168	1353.797	SPL
1020	458516.631	2595970.823	1354.879	SPL
1021	458517.529	2595978.085	1355.326	SPL
1022	458518.41	2595985.028	1356.637	SPL
1023	458521.089	2595990.928	1357.517	SPL
1024	458504.241	2596026.473	1357.855	SPL1 B
1025	458498.833	2596038.377	1356.523	SPL1
1026	458494.86	2596081.301	1357.081	SPL1
1027	458489.653	2596125.536	1357.421	SPL1
1028	458478.85	2596168.269	1357.521	SPL1
1029	458460.828	2596211.09	1357.985	SPL1
1030	458436.759	2596246.794	1358.863	SPL1

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
1031	458408.026	2596283.229	1359.044	SPL1
1032	458375.383	2596312.708	1359.415	SPL1
1033	458336.373	2596333.273	1359.501	SPL1
1034	458295.893	2596354.131	1359.84	SPL1
1035	458254.772	2596371.914	1360.678	SPL1
1036	458212.423	2596386.281	1360.82	SPL1
1037	458168.657	2596392.494	1361.944	SPL1
1038	458139.185	2596395.637	1361.845	SPL1
1039	458099.239	2596403.665	1358.348	SPL1
1040	458943.919	2596011.485	1371.952	ASP B
1041	458943.425	2595999.074	1372.154	RD B
1042	458942.473	2595986.127	1371.941	ASP1 B
1043	458898.641	2595987.455	1370.923	ASP1
1044	458899.493	2596000.273	1371.17	RD
1045	458898.895	2596013.013	1370.932	ASP
1046	458855.089	2596014.276	1369.683	ASP
1047	458855.3	2596001.755	1369.93	RD
1048	458856.214	2595988.596	1369.731	ASP1
1049	458813.56	2595989.735	1368.306	ASP1
1050	458814.52	2596002.573	1368.511	RD
1051	458814.738	2596015.363	1368.305	ASP
1052	458771.182	2596016.416	1366.58	ASP
1053	458771.327	2596004.061	1366.817	RD
1054	458770.975	2595991.121	1366.648	ASP1
1055	458761.979	2595985.395	1365.867	ASP1
1056	458753.305	2595981.92	1365.252	ASP1
1057	458747.455	2595979.762	1364.884	ASP1 GRV B
1058	458732.36	2595980.294	1364.382	ASP1 RD1 B
1059	458722.168	2595980.59	1363.771	ASP1 GRV1 B
1060	458715.683	2595987.303	1363.636	ASP1
1061	458709.417	2595992.479	1363.674	ASP1
1062	458710.616	2596005.408	1363.949	RD
1063	458711.212	2596018.289	1363.713	ASP
1064	458733.075	2596005.031	1365.083	SPOT
1065	458732.829	2595991.98	1364.867	SPOT
1066	458668.637	2595994.273	1361.722	ASP1
1067	458669.207	2596006.584	1361.927	RD
1068	458669.272	2596019.738	1361.715	ASP
1069	458626.468	2596021.209	1360.007	ASP
1070	458626.577	2596009.232	1360.345	RD
1071	458626.687	2595996.38	1360.135	ASP1
1072	458582.75	2595996.989	1358.978	ASP1
1073	458580.636	2596009.77	1359.195	RD
1074	458581.22	2596021.85	1359.002	ASP
1075	458536.925	2596023.185	1358.221	ASP
1076	458537.032	2596010.81	1358.385	RD
1077	458536.761	2595997.928	1358.185	ASP1
1078	458519.153	2595992.566	1357.563	ASP1
1079	458506.962	2595988.873	1357.276	ASP1 GRV2 B
1080	458469.124	2595988.748	1357.536	ASP1 RD2 B
1081	458470.165	2595998.165	1357.93	SPOT
1082	458469.86	2596011.978	1358.241	RD
1083	458470.07	2596025.294	1358.049	ASP
1084	458427.836	2596026.42	1358.229	ASP
1085	458428.113	2596013.654	1358.402	RD
1086	458427.696	2596000.45	1358.113	SPOT
1087	458438.389	2595988.99	1357.24	ASP1 GRV3 B

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
1088	458426.066	2595993.9	1357.483	ASP1
1089	458410.062	2596001.468	1358.261	ASP1
1090	458376.462	2596002.695	1358.594	ASP1
1091	458376.848	2596014.761	1358.792	RD
1092	458377.179	2596028.309	1358.585	ASP
1093	458333.462	2596029.942	1359.36	ASP
1094	458333.896	2596016.978	1359.567	RD
1095	458333.085	2596003.988	1359.362	ASP1
1096	458287.857	2596005.438	1361.002	ASP1
1097	458288.605	2596018.193	1361.193	RD
1098	458289.094	2596031.198	1360.962	ASP
1099	458244.031	2596032.149	1363.295	ASP
1100	458243.958	2596019.868	1363.504	RD
1101	458243.518	2596006.461	1363.214	ASP1
1102	458197.169	2596007.886	1365.655	ASP1
1103	458197.595	2596020.292	1365.892	RD
1104	458197.567	2596033.585	1365.714	ASP
1105	458163.617	2596034.815	1367.003	ASP
1106	458163.547	2596021.67	1367.179	RD E DAM B
1107	458163.209	2596008.701	1366.943	ASP1
1108	458108.024	2596011.9	1367.996	ASP1
1109	458107.943	2596022.9	1368.159	DAM
1110	458108.299	2596036.906	1367.927	ASP
1111	458058.673	2596036.877	1368.359	ASP
1112	458058.756	2596024.8	1368.534	DAM
1113	458058.372	2596013.978	1368.392	ASP1
1114	458010.785	2596013.515	1368.496	ASP1
1115	458011.061	2596025.744	1368.646	DAM
1116	458011.247	2596039.15	1368.426	ASP
1117	457964.422	2596040.879	1368.517	ASP
1118	457964.309	2596027.56	1368.738	DAM
1119	457964.086	2596014.057	1368.509	ASP1
1120	457920.716	2596015.551	1368.651	ASP1
1121	457921.61	2596028.21	1368.873	DAM
1122	457921.615	2596040.67	1368.713	ASP
1123	457875.455	2596043.102	1368.868	ASP
1124	457875.411	2596030.118	1369.084	DAM
1125	457875.126	2596016.761	1368.884	ASP1
1126	457823.34	2596018.079	1368.93	ASP1
1127	457823.963	2596031.071	1369.129	DAM
1128	457824.401	2596044.248	1368.924	ASP
1129	457773.164	2596045.828	1368.892	ASP
1130	457773.211	2596033.098	1369.1	DAM
1131	457772.663	2596019.753	1368.894	ASP1
1132	457715.926	2596022.026	1368.835	ASP1
1133	457716.052	2596034.293	1369.015	DAM
1134	457716.385	2596044.962	1368.912	ASP
1135	457668.593	2596047.98	1368.874	ASP
1136	457668.007	2596036.309	1369.02	DAM
1137	457667.429	2596023.117	1368.823	ASP1
1138	457619.693	2596024.188	1368.857	ASP1
1139	457620.172	2596037.323	1369.05	DAM
1140	457620.209	2596049.735	1368.89	ASP
1141	457571.595	2596051.865	1368.776	ASP
1142	457571.456	2596038.846	1368.984	DAM
1143	457570.918	2596025.752	1368.783	ASP1
1144	457519.911	2596027.384	1368.605	ASP1

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
1145	457520.071	2596040.142	1368.815	DAM
1146	457520.616	2596053.486	1368.608	ASP
1147	457470.659	2596055.122	1368.583	ASP
1148	457470.765	2596041.876	1368.834	DAM
1149	457469.978	2596029.304	1368.641	ASP1
1150	457425.988	2596030.231	1368.622	ASP1
1151	457426.325	2596042.813	1368.823	DAM
1152	457426.853	2596056.045	1368.567	ASP
1153	457380.045	2596057.532	1368.504	ASP
1154	457379.534	2596044.43	1368.717	DAM
1155	457378.933	2596031.165	1368.553	ASP1
1156	457329.641	2596032.701	1368.325	ASP1
1157	457329.886	2596045.719	1368.48	DAM
1158	457330.314	2596058.868	1368.25	ASP
1159	457280.491	2596059.964	1368.227	ASP
1160	457280.423	2596047.06	1368.434	DAM
1161	457280.12	2596033.923	1368.236	ASP1
1162	457225.753	2596035.413	1368.437	ASP1
1163	457226.115	2596048.313	1368.619	DAM
1164	457226.674	2596061.584	1368.403	ASP
1165	457181.003	2596063.136	1368.827	ASP
1166	457180.468	2596049.727	1369.05	DAM
1167	457179.666	2596036.875	1368.86	ASP1
1168	457133.14	2596038.664	1369.721	ASP1
1169	457133.466	2596051.113	1369.879	DAM
1170	457133.879	2596063.143	1369.767	ASP
1171	457097.708	2596065.616	1370.713	ASP
1172	457097.753	2596052.281	1370.893	DAM E RD B
1173	457096.751	2596039.591	1370.696	ASP1
1174	457061.336	2596040.7	1371.987	ASP1
1175	457061.032	2596053.247	1372.229	RD
1176	457061.488	2596066.381	1372.037	ASP
1177	457013.44	2596067.931	1374.009	ASP
1178	457012.855	2596054.653	1374.22	RD
1179	457012.275	2596042.102	1373.995	ASP1
1180	456965.799	2596043.678	1376.074	ASP1
1181	456965.728	2596056.075	1376.305	RD
1182	456966.106	2596069.669	1376.095	ASP
1183	456917.389	2596070.588	1378.358	ASP
1184	456917.016	2596057.689	1378.508	RD
1185	456916.652	2596045.375	1378.305	ASP1
1186	456871.136	2596046.703	1380.145	ASP1
1187	456871.726	2596059.237	1380.37	RD
1188	456871.861	2596072.403	1380.203	ASP
1189	456826.58	2596073.721	1381.858	ASP E
1190	456825.404	2596060.886	1382.036	RD E
1191	456824.356	2596048.26	1381.846	ASP1 E
1192	458057.702	2596425.825	1353.984	SPL1
1193	458018.306	2596451.972	1349.889	SPL
1194	457982.059	2596470.608	1345.753	SPL
1195	457943.41	2596486.547	1341.352	SPL
1196	457902.661	2596502.468	1337.257	SPL
1197	457858.742	2596517.595	1332.5	SPL
1198	457820.699	2596528.403	1328.209	SPL
1199	457779.137	2596539.9	1322.804	SPL
1200	457744.071	2596549.667	1317.427	SPL
1201	457707.031	2596558.425	1311.98	SPL

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
1202	457675.996	2596567.793	1306.568	SPL
1203	457639.061	2596574.543	1300.557	SPL
1204	457596.928	2596581.397	1293.904	SPL
1205	457559.333	2596585.323	1290.281	SPL
1206	457526.116	2596591.095	1288.922	SPL
1207	457498.972	2596591.558	1288.281	SPL E
1208	457484.364	2596896.171	1302.609	SPOT
1209	457484.503	2596880.093	1301.753	SPOT
1210	457485.919	2596857.065	1299.781	SPOT
1211	457485.331	2596846.746	1298.167	SPOT
1212	457485.517	2596820.139	1292.91	SPOT
1213	457485.436	2596803.874	1289.783	SPOT
1214	457484.97	2596789.105	1288.344	SPOT
1215	457489.589	2596754.484	1287.743	SPOT
1216	457496.572	2596719.615	1287.223	SPOT
1217	457499.278	2596681.233	1287.641	SPOT
1218	457504.838	2596631.831	1288.783	SPOT
1219	457507.766	2596591.295	1288.415	SPOT
1220	457511.938	2596549.958	1288.981	SPOT
1221	457515.094	2596506.718	1289.233	SPOT
1222	457516.604	2596453.651	1289.909	SPOT
1223	457518.121	2596412.432	1290.83	SPOT
1224	457516.836	2596394.14	1292.787	SPOT
1225	457516.029	2596382.898	1293.637	SPOT
1226	457579.027	2596376.8	1304.387	SPOT
1227	457579.793	2596386.285	1301.359	SPOT
1228	457579.271	2596391.746	1299.917	SPOT
1229	457575.345	2596431.263	1297.299	SPOT
1230	457571.922	2596482.162	1294.886	SPOT
1231	457563.291	2596536.115	1292.07	SPOT
1232	457561.294	2596588.523	1290.317	SPOT
1233	457558.779	2596640.829	1289.261	SPOT
1234	457554.281	2596694.579	1289.208	SPOT
1235	457550.592	2596732.397	1289.384	SPOT
1236	457548.992	2596759.406	1289.258	SPOT
1237	457545.645	2596785.533	1289.145	SPOT
1238	457542.305	2596799.382	1290.398	SPOT
1239	457539.309	2596812.464	1292.878	SPOT
1240	457540.265	2596829.868	1298.666	SPOT
1240	443066.31	2650989.402	1007.518	SPOT
1241	457541.194	2596845.446	1303.205	SPOT
1242	457541.797	2596860.122	1305.914	SPOT
1243	457541.828	2596880.936	1307.857	SPOT
1244	457543.443	2596904.858	1308.104	SPOT
1245	457592.487	2596904.584	1317	SPOT
1246	457593.641	2596882.32	1316.185	SPOT
1247	457594.161	2596872.83	1314.579	SPOT
1248	457594.415	2596854.695	1310.532	SPOT
1249	457595.552	2596834.936	1305.462	SPOT
1250	457595.129	2596813.323	1299.077	SPOT
1251	457596.232	2596793.841	1294.805	SPOT
1252	457599.39	2596780.078	1292.316	SPOT
1253	457596.288	2596768.918	1291.033	SPOT
1254	457597.864	2596754.036	1290.86	SPOT
1255	457601.173	2596731.567	1290.956	SPOT
1256	457605.558	2596692.17	1291.78	SPOT
1257	457604.726	2596644.48	1292.453	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
1259	457609.86	2596554.791	1297.212	SPOT
1260	457615.785	2596497.973	1300.818	SPOT
1261	457615.281	2596451.753	1302.789	SPOT
1262	457619.39	2596404.897	1305.355	SPOT
1263	457616.394	2596380.172	1306.838	SPOT
1264	457614.655	2596371.618	1309.282	SPOT
1265	457614.938	2596362.25	1311.93	SPOT
1266	457674.097	2596341.608	1322.792	SPOT
1267	457675.969	2596347.381	1321.752	SPOT
1268	457678.093	2596353.531	1319.9	SPOT
1268	442964.924	2650911.967	1008.507	H2O OPENING
1269	457678.51	2596359.006	1318.472	SPOT
1270	457673.026	2596417.787	1314.105	SPOT
1271	457673.123	2596467.651	1311.705	SPOT
1272	457671.628	2596521.101	1308.394	SPOT
1273	457668.485	2596571.206	1305.368	SPOT
1274	457667.394	2596623.731	1302.541	SPOT
1275	457664.413	2596673.528	1299.612	SPOT
1276	457659.221	2596713.194	1297.193	SPOT
1277	457658.645	2596736.871	1295.779	SPOT
1278	457657.047	2596752.05	1295.572	SPOT
1279	457655.778	2596776.933	1301.689	SPOT
1280	457656.304	2596811.588	1309.597	SPOT
1281	457651.524	2596855.097	1320.337	SPOT
1282	457654.513	2596869.77	1324.352	SPOT
1283	457647.015	2596901.175	1326.878	SPOT
1284	457695.189	2596893.888	1337.524	SPOT
1285	457695.876	2596871.939	1334.286	SPOT
1286	457695.257	2596850.451	1327.952	SPOT
1287	457699.942	2596815.518	1319.786	SPOT
1288	457701.686	2596790.949	1314.104	SPOT
1289	457704.339	2596764.04	1308.712	SPOT
1290	457707.226	2596743.916	1305.758	SPOT
1291	457707.958	2596735.149	1304.677	SPOT
1292	457709.584	2596697.919	1305.859	SPOT
1293	457711.405	2596649.146	1308.544	SPOT
1294	457717.711	2596596.099	1311.543	SPOT
1295	457722.708	2596545.539	1314.673	SPOT
1296	457726.791	2596496.823	1318.187	SPOT
1297	457730.288	2596447.004	1321.369	SPOT
1298	457729.626	2596388.718	1323.815	SPOT
1299	457727.042	2596356.546	1324.339	SPOT
1300	457724.295	2596342.182	1324.944	SPOT
1300-1	458249.4	2596557.778	1362.098	SOIL BORING 13
1301	457721.832	2596335.121	1327.04	SPOT
1301-1	458147.16	2596243.597	1361.612	SOIL BORING 12
1302	457720.033	2596327.762	1329.31	SPOT
1302-1	458507.17	2596251.345	1358.144	SOIL BORING 11
1303	457773.175	2596312.023	1335.58	SPOT
1303-1	457589.64	2596173.028	1327.024	SOIL BORING 15
1304	457774.937	2596320.453	1332.901	SPOT
1304-1	457417.965	2596179.471	1326.109	SOIL BORING 16
1305	457776.38	2596326.816	1331.072	SPOT

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1305-1	457582.763	2596056.504	1368.236	SOIL BORING 14
1306	457781.092	2596377.153	1330.03	SPOT
1307	457777.599	2596433.965	1327.762	SPOT
1308	457781.788	2596492.599	1325.303	SPOT
1309	457784.148	2596548.606	1323.035	SPOT
1310	457776.219	2596599.891	1319.951	SPOT
1311	457774.028	2596646.978	1317.146	SPOT
1312	457766.79	2596692.011	1314.563	SPOT
1313	457762.947	2596723.18	1313.77	SPOT
1314	457759.275	2596752.184	1318.563	SPOT
1315	457757.129	2596784.176	1324.819	SPOT
1316	457753.761	2596813.654	1331.528	SPOT
1317	457755.738	2596842.982	1340.324	SPOT
1318	457755.533	2596858.39	1344.424	SPOT
1319	457755.265	2596884.025	1351.285	SPOT
1320	457806.163	2596877.884	1360.086	SPOT
1321	457807.198	2596844.442	1352.009	SPOT
1322	457808.855	2596836.019	1350.296	SPOT
1323	457811.169	2596806.202	1343.767	SPOT
1324	457813.659	2596772.812	1335.864	SPOT
1325	457819.115	2596732.932	1328.14	SPOT
1326	457819.941	2596716.903	1324.642	SPOT
1327	457822.003	2596707.545	1322.873	SPOT
1328	457821.29	2596665.981	1322.648	SPOT
1329	457824.789	2596609.591	1326.039	SPOT
1330	457826.258	2596548.376	1327.958	SPOT
1331	457826.32	2596501.372	1329.911	SPOT
1332	457825.757	2596452.202	1331.83	SPOT
1333	457823.976	2596406.61	1333.375	SPOT
1334	457824.969	2596354.8	1334.962	SPOT
1335	457822.673	2596325.037	1335.208	SPOT
1336	457821.255	2596312.816	1335.775	SPOT
1337	457822.005	2596304.214	1338.177	SPOT
1338	457820.464	2596297.934	1340.153	SPOT
1339	457874.767	2596290.331	1342.905	SPOT
1340	457875.106	2596297.6	1341.173	SPOT
1341	457889.121	2596348.32	1340.831	SPOT
1342	457902.365	2596401.422	1340.755	SPOT
1343	457913.833	2596452.533	1339.87	SPOT
1344	457924.5	2596497.2	1339.44	SPOT
1345	457934.695	2596539.216	1339.022	SPOT
1346	457951.143	2596595.882	1339.251	SPOT
1347	457962.444	2596630.787	1339.362	SPOT
1348	457971.397	2596658.375	1340.657	SPOT
1349	457973.537	2596665.678	1343.108	SPOT
1350	457982.877	2596701.446	1353.256	SPOT
1351	457989.54	2596723.268	1360.385	SPOT
1352	457994.758	2596746.366	1367.442	SPOT
1353	457999.42	2596758.992	1371.052	SPOT
1354	458002.365	2596764.078	1371.014	SPOT
1355	458003.832	2596768.613	1370.179	SPOT
1356	458007.768	2596778.127	1370.235	SPOT
1357	458010.716	2596783.243	1371.537	SPOT
1358	458019.446	2596800.686	1371.691	SPOT
1359	457980.933	2596827.986	1371.502	SPOT
1360	457973.417	2596808.569	1371.104	SPOT
1361	457971.927	2596803.023	1369.969	SPOT
1362	457968.921	2596791.582	1369.815	SPOT
1363	457967.474	2596786.568	1370.505	SPOT
1364	457965.598	2596780.713	1370.121	SPOT
1365	457958.709	2596745.7	1360.063	SPOT
1366	457951.506	2596714.317	1350.563	SPOT
1367	457945.606	2596686.81	1342.362	SPOT
1368	457941.826	2596670.787	1338.297	SPOT
1369	457935.14	2596658.932	1336.141	SPOT
1370	457923.334	2596626.893	1335.305	SPOT
1371	457914.051	2596585.622	1336.143	SPOT
1372	457897.852	2596536.152	1335.941	SPOT
1373	457879.228	2596478.159	1336.074	SPOT
1374	457870.471	2596432.512	1336.582	SPOT
1375	457860.866	2596377.632	1337.235	SPOT
1376	457846.256	2596455.062	1333.645	SPOT
1377	457852.609	2596506.859	1332.38	SPOT
1378	457867.468	2596554.027	1332.62	SPOT
1379	457882.725	2596616.234	1331.935	SPOT
1380	457892.56	2596665.594	1331.677	SPOT
1381	457897.468	2596685.135	1332.519	SPOT
1382	457899.838	2596701.24	1337.016	SPOT
1383	457904.619	2596736.095	1347.083	SPOT
1384	457910.31	2596768.407	1356.677	SPOT
1385	457917.416	2596794.775	1365.022	SPOT
1386	457922.403	2596806.346	1368.512	SPOT
1387	457925.352	2596812.266	1369.593	SPOT
1388	457928.625	2596819.033	1368.835	SPOT
1389	457935.074	2596826.976	1368.798	SPOT
1390	457939.158	2596834.37	1370.113	SPOT
1391	457942.752	2596854.62	1370.773	SPOT
1392	457895.971	2596874.469	1369.975	SPOT
1393	457849.038	2596885.513	1367.087	SPOT
1394	457846.517	2596877.412	1367.408	SPOT
1395	457844.919	2596852.854	1362.811	SPOT
1396	457888.317	2596838.396	1368.709	SPOT
1397	457892.183	2596844.234	1368.161	SPOT
1398	457893.551	2596856.558	1368.118	SPOT
1399	457895.497	2596865.032	1369.558	SPOT
1400	457882.598	2596825.634	1365.825	SPOT
1401	457877.196	2596798.568	1357.909	SPOT
1402	457846.15	2596811.06	1353.254	SPOT
1403	457842.13	2596768.695	1341.933	SPOT
1404	457875.52	2596747.99	1344.226	SPOT
1405	457868.233	2596713.052	1333.314	SPOT
1406	457844.065	2596726.723	1331.63	SPOT
1407	457846.866	2596700.548	1326.588	SPOT
1408	457872.091	2596692.785	1329.414	SPOT
1409	457864.37	2596650.718	1328.885	SPOT
1410	457836.972	2596654.558	1325.191	SPOT
1411	457852.127	2596612.249	1329.113	SPOT
1412	457853.213	2596583.47	1330.069	SPOT
1413	457922.546	2596280.543	1346.466	SPOT
1414	457923.505	2596273.736	1348.13	SPOT
1415	457923.264	2596267.406	1349.449	SPOT
1416	457933.763	2596334.144	1345.559	SPOT
1417	457948.259	2596385.086	1345.688	SPOT
1418	457960.23	2596435.465	1345.045	SPOT
1419	457973.593	2596498.083	1343.953	SPOT
1420	457991.603	2596563.025	1343.912	SPOT
1421	458008.323	2596614.506	1343.712	SPOT
1422	458017.748	2596644.574	1344.807	SPOT
1423	458020.886	2596652.128	1347.762	SPOT
1424	458031.797	2596681.37	1357.563	SPOT
1425	458039.565	2596699.896	1363.764	SPOT
1426	458045.27	2596715.022	1368.78	SPOT
1427	458049.353	2596724.552	1371.228	SPOT
1428	458052.392	2596728.491	1371.364	SPOT
1429	458053.731	2596730.432	1370.661	SPOT
1430	458055.57	2596741.352	1370.72	SPOT
1431	458058.594	2596748.214	1372.174	SPOT
1432	458066.759	2596773.32	1371.799	SPOT
1433	458106.315	2596744.14	1371.219	SPOT
1434	458095.572	2596716.833	1371.444	SPOT
1435	458093.575	2596709.989	1370.522	SPOT
1436	458089.728	2596700.975	1370.409	SPOT
1437	458089.054	2596696.496	1370.968	SPOT
1438	458087.76	2596691.645	1370.772	SPOT
1439	458085.029	2596679.228	1367.507	SPOT
1440	458074.615	2596656.362	1359.224	SPOT
1441	458065.916	2596636.851	1351.843	SPOT
1442	458064.954	2596629.227	1349.224	SPOT
1443	458049.535	2596584.677	1348.759	SPOT
1444	458039.255	2596539.303	1348.572	SPOT
1445	458023.851	2596486.122	1348.851	SPOT
1446	458013.44	2596436.545	1349.816	SPOT
1447	458000.057	2596392.307	1349.917	SPOT
1448	457985.426	2596341.342	1350.064	SPOT
1449	457970.956	2596298.614	1350.348	SPOT
1450	457963.743	2596281.006	1350.292	SPOT
1451	457958.892	2596271.261	1350.52	SPOT
1452	457955.357	2596263.036	1351.78	SPOT
1453	457952.001	2596256.447	1352.449	SPOT
1454	457989.236	2596220.521	1364.068	SPOT
1455	457990.901	2596229.574	1361.594	SPOT
1456	457994.701	2596244.082	1357.131	SPOT
1457	457997.31	2596254.358	1354.831	SPOT
1458	458012.05	2596299.508	1353.843	SPOT
1459	458026.214	2596348.866	1353.67	SPOT
1460	458040.441	2596392.899	1353.374	SPOT
1461	458057.504	2596433.376	1353.628	SPOT
1462	458074.389	2596480.011	1353.612	SPOT
1463	458090.857	2596533.234	1353.411	SPOT
1464	458101.593	2596575.529	1353.589	SPOT
1465	458107.541	2596603.324	1353.283	SPOT
1466	458110.919	2596614.114	1354.046	SPOT
1467	458114.818	2596635.254	1361.071	SPOT
1468	458116.37	2596649.038	1365.363	SPOT
1469	458122.156	2596661.915	1368.618	SPOT
1470	458123.284	2596673.181	1368.846	SPOT
1471	458125.982	2596681.589	1369.272	SPOT
1472	458128.188	2596689.803	1370.456	SPOT
1473	458138.627	2596717.313	1370.731	SPOT
1474	458175.903	2596693.258	1368.908	SPOT
1475	458167.892	2596659.883	1367.093	SPOT

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1476	458162.974	2596638.826	1366.717	SPOT
1477	458160.29	2596625.363	1366.245	SPOT
1478	458158.349	2596615.121	1363.017	SPOT
1479	458154.372	2596598.243	1358.62	SPOT
1480	458145.023	2596553.995	1358.281	SPOT
1481	458132.548	2596505.101	1358.422	SPOT
1482	458115.995	2596453.862	1358.695	SPOT
1483	458105.484	2596408.21	1358.873	SPOT
1484	458091.548	2596360.659	1358.951	SPOT
1485	458076.755	2596315.932	1358.956	SPOT
1486	458058.616	2596272.875	1358.831	SPOT
1487	458043.167	2596236.052	1358.908	SPOT
1488	458036.692	2596223.115	1362.543	SPOT
1489	458033.018	2596213.88	1365.326	SPOT
1490	458029.782	2596208.238	1366.235	SPOT
1491	458458.185	2595958.775	1356.248	GRV2
1492	458440.147	2595974.783	1356.099	GRV3
1493	458435.464	2595966.69	1355.24	GRV3
1494	458425.872	2595958.999	1354.561	GRV3
1495	458438.199	2595943.709	1355.173	GRV2
1496	458417.401	2595935.916	1353.977	GRV2
1497	458410.851	2595951.143	1353.988	GRV3
1498	458374.22	2595940.551	1352.848	GRV3
1499	458376.901	2595926.631	1352.55	GRV2
1500	458343.473	2595919.849	1351.343	GRV2
1501	458339.438	2595932.363	1351.332	GRV3
1502	458304.32	2595923.043	1349.766	GRV3
1503	458308.657	2595910.45	1349.792	GRV2
1504	458278.261	2595901.471	1348.12	GRV2
1505	458273.604	2595912.943	1348.243	GRV3
1506	458248.606	2595903.818	1347.388	GRV3
1507	458223.983	2595894.509	1346.228	GRV3
1508	458200.111	2595887.824	1345.045	GRV3
1509	458163.574	2595880.628	1343.393	GRV3
1510	458263.272	2595894.797	1347.379	GRV2
1511	458243.936	2595883.389	1346.556	GRV2
1512	458221.86	2595867.212	1345.705	GRV2
1513	458203.922	2595848.296	1345.018	GRV2
1514	458186.175	2595821.409	1344.478	GRV2
1515	458173.158	2595792.525	1343.766	GRV2
1516	458163.942	2595762.73	1343.201	GRV2
1517	458157.581	2595723.408	1343.106	GRV2
1518	458151.536	2595685.36	1342.958	GRV2
1519	458145.341	2595647.563	1343.106	GRV2
1520	458141.17	2595609.224	1343.261	GRV2
1521	458133.022	2595571.46	1343.417	GRV2
1522	458129.576	2595538.04	1343.485	GRV2
1523	458128.923	2595508.031	1343.608	GRV2
1524	458127.88	2595489.068	1343.742	GRV2
1525	458120.242	2595485.529	1343.651	GRV2
1526	458113.548	2595474.842	1343.737	GRV2
1527	458107.129	2595465.925	1343.601	GRV2
1528	458095.556	2595462.625	1343.321	GRV2
1529	458050.25	2595460.517	1342.74	GRV2
1530	458029.307	2595459.137	1342.264	GRV2
1531	458019.637	2595454.886	1341.834	GRV2
1532	458009.703	2595443.528	1341.291	GRV2

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1533	457999.809	2595424.303	1342.209	GRV2
1534	457992.102	2595406.454	1343.361	GRV2 E
1535	457982.198	2595409.656	1343.47	GRV2 B
1536	457992.654	2595434.13	1341.867	GRV2
1537	457995.534	2595442.262	1341.471	GRV2
1538	457995.162	2595448.647	1340.879	GRV2
1539	457987.073	2595453.916	1340.07	GRV2
1540	457973.676	2595452.56	1339.134	GRV2
1541	457962.669	2595452.635	1337.904	GRV2 E CON B
1542	457942.058	2595450.985	1336.019	CON
1543	457941.64	2595467.386	1335.921	CON
1544	457963.962	2595468.314	1337.933	CON CLOSE
1545	458129.411	2595873.613	1342.284	GRV3
1546	458100.858	2595863.21	1341.337	GRV3
1547	458069.047	2595848.537	1340.641	GRV3
1548	458023.458	2595828.718	1339.622	GRV3
1549	458001.67	2595827.833	1339.196	GRV3
1550	457964.575	2595820.039	1338.006	GRV3
1551	457920.455	2595807.828	1336.976	GRV3
1552	457889.259	2595794.745	1337.054	GRV3
1553	457873.23	2595784.049	1336.081	GRV3 E
1554	458013.574	2595799.533	1339.793	GRV3 B
1555	458021.384	2595811.45	1339.983	GRV3
1556	458034.085	2595818.636	1340.123	GRV3
1557	458057.143	2595831.306	1340.751	GRV3
1558	458082.303	2595844.79	1340.946	GRV3
1559	458115.271	2595859.145	1341.664	GRV3
1560	458142.284	2595866.854	1342.577	GRV3
1561	458171.941	2595873.122	1343.796	GRV3
1562	458202.948	2595877.473	1345.237	GRV3
1563	458204.273	2595875.162	1345.415	GRV3
1564	458205.068	2595871.174	1345.716	GRV3
1565	458197.323	2595862.618	1345.357	GRV3
1566	458179.322	2595839.576	1344.742	GRV3
1567	458163.705	2595813.086	1344.154	GRV3
1568	458149.568	2595792.398	1343.565	GRV3
1569	458135.179	2595778.069	1342.904	GRV3
1570	458118.492	2595768.206	1342.251	GRV3
1571	458091.316	2595759.092	1341.469	GRV3
1572	458064.561	2595755.252	1340.659	GRV3
1573	458042.054	2595754.647	1340.021	GRV3
1574	458024.489	2595757.313	1339.913	GRV3
1575	458010.939	2595767.618	1339.779	GRV3
1576	458005.307	2595777.154	1339.55	GRV3
1577	458009.59	2595790.117	1339.456	GRV3 CLOSE
1578	458613.403	2595780.793	1352.738	DRN B
1579	458590.134	2595741.643	1352.055	DRN
1580	458556.992	2595698.392	1351.58	DRN
1581	458523.576	2595647.9	1350.611	DRN
1582	458501.43	2595615.747	1349.998	DRN
1583	458466.114	2595578.486	1349.241	DRN
1584	458422.56	2595539.653	1349.189	DRN
1585	458373.485	2595510.678	1348.548	DRN
1586	458351.934	2595500.914	1347.39	DRN DRN1 B
1587	458299.747	2595475.613	1346.092	DRN
1588	458232.912	2595452.922	1344.743	DRN
1589	458189.327	2595445.519	1343.994	DRN

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1590	458149.961	2595441.78	1343.386	DRN
1591	458100.921	2595439.617	1341.99	DRN
1592	458047.821	2595437.477	1339.605	DRN
1593	458013.465	2595438.082	1338.072	CMP B 18
1594	458013.184	2595438.242	1338.127	DRN E
1595	457987.953	2595439.041	1337.796	CMP E 18
1596	457988.129	2595439.088	1337.874	DRN B
1597	457962.317	2595438.584	1337.234	DRN
1598	457945.592	2595441.547	1336.292	DRN E
1599	458341.721	2595545.979	1347.021	DRN1
1600	458330.113	2595596.668	1346.826	DRN1
1601	458321.543	2595649.634	1346.742	DRN1
1602	458315.278	2595692.121	1346.751	DRN1
1603	458305.085	2595746.411	1347.045	DRN1
1604	458295.482	2595808.979	1347.128	DRN1
1605	458293.461	2595820.656	1347.602	DRN1
1606	458289.569	2595844.863	1347.974	DRN1
1607	458285.635	2595862.31	1347.754	DRN1
1608	458280.72	2595889.573	1348.183	DRN1 E
1609	458306.696	2595841.024	1348.374	SPOT
1610	458284.054	2595829.99	1347.605	SPOT
1611	458266.815	2595819.965	1346.993	SPOT
1612	458506.834	2595469.113	1363.078	CHK HECP 3
1613	458652.036	2595976.135	1355.48	RCP B 24
1614	458654.434	2596037.462	1356.061	RCP E 24
1615	458742.201	2595951.816	1364.102	CHK HECP 2
1616	457097.717	2596033.527	1370.21	CHK HECP 4
1617	457435.396	2595890.377	1354.832	CON B CON3 B
1618	457432.625	2595890.776	1349.154	CON1 B
1619	457433.866	2595901.356	1349.113	CON1
1620	457436.647	2595901.03	1354.791	CON
1621	457434.216	2595898.192	1335.413	WEIR B
1622	457433.628	2595892.704	1335.404	WEIR E
1623	457431.505	2595905.685	1354.993	RTW B
1624	457431.626	2595905.648	1359.469	RTW
1625	457429.577	2595886.918	1359.37	RTW
1626	457424.977	2595902.4	1354.901	CON3 E CON E
1627	457427.787	2595902.237	1349.23	CON1
1628	457426.481	2595891.54	1349.137	CON1 CLOSE
1629	457423.751	2595891.919	1354.964	CON3
1630	457431.128	2595905.673	1354.962	RTW1 B
1631	457430.925	2595905.702	1359.458	RTW1
1632	457428.844	2595887.026	1359.396	RTW1
1633	457426.385	2595898.923	1335.43	WEIR B
1634	457425.84	2595893.5	1335.428	WEIR E
1635	457486.536	2596311.012	1284.777	RTW2 B RTW3 B
1636	457486.99	2596310.959	1284.598	RTW2
1637	457481.089	2596305.659	1292.336	RTW2
1638	457480.645	2596306.129	1292.34	RTW3
1639	457479.764	2596305.35	1292.361	RTW3
1640	457477.024	2596271.532	1292.439	RTW2
1641	457476.339	2596271.358	1292.444	RTW3
1642	457473.603	2596237.538	1305.156	RTW2
1643	457472.945	2596238.311	1305.185	RTW3
1644	457458.473	2596239.643	1305.277	RTW3
1645	457457.616	2596239.072	1305.27	RTW2

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1646	457461.006	2596273.606	1292.411	RTW2
1647	457461.693	2596272.948	1292.441	RTW3
1648	457465.085	2596306.761	1292.363	RTW3
1649	457464.322	2596307.745	1292.367	RTW3
1650	457463.866	2596307.378	1292.348	RTW2
1651	457460.831	2596311.874	1286.983	RTW3
1652	457460.499	2596311.426	1287.098	RTW3 E RTW2 E
1653	457464.547	2596305.268	1292.389	FNC B
1654	457457.835	2596239.702	1305.619	FNC
1655	457473.364	2596238.108	1305.229	FNC
1656	457480.132	2596303.738	1292.38	FNC E
1657	457465.659	2596239.042	1296.223	BXC 14.5 W x 5 H
1658	457479.714	2596304.773	1279.375	INV AT OUTLET
1659	457478.809	2596296.142	1279.464	INV
1660	458192.848	2596616.12	1366.661	CHK HECP 1
1661	457497.091	2596055.037	1368.557	CHK RP 998
2195	446557.496	2675665.207	999	XS
2196	446611.828	2676119.606	999	XS
2197	446568.591	2676528.34	999	XS
2198	446489.837	2676980.332	999	XS
2199	446579.87	2677434.177	999	XS
2200	446703.107	2677850.37	999	XS
2201	447011.839	2677916.082	999	XS
2202	447367.056	2678144.705	999	XS
2203	447376.434	2678510.567	999	XS
2204	446967.145	2678774.438	999	XS
2205	446565.429	2678870.319	999	XS
2206	446250.11	2679233.867	999	XS
2207	446358.638	2679690.508	999	XS
2208	446722.871	2679862.437	999	XS
2209	446813.566	2680325.279	999	XS
5000	458742.194	2595951.825	1364.088	CHK*2
5000-1	458742.194	2595951.825	1364.088	CHK*2
5001	457062.104	2596069.578	1371.783	SPOT
5002	457061.954	2596075.194	1370.897	SPOT
5003	457062.175	2596084.463	1368.688	SPOT
5004	457062.289	2596097.572	1367.845	SPOT
5005	457063.343	2596106.952	1367.529	SPOT
5006	457062.881	2596110.78	1368.309	SPOT
5007	457063.308	2596118.105	1369.728	SPOT
5008	457062.956	2596130.692	1370.86	SPOT
5009	457097.628	2596068.066	1370.421	SPOT
5010	457097.888	2596081.093	1368.391	SPOT
5011	457098.649	2596091.392	1367.268	SPOT
5012	457098.567	2596095.033	1366.014	SPOT
5013	457099.497	2596116.746	1364.534	SPOT
5014	457100.9	2596128.982	1364.788	SPOT
5015	457132.635	2596065.787	1369.69	SPOT
5016	457132.756	2596073.506	1367.829	SPOT
5017	457132.154	2596081.281	1365.419	SPOT
5018	457131.805	2596087.751	1364.219	SPOT
5019	457131.576	2596090.797	1364.292	SPOT
5020	457130.629	2596101.093	1363.524	SPOT
5021	457130.839	2596103.542	1362.761	SPOT
5022	457131.548	2596126.582	1361.942	SPOT
5023	457180.421	2596066.752	1368.352	SPOT
5024	457180.678	2596073.037	1366.675	SPOT

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5025	457181.159	2596084.337	1362.461	SPOT
5026	457180.524	2596090.065	1360.301	SPOT
5027	457180.22	2596097.964	1359.439	SPOT
5028	457179.337	2596109.348	1358.756	SPOT
5029	457178.528	2596122.956	1357.252	SPOT
5030	457178.095	2596129.791	1355.647	SPOT
5031	457176.648	2596141.482	1355.121	SPOT
5032	457175.347	2596154.205	1357.807	SPOT
5033	457224.731	2596065.351	1367.865	SPOT
5034	457224.964	2596069.61	1366.791	SPOT
5035	457225.037	2596075.359	1364.744	SPOT
5036	457225.315	2596100.023	1355.135	SPOT
5037	457225.274	2596109.74	1352.014	SPOT
5038	457224.946	2596127.228	1351.213	SPOT
5039	457226.411	2596148.374	1350.529	SPOT
5040	457228.502	2596167.141	1349.733	SPOT
5041	457229.275	2596183.193	1348.174	SPOT
5042	457230.291	2596211.067	1345.192	SPOT
5043	457231.828	2596251.088	1339.589	SPOT
5044	457230.552	2596284.767	1335.587	SPOT
5045	457231.938	2596317.317	1330.779	SPOT
5046	457280.165	2596319.115	1320.504	SPOT
5047	457280.378	2596289.825	1323.822	SPOT
5048	457280.438	2596271.659	1325.417	SPOT
5049	457280.062	2596255.432	1328.662	SPOT
5050	457279.588	2596229.368	1332.917	SPOT
5051	457280.176	2596202.656	1336.62	SPOT
5052	457280.749	2596178.555	1339.057	SPOT
5053	457282.018	2596152.144	1341.618	SPOT
5054	457282.268	2596129.95	1343.095	SPOT
5055	457281.559	2596109.767	1349.938	SPOT
5056	457280.864	2596081.481	1361.505	SPOT
5057	457280.554	2596068.638	1366.368	SPOT
5058	457280.432	2596063.969	1367.761	SPOT
5059	457330.3	2596062.74	1367.802	SPOT
5060	457330.261	2596066.754	1366.888	SPOT
5061	457330.231	2596068.359	1366.042	SPOT
5062	457329.692	2596095.486	1354.414	SPOT
5063	457331.416	2596120.04	1344.359	SPOT
5064	457331.825	2596146.189	1334.429	SPOT
5065	457330.129	2596169.437	1329.79	SPOT
5066	457329.239	2596189.7	1327.333	SPOT
5067	457328.785	2596206.381	1325.419	SPOT
5068	457328.766	2596211.087	1323.675	SPOT
5069	457327.956	2596225.068	1321.773	SPOT
5070	457326.974	2596237.001	1320.091	SPOT
5071	457327.065	2596260.182	1317.008	SPOT
5072	457327.904	2596272.822	1315.624	SPOT
5073	457328.376	2596283.702	1313.337	SPOT
5074	457329.153	2596290.243	1311.439	SPOT
5075	457330.085	2596306.971	1309.763	SPOT
5076	457331.218	2596335.154	1307.516	SPOT
5077	457375.66	2596331.897	1303.956	SPOT
5078	457377.074	2596305.878	1303.878	SPOT
5079	457379.072	2596279.087	1305.091	SPOT
5080	457379.834	2596255.31	1308.043	SPOT
5081	457379.015	2596236.502	1311.228	SPOT

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5082	457379.66	2596220.565	1315.226	SPOT
5083	457380.143	2596215.331	1316.39	SPOT
5084	457380.62	2596200.569	1321.383	SPOT
5085	457380.038	2596186.597	1325.87	SPOT
5086	457381.417	2596164.219	1326.994	SPOT
5087	457381.701	2596159.246	1328.017	SPOT
5088	457381.527	2596138.614	1336.42	SPOT
5089	457380.931	2596117.774	1345.066	SPOT
5090	457381.181	2596097.518	1353.476	SPOT
5091	457380.548	2596077.459	1361.935	SPOT
5092	457379.925	2596066.351	1366.658	SPOT
5093	457379.825	2596064.129	1367.585	SPOT
5094	457379.918	2596061.486	1368.085	SPOT
5095	457426.699	2596060.087	1368.024	SPOT
5096	457426.438	2596064.593	1366.653	SPOT
5097	457426.463	2596066.435	1365.901	SPOT
5098	457425.657	2596091.73	1355.165	SPOT
5099	457425.666	2596117.367	1344.727	SPOT
5100	457427.004	2596140.781	1335.071	SPOT
5101	457426.948	2596151.099	1330.45	SPOT
5102	457426.87	2596158.486	1327.664	SPOT
5103	457426.616	2596163.654	1326.332	SPOT
5104	457426.484	2596173.709	1325.963	SPOT
5105	457426.707	2596180.585	1326.39	SPOT
5106	457426.759	2596184.085	1326.06	SPOT
5107	457426.991	2596198.001	1321.55	SPOT
5108	457427.445	2596216.745	1315.422	SPOT
5109	457427.936	2596222.819	1313.647	SPOT
5110	457429.135	2596231.709	1311.428	SPOT
5111	457429.65	2596239.359	1308.638	SPOT
5112	457429.775	2596249.569	1305.08	SPOT
5113	457430.769	2596266.667	1299.297	SPOT
5114	457429.276	2596287.45	1295.953	SPOT
5115	457429.77	2596306.146	1294.35	SPOT
5116	457429.595	2596312.238	1294.775	SPOT
5117	457429.218	2596323.278	1293.656	SPOT
5118	457438.934	2596324.629	1293.57	SPOT
5119	457442.482	2596319.058	1292.722	SPOT
5120	457447.076	2596311.607	1291.451	SPOT
5121	457454.224	2596306.733	1291.416	SPOT
5122	457463.246	2596305.463	1291.159	SPOT
5123	457462.99	2596303.138	1291.918	SPOT
5124	457461.757	2596292.571	1292.315	SPOT
5125	457460.403	2596276.557	1292.416	SPOT
5126	457459.198	2596261.836	1296.355	SPOT
5127	457457.684	2596247.2	1301.719	SPOT
5128	457456.514	2596239.469	1305.305	SPOT
5129	457457.109	2596238.403	1305.965	SPOT
5130	457466.954	2596237.366	1306.257	SPOT
5131	457473.923	2596236.871	1305.897	SPOT
5132	457474.941	2596244.605	1302.399	SPOT
5133	457476.656	2596261.201	1296.276	SPOT
5134	457477.875	2596272.209	1292.686	SPOT
5135	457479.181	2596283.409	1292.158	SPOT
5136	457481.204	2596301.293	1291.912	SPOT
5137	457481.836	2596303.055	1291.077	SPOT
5138	457474.821	2596234.315	1306.809	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
5139	457473.168	2596226.582	1310.147	SPOT
5140	457472.765	2596205.677	1317.914	SPOT
5141	457473.334	2596189.422	1323.86	SPOT
5142	457472.003	2596180.191	1326.374	SPOT
5143	457472.479	2596177.644	1326.722	SPOT
5144	457471.968	2596164.898	1326.085	SPOT
5145	457472.18	2596159.935	1326.628	SPOT
5146	457471.913	2596147.461	1331.519	SPOT
5147	457472.359	2596126.771	1340.161	SPOT
5148	457472.39	2596110.328	1347.238	SPOT
5149	457472.196	2596095.679	1353.436	SPOT
5150	457470.941	2596078.476	1360.438	SPOT
5151	457470.75	2596064.15	1366.053	SPOT
5152	457470.584	2596060.418	1367.668	SPOT
5153	457470.754	2596058.907	1367.925	SPOT
5154	457520.153	2596057.726	1368.058	SPOT
5155	457520.033	2596060.992	1366.961	SPOT
5156	457520.015	2596062.996	1366.132	SPOT
5157	457520.276	2596077.485	1360.306	SPOT
5158	457519.772	2596097.365	1352.236	SPOT
5159	457520.282	2596115.121	1344.319	SPOT
5160	457521.624	2596133.616	1336.721	SPOT
5161	457521.582	2596142.914	1332.713	SPOT
5162	457521.707	2596154.507	1328.465	SPOT
5163	457521.813	2596160.831	1326.631	SPOT
5164	457521.596	2596168.312	1326.711	SPOT
5165	457521.674	2596177.171	1326.847	SPOT
5166	457521.332	2596184.814	1324.95	SPOT
5167	457521.594	2596203.157	1317.975	SPOT
5168	457521.821	2596219.392	1312.054	SPOT
5169	457521.989	2596235.094	1306.278	SPOT
5170	457521.865	2596249.696	1301.394	SPOT
5171	457522.02	2596266.816	1296.715	SPOT
5172	457522.152	2596280.332	1295.138	SPOT
5173	457523.049	2596308.493	1293.444	SPOT
5174	457524.241	2596345.065	1292.997	SPOT
5175	457525.344	2596364.56	1295.005	SPOT
5176	457526.825	2596379.351	1295.227	SPOT
5177	457577.763	2596370.057	1304.905	SPOT
5178	457576.683	2596359.56	1305.013	SPOT
5179	457575.302	2596348.277	1302.494	SPOT
5180	457575.865	2596335.451	1299.16	SPOT
5181	457576.786	2596323.057	1296.639	SPOT
5182	457575.88	2596313.877	1295.218	SPOT
5183	457574.857	2596297.052	1296.297	SPOT
5184	457573.881	2596278.156	1297.618	SPOT
5185	457572.843	2596259.735	1299.371	SPOT
5186	457572.842	2596250.642	1301.767	SPOT
5187	457573.788	2596227.915	1309.412	SPOT
5188	457573.108	2596201.161	1318.998	SPOT
5189	457572.681	2596182.742	1325.688	SPOT
5190	457572.812	2596176.585	1326.947	SPOT
5191	457573.046	2596167.524	1326.491	SPOT
5192	457572.709	2596160.487	1326.369	SPOT
5193	457571.732	2596141.548	1333.655	SPOT
5194	457571.075	2596117.845	1343.389	SPOT
5195	457570.774	2596095.553	1352.402	SPOT
5196	457570.631	2596073.016	1361.743	SPOT
5197	457571.346	2596061.022	1366.675	SPOT
5198	457571.382	2596059.435	1367.349	SPOT
5199	457571.188	2596056.074	1368.201	SPOT
5200	457619.501	2596054.44	1368.332	SPOT
5201	457619.704	2596059.47	1367.185	SPOT
5202	457619.886	2596067.969	1363.848	SPOT
5203	457619.209	2596077.926	1359.284	SPOT
5204	457618.245	2596095.16	1352.103	SPOT
5205	457617.63	2596110.686	1345.753	SPOT
5206	457617.724	2596122.905	1340.733	SPOT
5207	457618.304	2596137.546	1334.841	SPOT
5208	457618.695	2596148.107	1330.6	SPOT
5209	457619.203	2596157.402	1327.203	SPOT
5210	457619.103	2596164.38	1326.355	SPOT
5211	457618.484	2596176.925	1327.296	SPOT
5212	457619.097	2596180.143	1326.442	SPOT
5213	457619.859	2596196.034	1321.07	SPOT
5214	457619.964	2596214.129	1314.439	SPOT
5215	457619.611	2596230.418	1308.961	SPOT
5216	457621.185	2596245.35	1304.227	SPOT
5217	457621.766	2596255.37	1301.893	SPOT
5218	457621.586	2596270.159	1300.859	SPOT
5219	457622.066	2596287.893	1299.536	SPOT
5220	457622.26	2596294.018	1300.236	SPOT
5221	457622.791	2596316.665	1306.607	SPOT
5222	457624.146	2596340.979	1313.544	SPOT
5223	457624.177	2596344.43	1314.346	SPOT
5224	457623.537	2596352.177	1314.13	SPOT
5225	457672.722	2596341.849	1322.531	SPOT
5226	457674.01	2596331.532	1323.013	SPOT
5227	457673.169	2596322.173	1320.388	SPOT
5228	457674.053	2596299.918	1313.566	SPOT
5229	457672.736	2596280.105	1307.679	SPOT
5230	457672.881	2596269.393	1305.477	SPOT
5231	457670.906	2596258.082	1304.998	SPOT
5232	457671.321	2596246.275	1306.015	SPOT
5233	457669.429	2596234.037	1308.944	SPOT
5234	457669.346	2596213.626	1315.461	SPOT
5235	457669.479	2596190.258	1322.958	SPOT
5236	457668.61	2596176.35	1327.255	SPOT
5237	457669.133	2596166.877	1326.76	SPOT
5238	457669.23	2596159.786	1326.063	SPOT
5239	457669.29	2596140.856	1332.991	SPOT
5240	457669.618	2596123.772	1339.891	SPOT
5241	457669.471	2596106.536	1346.839	SPOT
5242	457669.594	2596086.209	1355.529	SPOT
5243	457669.007	2596067.12	1363.694	SPOT
5244	457669.051	2596055.839	1367.75	SPOT
5245	457668.962	2596053.193	1368.296	SPOT
5246	457716.627	2596051.624	1368.271	SPOT
5247	457716.518	2596055.285	1367.442	SPOT
5248	457716.118	2596066.938	1362.814	SPOT
5249	457717.012	2596083.775	1355.907	SPOT
5250	457717.192	2596104.378	1346.922	SPOT
5251	457718.428	2596131.54	1336.058	SPOT
5252	457719.044	2596145.616	1330.552	SPOT
5253	457719.169	2596153.98	1327.468	SPOT
5254	457719.147	2596158.019	1326.29	SPOT
5255	457718.741	2596161.82	1325.813	SPOT
5256	457718.464	2596168.395	1326.713	SPOT
5257	457719.028	2596175.077	1327.1	SPOT
5258	457718.366	2596193.731	1321.58	SPOT
5259	457718.116	2596209.3	1317.148	SPOT
5260	457719.13	2596220.189	1314.168	SPOT
5261	457720.22	2596230.717	1311.541	SPOT
5262	457719.012	2596238.877	1310.338	SPOT
5263	457719.963	2596250.469	1310.094	SPOT
5264	457721.161	2596261.527	1312.57	SPOT
5265	457722.289	2596286.05	1319.882	SPOT
5266	457723.081	2596307.521	1326.767	SPOT
5267	457723.021	2596316.288	1329.567	SPOT
5268	457722.59	2596322.916	1329.777	SPOT
5269	457771.71	2596309.526	1335.449	SPOT
5270	457772.989	2596301.783	1335.511	SPOT
5271	457773.162	2596296.55	1334.004	SPOT
5272	457774.185	2596277.116	1327.843	SPOT
5273	457774.278	2596254.853	1320.965	SPOT
5274	457775.075	2596238.595	1316.887	SPOT
5275	457774.897	2596230.677	1316.152	SPOT
5276	457774.928	2596219.366	1316.892	SPOT
5277	457774.957	2596212.646	1317.436	SPOT
5278	457774.837	2596194.65	1321.913	SPOT
5279	457776.002	2596173.909	1327.003	SPOT
5280	457775.764	2596164.395	1326.674	SPOT
5281	457775.765	2596155.942	1326.597	SPOT
5282	457776.021	2596152.341	1327.482	SPOT
5283	457775.686	2596130.488	1336.131	SPOT
5284	457775.896	2596106.577	1345.412	SPOT
5285	457775.801	2596083.43	1355.302	SPOT
5286	457774.174	2596065.573	1362.559	SPOT
5287	457773.491	2596053.525	1367.6	SPOT
5288	457773.585	2596050.019	1368.303	SPOT
5289	457822.069	2596048.608	1368.375	SPOT
5290	457822.275	2596050.453	1367.919	SPOT
5291	457822.386	2596054.93	1366.708	SPOT
5292	457822.546	2596061.591	1364.135	SPOT
5293	457821.76	2596076.199	1357.811	SPOT
5294	457822.377	2596090.753	1351.671	SPOT
5295	457821.984	2596103.511	1346.269	SPOT
5296	457822.026	2596117.303	1340.787	SPOT
5297	457821.979	2596132.811	1335.113	SPOT
5298	457823.567	2596144.312	1330.399	SPOT
5299	457822.627	2596153.836	1327.388	SPOT
5300	457822.935	2596162.331	1327.389	SPOT
5301	457822.95	2596172.172	1327.424	SPOT
5302	457823.175	2596180.439	1325.852	SPOT
5303	457821.724	2596197.685	1322.412	SPOT
5304	457821.442	2596214.988	1321.795	SPOT
5305	457822.569	2596234.973	1325.007	SPOT
5306	457823.774	2596256.65	1330.72	SPOT
5307	457824.445	2596271.56	1335.553	SPOT
5308	457824.424	2596285.532	1340.372	SPOT
5309	457823.92	2596292.296	1340.606	SPOT

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5310	457872.647	2596282.33	1344.96	SPOT
5311	457872.339	2596273.784	1345.041	SPOT
5312	457871.601	2596270.781	1344.166	SPOT
5313	457872.321	2596253.068	1339.05	SPOT
5314	457874.032	2596218.452	1331.366	SPOT
5315	457873.612	2596203.811	1330.623	SPOT
5316	457874.987	2596182.32	1329.646	SPOT
5317	457876.647	2596161.982	1329.996	SPOT
5318	457877.505	2596143.015	1332.362	SPOT
5319	457876.787	2596123.262	1338.44	SPOT
5320	457876.592	2596100.562	1347.132	SPOT
5321	457875.801	2596079.354	1356.138	SPOT
5322	457874.995	2596060.731	1363.895	SPOT
5323	457875.311	2596056.718	1365.573	SPOT
5324	457875.511	2596049.235	1368.059	SPOT
5325	457875.416	2596046.889	1368.328	SPOT
5326	457922.033	2596045.494	1368.179	SPOT
5327	457922.276	2596049.021	1367.533	SPOT
5328	457922.264	2596052.765	1366.832	SPOT
5329	457922.02	2596058.945	1364.611	SPOT
5330	457922.149	2596074.543	1358.238	SPOT
5331	457921.561	2596087.741	1352.453	SPOT
5332	457921.445	2596102.257	1346.663	SPOT
5333	457921.354	2596113.988	1342.324	SPOT
5334	457922.069	2596121.856	1340.685	SPOT
5335	457920.983	2596132.639	1339.003	SPOT
5336	457921.673	2596136.477	1339.528	SPOT
5337	457922.047	2596145.879	1341.449	SPOT
5338	457922.207	2596161.732	1342.59	SPOT
5339	457920.955	2596188.436	1343.269	SPOT
5340	457922.521	2596207.085	1343.273	SPOT
5341	457922.991	2596218.135	1342.97	SPOT
5342	457921.358	2596231.543	1343.655	SPOT
5343	457923.048	2596246.703	1347.313	SPOT
5344	457922.84	2596258.9	1349.694	SPOT
5345	457923.156	2596265.051	1349.545	SPOT
5346	457964.778	2596237.041	1356.895	SPOT
5347	457962.834	2596216.942	1356.73	SPOT
5348	457964.315	2596183.712	1354.321	SPOT
5349	457963.835	2596149.152	1352.034	SPOT
5350	457963.641	2596130.936	1350.083	SPOT
5351	457964.826	2596118.033	1348.578	SPOT
5352	457964.325	2596110.546	1347.899	SPOT
5353	457963.635	2596100.978	1348.431	SPOT
5354	457964.824	2596080.501	1355.682	SPOT
5355	457964.394	2596065.797	1361.729	SPOT
5356	457964.289	2596062.291	1363.211	SPOT
5357	457964.625	2596057.969	1364.554	SPOT
5358	457964.738	2596051.124	1366.878	SPOT
5359	457964.758	2596048.191	1367.65	SPOT
5360	457964.63	2596044.366	1367.991	SPOT
5361	458010.705	2596042.957	1367.884	SPOT
5362	458011.062	2596046.779	1367.371	SPOT
5363	458010.336	2596054.898	1365.168	SPOT
5364	458010.277	2596065.231	1361.281	SPOT
5365	458011.168	2596082.335	1355.761	SPOT
5366	458010.345	2596092.093	1353.901	SPOT

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5367	458010.349	2596097.868	1353.731	SPOT
5368	458010.285	2596103.756	1353.714	SPOT
5369	458011.025	2596109.442	1354.16	SPOT
5370	458011.179	2596128.532	1356.469	SPOT
5371	458011.288	2596145.73	1359.115	SPOT
5372	458011.347	2596164.967	1361.642	SPOT
5373	458011.023	2596189.758	1363.068	SPOT
5374	458011.13	2596206.213	1365.251	SPOT
5375	458010.544	2596212.8	1365.708	SPOT
5376	458055.045	2596199.142	1367.446	SPOT
5377	458055.894	2596170.393	1366.315	SPOT
5378	458057.044	2596140.242	1364.421	SPOT
5379	458057.66	2596121.824	1361.899	SPOT
5380	458057.613	2596103.138	1359.68	SPOT
5381	458058.247	2596089.119	1358.204	SPOT
5382	458058.31	2596085.871	1358.391	SPOT
5383	458058.298	2596081.008	1358.745	SPOT
5384	458058.001	2596070.801	1360.222	SPOT
5385	458057.963	2596058.296	1363.792	SPOT
5386	458058.385	2596048.774	1366.523	SPOT
5387	458058.232	2596041.805	1367.895	SPOT
5388	458104.783	2596040.623	1367.535	SPOT
5389	458104.859	2596047.479	1366.732	SPOT
5390	458104.489	2596052.983	1365.683	SPOT
5391	458105.086	2596066.037	1363.143	SPOT
5392	458104.746	2596071.885	1362.188	SPOT
5393	458104.155	2596078.343	1362.223	SPOT
5394	458104.394	2596096.483	1364.185	SPOT
5395	458104.176	2596112.216	1365.998	SPOT
5396	458105.058	2596131.663	1366.813	SPOT
5397	458106.29	2596151.751	1367.544	SPOT
5398	458105.712	2596174.874	1368.954	SPOT
5399	458105.409	2596183.279	1368.875	SPOT
5400	458151.995	2596165.41	1369.719	SPOT
5401	458153.35	2596141.215	1369.362	SPOT
5402	458154.942	2596109.456	1369.535	SPOT
5403	458153.336	2596090.643	1368.067	SPOT
5404	458153.689	2596078.025	1366.788	SPOT
5405	458155.291	2596062.561	1366.2	SPOT
5406	458154.883	2596055.288	1365.994	SPOT
5407	458155.304	2596044.419	1366.377	SPOT
5408	458155.227	2596038.717	1367.137	SPOT
5409	458203.224	2596036.017	1365.35	SPOT
5410	458203.2	2596041.627	1364.369	SPOT
5411	458203.041	2596045.186	1364.486	SPOT
5412	458203.609	2596057.067	1367.058	SPOT
5413	458203.843	2596071.064	1369.695	SPOT
5414	458204.298	2596096.572	1370.267	SPOT
5415	458203.29	2596127.487	1370.165	SPOT
5416	458204.033	2596145.142	1369.936	SPOT
5417	458203.597	2596152.635	1369.191	SPOT
5418	458242.68	2596123.702	1370.45	SPOT
5419	458243.418	2596097.035	1371.135	SPOT
5420	458244.685	2596079.756	1370.408	SPOT
5421	458244.698	2596069.459	1368.684	SPOT
5422	458244.923	2596058.948	1365.96	SPOT
5423	458245.292	2596046.157	1362.367	SPOT

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5424	458245.404	2596041.75	1361.685	SPOT
5425	458245.654	2596034.418	1363.038	SPOT
5426	457097.662	2596033.54	1370.204	CHK*4
5426-1	457097.662	2596033.54	1370.204	CHK*4
5427	457059.819	2596038.546	1371.855	SPOT
5428	457059.486	2596034.617	1371.432	SPOT
5429	457060.048	2596019.219	1367.717	SPOT
5430	457059.816	2596011.065	1367.178	SPOT
5431	457059.769	2596004.186	1367.85	SPOT
5432	457060.917	2595978.833	1372.779	SPOT
5433	457062.576	2595960.784	1377.737	SPOT
5434	457095.443	2596036.849	1370.556	SPOT
5435	457094.884	2596032.008	1370.033	SPOT
5436	457096.424	2596014.744	1365.605	SPOT
5437	457096.377	2596010.677	1365.5	SPOT
5438	457095.761	2596008.012	1366.61	SPOT
5439	457097.641	2595976.576	1374.008	SPOT
5440	457098.431	2595958.526	1375.034	SPOT
5441	457135.945	2596034.868	1369.36	SPOT
5442	457135.519	2596030.162	1368.622	SPOT
5443	457135.253	2596012.559	1364.126	SPOT
5444	457135.15	2596004.539	1363.357	SPOT
5445	457131.343	2595957.232	1367.541	SPOT
5446	457180.712	2596033.22	1368.32	SPOT
5447	457180.913	2596024.924	1366.419	SPOT
5448	457179.974	2596011.41	1363.007	SPOT
5449	457179.139	2595982.346	1357.464	SPOT
5450	457226.987	2596032.43	1367.891	SPOT
5451	457225.89	2596026.838	1366.886	SPOT
5452	457228.427	2596006.788	1361.289	SPOT
5453	457228.503	2595987.24	1355.577	SPOT
5454	457226.989	2595974.979	1355.224	SPOT
5455	457227.237	2595958.889	1351.797	SPOT
5456	457224.988	2595951.663	1352.117	SPOT
5457	457279.437	2596031.007	1368.021	SPOT
5458	457279.406	2596024.579	1366.75	SPOT
5459	457280.413	2596006.932	1361.304	SPOT
5460	457280.465	2595987.459	1355.601	SPOT
5461	457280.397	2595975.771	1354.813	SPOT
5462	457281.766	2595960.464	1350.923	SPOT
5463	457280.115	2595948.065	1347.537	SPOT
5464	457280.029	2595925.473	1343.743	SPOT
5465	457281.236	2595906.895	1341.8	SPOT
5466	457281.605	2595885.316	1338.095	SPOT
5467	457282.165	2595872.516	1336.872	SPOT
5468	457282.578	2595861.684	1336.223	SPOT
5469	457283.359	2595856.178	1335.95	SPOT
5470	457338.096	2595887.513	1336.115	SPOT
5471	457337.975	2595889.193	1337.49	SPOT
5472	457338.55	2595894.319	1338.138	SPOT
5473	457338.056	2595913.625	1340.07	SPOT
5474	457337.648	2595927.027	1342.446	SPOT
5475	457337.621	2595946.34	1347.331	SPOT
5476	457336.115	2595973.424	1354.996	SPOT
5477	457336.687	2595977.802	1355.208	SPOT
5478	457336.665	2595985.695	1355.37	SPOT
5479	457336.669	2596000.308	1359.647	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
5480	457334.827	2596016.087	1364.506	SPOT
5481	457333.718	2596026.283	1367.36	SPOT
5482	457333.545	2596029.429	1368.019	SPOT
5483	457379.394	2596028.043	1368.168	SPOT
5484	457379.784	2596023.425	1367.125	SPOT
5485	457380.274	2596008.606	1362.246	SPOT
5486	457381.62	2595984.723	1355.791	SPOT
5487	457382.002	2595973.965	1355.487	SPOT
5488	457382.145	2595961.502	1352.224	SPOT
5489	457383.882	2595937.339	1345.36	SPOT
5490	457382.722	2595916.744	1340.466	SPOT
5491	457382.563	2595904.221	1337.943	SPOT
5492	457382.92	2595892.399	1337.323	SPOT
5493	457383.739	2595884.545	1336.82	SPOT
5494	457384.255	2595881.803	1335.828	SPOT
5495	457430.006	2595903.031	1335.773	SPOT
5496	457431.196	2595908.371	1338.154	SPOT
5497	457430.348	2595920.05	1341.188	SPOT
5498	457430.229	2595938.848	1345.722	SPOT
5499	457431.134	2595956.168	1351.11	SPOT
5500	457431.695	2595972.415	1355.335	SPOT
5501	457430.842	2595980.98	1355.551	SPOT
5502	457430.906	2595997.618	1359.294	SPOT
5503	457430.4	2596017.718	1365.671	SPOT
5504	457430.112	2596026.319	1368.063	SPOT
5505	457472.242	2596025.007	1368.065	SPOT
5506	457472.641	2596010.33	1363.486	SPOT
5507	457472.318	2595989.319	1357.101	SPOT
5508	457472.318	2595980.202	1355.538	SPOT
5509	457472.682	2595972.048	1355.292	SPOT
5510	457471.689	2595959.269	1352.279	SPOT
5511	457474.658	2595934.701	1344.83	SPOT
5512	457475.295	2595920.293	1341.236	SPOT
5513	457474.171	2595905.196	1338.386	SPOT
5514	457473.04	2595892.632	1337.196	SPOT
5515	457473.697	2595886.497	1336.701	SPOT
5516	457473.574	2595884.459	1335.908	SPOT
5517	457523.252	2595882.41	1335.879	SPOT
5518	457523.319	2595887.358	1336.673	SPOT
5519	457523.764	2595895.056	1337.009	SPOT
5520	457522.544	2595904.665	1337.989	SPOT
5521	457525.764	2595916.741	1340.598	SPOT
5522	457525.41	2595928.089	1343.335	SPOT
5523	457524.846	2595942.651	1347.86	SPOT
5524	457524.545	2595951.118	1350.504	SPOT
5525	457524.25	2595964.195	1354.114	SPOT
5526	457523.734	2595968.901	1354.852	SPOT
5527	457523.969	2595981.495	1355.745	SPOT
5528	457523.376	2595995.676	1359.35	SPOT
5529	457522.838	2596011.081	1364.228	SPOT
5530	457522.575	2596020.693	1367.512	SPOT
5531	457522.201	2596023.614	1368.218	SPOT
5532	457572.236	2596022.087	1368.314	SPOT
5533	457573.421	2596008.12	1363.881	SPOT
5534	457573.702	2595986.154	1357.11	SPOT
5535	457573.515	2595980.801	1355.961	SPOT
5536	457573.737	2595966.957	1355.068	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
5537	457573.23	2595951.852	1351.212	SPOT
5538	457573.234	2595928.29	1343.989	SPOT
5539	457572.479	2595909.714	1339.569	SPOT
5540	457572.635	2595896.644	1336.952	SPOT
5541	457570.985	2595887.465	1336.406	SPOT
5542	457570.389	2595881.586	1335.563	SPOT
5543	457621.633	2595876.198	1335.517	SPOT
5544	457622.617	2595880.605	1336.445	SPOT
5545	457621.76	2595889.319	1336.88	SPOT
5546	457622.503	2595900.231	1338.21	SPOT
5547	457622.068	2595909.821	1340.147	SPOT
5548	457622.619	2595916.886	1341.79	SPOT
5549	457622.247	2595930.147	1345.347	SPOT
5550	457621.535	2595939.859	1348.353	SPOT
5551	457621.597	2595963.744	1354.764	SPOT
5552	457622.066	2595977.296	1355.678	SPOT
5553	457621.581	2595992.946	1359.588	SPOT
5554	457621.527	2596007.504	1364.274	SPOT
5555	457621.357	2596018.779	1368.047	SPOT
5556	457621.036	2596020.769	1368.446	SPOT
5557	457670.578	2596019.515	1368.404	SPOT
5558	457671.531	2596005.626	1364.1	SPOT
5559	457672.105	2595981.236	1356.759	SPOT
5560	457671.538	2595975.88	1355.793	SPOT
5561	457671.554	2595966.591	1355.156	SPOT
5562	457672.538	2595954.487	1353.185	SPOT
5563	457672.766	2595935.068	1347.684	SPOT
5564	457672.939	2595920.676	1343.255	SPOT
5565	457672.309	2595914.453	1341.318	SPOT
5566	457672.031	2595899.442	1338.26	SPOT
5567	457671.32	2595888.985	1337.179	SPOT
5568	457671.377	2595882.618	1336.922	SPOT
5569	457670.396	2595873.2	1335.649	SPOT
5570	457721.558	2595865.754	1335.585	SPOT
5571	457721.519	2595873.087	1336.656	SPOT
5572	457721.173	2595876.331	1337.309	SPOT
5573	457721.431	2595889.937	1337.668	SPOT
5574	457722.82	2595904.311	1339.943	SPOT
5575	457722.14	2595917.756	1343.264	SPOT
5576	457722.069	2595930.645	1346.998	SPOT
5577	457722.045	2595944.989	1351.06	SPOT
5578	457721.182	2595956.842	1354.192	SPOT
5579	457720.755	2595961.404	1355.117	SPOT
5580	457721.194	2595971.84	1355.295	SPOT
5581	457720.78	2595978.852	1356.612	SPOT
5582	457720.408	2595991.357	1360.353	SPOT
5583	457719.6	2596009.473	1365.962	SPOT
5584	457719.261	2596016.651	1367.97	SPOT
5585	457719.019	2596018.139	1368.334	SPOT
5586	457773.351	2596016.795	1368.519	SPOT
5587	457773.232	2596009.416	1366.637	SPOT
5588	457773.38	2595974.587	1355.991	SPOT
5589	457773.412	2595970.058	1355.242	SPOT
5590	457773.452	2595959.66	1354.837	SPOT
5591	457773.086	2595950.494	1353.362	SPOT
5592	457773.006	2595929.805	1347.756	SPOT
5593	457772.659	2595904.313	1340.956	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
5594	457771.905	2595892.001	1338.562	SPOT
5595	457770.908	2595882.753	1337.849	SPOT
5596	457771.761	2595876.663	1338.032	SPOT
5597	457772.432	2595871.313	1336.784	SPOT
5598	457771.147	2595864.955	1335.544	SPOT
5599	457827.764	2595831.482	1335.943	SPOT
5600	457827.475	2595837.645	1336.647	SPOT
5601	457827.647	2595862.575	1337.054	SPOT
5602	457826.314	2595880.008	1337.733	SPOT
5603	457824.72	2595900.323	1341.314	SPOT
5604	457825.951	2595915.982	1345.036	SPOT
5605	457825.421	2595932.307	1348.97	SPOT
5606	457824.779	2595947.937	1353.352	SPOT
5607	457824.357	2595958.259	1355.087	SPOT
5608	457823.551	2595969.584	1355.644	SPOT
5609	457823.806	2595976.367	1357.046	SPOT
5610	457822.97	2595995.943	1362.815	SPOT
5611	457823.144	2596011.989	1367.912	SPOT
5612	457822.886	2596015.254	1368.504	SPOT
5613	457874.775	2596013.684	1368.533	SPOT
5614	457875.426	2596005.443	1366.402	SPOT
5615	457874.568	2595991.615	1362.347	SPOT
5616	457874.998	2595971.093	1355.982	SPOT
5617	457874.99	2595967.58	1355.332	SPOT
5618	457876.187	2595954.813	1354.694	SPOT
5619	457875.621	2595946.201	1353.177	SPOT
5620	457874.681	2595917.239	1346.741	SPOT
5621	457875.765	2595897.967	1343.127	SPOT
5622	457876.956	2595878.383	1339.573	SPOT
5623	457876.35	2595861.843	1336.959	SPOT
5624	457875.574	2595843.813	1336.394	SPOT
5625	457876.346	2595832.716	1336.526	SPOT
5626	457875.624	2595823.456	1336.835	SPOT
5627	457875.153	2595807.605	1337.108	SPOT
5628	457874.899	2595796.322	1336.878	SPOT
5629	457874.332	2595788.537	1336.486	SPOT
5630	457871.922	2595781.319	1335.728	SPOT
5631	457920.975	2596012.4	1368.383	SPOT
5632	457920.74	2596004	1366.664	SPOT
5633	457920.452	2595984.598	1360.75	SPOT
5634	457920.945	2595972.133	1357.009	SPOT
5635	457920.356	2595966.152	1355.53	SPOT
5636	457920.509	2595962.977	1355.092	SPOT
5637	457920.099	2595950.049	1354.237	SPOT
5638	457920.682	2595940.031	1352.811	SPOT
5639	457920.82	2595937.083	1351.726	SPOT
5640	457920.463	2595934.345	1351.629	SPOT
5641	457919.769	2595927.643	1351.686	SPOT
5642	457919.917	2595919.924	1352.208	SPOT
5643	457965.557	2595930.185	1355.728	SPOT
5644	457965.546	2595935.696	1355.665	SPOT
5645	457965.884	2595940.179	1354.715	SPOT
5646	457965.975	2595944.326	1354.5	SPOT
5647	457965.645	2595948.036	1354.7	SPOT
5648	457964.276	2595955.671	1355.691	SPOT
5649	457965.147	2595965.26	1356.705	SPOT
5650	457964.657	2595996.438	1365.243	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
5651	457964.155	2596006.381	1367.444	SPOT
5652	457964.244	2596011.129	1368.344	SPOT
5653	458011.774	2596009.614	1368.152	SPOT
5654	458011.644	2596001.332	1366.773	SPOT
5655	458010.792	2595980.09	1361.226	SPOT
5656	458010.692	2595969.871	1358.902	SPOT
5657	458010.195	2595954.446	1357.089	SPOT
5658	458010.294	2595949.961	1357.419	SPOT
5659	458009.689	2595947.108	1358.079	SPOT
5660	458009.459	2595941.318	1358.199	SPOT
5661	458061.929	2595951.921	1360.673	SPOT
5662	458061.962	2595957.983	1360.712	SPOT
5663	458062.143	2595961.533	1360.187	SPOT
5664	458062.4	2595966.152	1360.294	SPOT
5665	458062.289	2595972.427	1360.968	SPOT
5666	458062.305	2595978.573	1361.986	SPOT
5667	458062.029	2595988.679	1364.574	SPOT
5668	458061.794	2595999.65	1366.566	SPOT
5669	458059.876	2596008.278	1368.068	SPOT
5670	458108.171	2596006.055	1367.623	SPOT
5671	458107.048	2595997.076	1366.675	SPOT
5672	458106.73	2595993.83	1366.223	SPOT
5673	458107.235	2595981.504	1363.931	SPOT
5674	458105.086	2595972.705	1363.032	SPOT
5675	458106.552	2595961.33	1362.683	SPOT
5676	457920.678	2595914.053	1351.368	SPOT
5677	457920.983	2595900.544	1347.687	SPOT
5678	457920.6	2595890.067	1344.873	SPOT
5679	457921.242	2595876.44	1341.137	SPOT
5680	457922.16	2595867.587	1338.773	SPOT
5681	457922.175	2595857.811	1337.176	SPOT
5682	457922.258	2595852.564	1336.848	SPOT
5683	457923.141	2595840.026	1337.046	SPOT
5684	457922.72	2595827.293	1337.138	SPOT
5685	457923.561	2595815.383	1336.891	SPOT
5686	457923.818	2595795.503	1337.522	SPOT
5687	457925.912	2595766.026	1337.488	SPOT
5688	457926.445	2595731.37	1337.781	SPOT
5689	457929.03	2595689.445	1337.82	SPOT
5690	457931.205	2595646.563	1336.929	SPOT
5691	457940.144	2595585.562	1336.325	SPOT
5692	457946.339	2595560.193	1336.293	SPOT
5693	457949.641	2595521.382	1336.407	SPOT
5694	457951.631	2595491.328	1336.237	SPOT
5695	457950.801	2595467.604	1336.849	SPOT
5696	457949.779	2595447.942	1336.858	SPOT
5697	457950.014	2595433.555	1337.216	SPOT
5698	457950.773	2595409.039	1338.919	SPOT
5699	457950.806	2595390.345	1341.254	SPOT
5700	457949.659	2595367.852	1344.427	SPOT
5701	457951.453	2595352.746	1347.481	SPOT
5702	457951.917	2595334.967	1351.506	SPOT
5703	457953.619	2595310.663	1353.904	SPOT
5704	457953.16	2595292.19	1356.194	SPOT
5705	457953.761	2595282.215	1357.694	SPOT
5706	457955.387	2595270.131	1360.261	SPOT
5707	457957.605	2595235.741	1365.291	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
5708	457955.106	2595202.522	1367.743	SPOT
5709	457955.056	2595184.775	1367.844	SPOT
5710	457996.598	2595238.689	1367.846	SPOT
5711	457995.645	2595253.779	1367.092	SPOT
5712	457994.775	2595281.694	1364.076	SPOT
5713	457992.653	2595316.578	1359.198	SPOT
5714	457991.79	2595339.888	1355.238	SPOT
5715	457990.371	2595363.744	1350.411	SPOT
5716	457989.187	2595380.326	1347.052	SPOT
5717	457989.693	2595382.037	1346.062	SPOT
5718	457989.354	2595393.215	1344.24	SPOT
5719	457988.713	2595397.871	1344.119	SPOT
5720	457988.031	2595424.191	1342.432	SPOT
5721	457987.432	2595428.562	1341.357	SPOT
5722	457986.661	2595436.595	1339.35	SPOT
5723	457986.164	2595439.792	1339.044	SPOT
5724	457987.515	2595446.299	1340.14	SPOT
5725	457986.979	2595456.705	1339.951	SPOT
5726	457986.923	2595487.03	1339.925	SPOT
5727	457985.103	2595527.459	1338.675	SPOT
5728	457982.94	2595565.916	1338.437	SPOT
5729	457981.697	2595600.897	1338.235	SPOT
5730	457979.507	2595641.228	1338.322	SPOT
5731	457977.522	2595679.202	1338.469	SPOT
5732	457975.58	2595719.106	1338.341	SPOT
5733	457976.723	2595757.577	1338.546	SPOT
5734	457974.714	2595791.303	1338.569	SPOT
5735	457973.669	2595820.876	1338.414	SPOT
5736	457971.192	2595855.541	1338.108	SPOT
5737	457972.032	2595865.641	1338.705	SPOT
5738	457970.46	2595876.613	1341.514	SPOT
5739	457970.688	2595894.476	1346.65	SPOT
5740	457968.727	2595909.664	1350.825	SPOT
5741	457967.044	2595922.933	1354.543	SPOT
5742	457965.79	2595927.506	1355.531	SPOT
5743	458009.692	2595939.439	1358.204	SPOT
5744	458009.731	2595936.196	1357.731	SPOT
5745	458011.349	2595921.97	1354.112	SPOT
5746	458013.137	2595896.987	1346.973	SPOT
5747	458014.956	2595877.98	1341.5	SPOT
5748	458015.121	2595868.426	1339.696	SPOT
5749	458016.765	2595848.038	1339.118	SPOT
5750	458017.456	2595834.066	1339.527	SPOT
5751	458018.83	2595805.884	1339.996	SPOT
5752	458020.754	2595775.754	1339.825	SPOT
5753	458021.845	2595742.473	1339.554	SPOT
5754	458022.083	2595707.208	1339.178	SPOT
5755	458022.42	2595677.376	1339.414	SPOT
5756	458022.566	2595647.213	1339.861	SPOT
5757	458022.343	2595600.302	1339.836	SPOT
5758	458022.896	2595562.448	1340.158	SPOT
5759	458022.666	2595529.04	1340.614	SPOT
5760	458023.842	2595492.256	1341.371	SPOT
5761	458023.793	2595456.004	1342.13	SPOT
5762	458023.788	2595451.957	1342.218	SPOT
5763	458022.311	2595439.306	1339.264	SPOT
5764	458023.619	2595435.22	1339.477	SPOT

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5765	458022.773	2595428.519	1340.835	SPOT
5766	458024.781	2595415.072	1343.176	SPOT
5767	458023.502	2595393.32	1347.066	SPOT
5768	458022.295	2595373.138	1351.211	SPOT
5769	458025.238	2595347.302	1356.918	SPOT
5770	458023.866	2595319.881	1362.27	SPOT
5771	458026.702	2595288.803	1366.247	SPOT
5772	458026.587	2595272.9	1367.378	SPOT
5773	458028.081	2595252.886	1368.156	SPOT
5774	458067.42	2595275.119	1368.587	SPOT
5775	458067.089	2595304.403	1367.27	SPOT
5776	458067.85	2595317.93	1366.057	SPOT
5777	458067.059	2595342.983	1360.864	SPOT
5778	458069.841	2595371.629	1354.377	SPOT
5779	458068.882	2595394.307	1348.937	SPOT
5780	458069.863	2595410.2	1345.68	SPOT
5781	458068.278	2595430.538	1341.982	SPOT
5782	458068.522	2595437.265	1340.738	SPOT
5783	458067.879	2595439.245	1340.718	SPOT
5784	458068.857	2595444.881	1341.564	SPOT
5785	458068.454	2595451.885	1342.385	SPOT
5786	458067.905	2595459.405	1342.848	SPOT
5787	458069.462	2595496.204	1342.524	SPOT
5788	458067.323	2595531.111	1342.26	SPOT
5789	458065.395	2595568.174	1341.588	SPOT
5790	458064.826	2595601.559	1341.267	SPOT
5791	458061.832	2595657.363	1340.903	SPOT
5792	458062.452	2595693.546	1340.193	SPOT
5793	458062.739	2595725.081	1340.325	SPOT
5794	458062.39	2595762.031	1340.739	SPOT
5795	458061.455	2595798.639	1341.108	SPOT
5796	458062.679	2595831.221	1340.967	SPOT
5797	458064.26	2595851.695	1340.539	SPOT
5798	458063.674	2595865.237	1340.09	SPOT
5799	458063.154	2595878.407	1341.111	SPOT
5800	458063.028	2595885.873	1343.599	SPOT
5801	458063.809	2595905.183	1348.794	SPOT
5802	458062.701	2595923.008	1354.203	SPOT
5803	458061.095	2595943.091	1359.118	SPOT
5804	458060.636	2595947.629	1360.07	SPOT
5805	458107.083	2595956.63	1362.22	SPOT
5806	458106.93	2595941.886	1358.917	SPOT
5807	458107.694	2595918.033	1352.372	SPOT
5808	458107.891	2595898.46	1346.371	SPOT
5809	458109.745	2595885.227	1342.658	SPOT
5810	458109.162	2595867.167	1341.665	SPOT
5811	458108.568	2595851.737	1341.837	SPOT
5812	458111.823	2595816.334	1341.924	SPOT
5813	458111.636	2595785.186	1342.016	SPOT
5814	458109.339	2595749.239	1341.887	SPOT
5815	458107.835	2595722.096	1341.502	SPOT
5816	458106.882	2595693.645	1341.636	SPOT
5817	458107.033	2595665.567	1341.987	SPOT
5818	458104.662	2595632.859	1342.319	SPOT
5819	458105.231	2595594.847	1342.632	SPOT
5820	458105.299	2595555.754	1342.896	SPOT
5821	458106.493	2595520.712	1343.164	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
5822	458107.591	2595488.363	1343.383	SPOT
5823	458107.984	2595456.009	1343.334	SPOT
5824	458109.307	2595447.981	1343.072	SPOT
5825	458109.558	2595441.017	1342.524	SPOT
5826	458109.106	2595435.602	1342.82	SPOT
5827	458109.394	2595426.618	1344.143	SPOT
5828	457955.986	2595175.35	1367.833	SPOT
5829	457957.942	2595156.469	1367.808	SPOT
5830	458001.857	2595189.936	1368.269	SPOT
5831	457999.859	2595209.299	1367.747	SPOT
5832	458109.55	2595424.666	1344.829	SPOT
5833	458109.266	2595403.424	1349.559	SPOT
5834	458110.855	2595374.875	1356.38	SPOT
5835	458112.203	2595349.19	1362.254	SPOT
5836	458112.308	2595337.531	1364.97	SPOT
5837	458111.905	2595329.423	1367.392	SPOT
5838	458112.415	2595313.535	1369.017	SPOT
5839	458110.652	2595293.139	1369.205	SPOT
5840	458111.077	2595280.38	1368.608	SPOT
5841	458151.133	2595296.301	1369.122	SPOT
5842	458150.136	2595308.614	1369.485	SPOT
5843	458150.034	2595325.317	1369.43	SPOT
5844	458150.199	2595343.043	1367.059	SPOT
5845	458150.258	2595363.41	1361.483	SPOT
5846	458151.27	2595385.008	1356.2	SPOT
5847	458150.537	2595406.872	1351.114	SPOT
5848	458151.151	2595420.435	1348.303	SPOT
5849	458150.424	2595425.213	1346.787	SPOT
5850	458150.462	2595431.915	1344.787	SPOT
5851	458150.258	2595444.944	1343.854	SPOT
5852	458149.862	2595452.676	1344.065	SPOT
5853	458151.069	2595478.586	1344.533	SPOT
5854	458151.79	2595515.967	1344.182	SPOT
5855	458150.174	2595546.448	1343.99	SPOT
5856	458148.621	2595586.34	1343.169	SPOT
5857	458146.683	2595621.464	1343.115	SPOT
5858	458144.428	2595697.639	1342.804	SPOT
5859	458145.148	2595743.811	1342.768	SPOT
5860	458144.871	2595786.408	1343.289	SPOT
5861	458144.226	2595805.471	1343.56	SPOT
5862	458145.414	2595835.799	1343.377	SPOT
5863	458147.559	2595867.876	1342.877	SPOT
5864	458149.554	2595879.261	1343.048	SPOT
5865	458149.269	2595890.743	1344.16	SPOT
5866	458149.357	2595907.129	1348.768	SPOT
5867	458150.139	2595927.243	1354.592	SPOT
5868	458152.038	2595945.751	1359.726	SPOT
5869	458152.677	2595961.586	1363.965	SPOT
5870	458153.842	2595978.246	1365.968	SPOT
5871	458154.08	2595986.149	1366.396	SPOT
5872	458155.189	2595998.607	1366.592	SPOT
5873	458202.989	2596002.827	1364.943	SPOT
5874	458200.96	2595987.475	1365.601	SPOT
5875	458200.71	2595978.472	1366.36	SPOT
5876	458201.286	2595975.473	1366.29	SPOT
5877	458197.285	2595962.891	1363.74	SPOT
5878	458193.959	2595940.411	1357.315	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
5879	458192.391	2595918.308	1351.344	SPOT
5880	458193.166	2595901.52	1346.471	SPOT
5881	458192.616	2595895.165	1345.07	SPOT
5882	458192.396	2595886.974	1344.66	SPOT
5883	458192.374	2595874.935	1344.667	SPOT
5884	458190.683	2595852.371	1345.181	SPOT
5885	458191.522	2595830.429	1344.647	SPOT
5886	458191.543	2595822.413	1344.498	SPOT
5887	458189.542	2595790.458	1344.346	SPOT
5888	458189.821	2595759.276	1343.761	SPOT
5889	458189.378	2595728.12	1343.707	SPOT
5890	458187.457	2595692.356	1343.453	SPOT
5891	458187.435	2595651.919	1343.891	SPOT
5892	458189.999	2595613.243	1344.303	SPOT
5893	458189.066	2595573.095	1344.792	SPOT
5894	458188.242	2595548.267	1345.34	SPOT
5895	458187.769	2595534.933	1346.374	SPOT
5896	458188.365	2595509.661	1345.708	SPOT
5897	458188.718	2595501.43	1345.173	SPOT
5898	458189.32	2595481.916	1345.347	SPOT
5899	458193.35	2595458.913	1345.114	SPOT
5900	458191.58	2595451.317	1344.243	SPOT
5901	458191.758	2595439.17	1344.486	SPOT
5902	458191.965	2595435.237	1345.59	SPOT
5903	458192.903	2595427.125	1348.687	SPOT
5904	458191.911	2595420.167	1350.234	SPOT
5905	458191.633	2595392.418	1356.903	SPOT
5906	458190.67	2595365.283	1363.59	SPOT
5907	458190.175	2595353.87	1366.852	SPOT
5908	458188.789	2595337.798	1368.604	SPOT
5909	458187.628	2595319.578	1369.02	SPOT
5910	458189.949	2595307.309	1368.629	SPOT
5911	458236.419	2595338.512	1368.61	SPOT
5912	458236.168	2595353.457	1367.944	SPOT
5913	458236.843	2595367.29	1366.255	SPOT
5914	458236.86	2595381.616	1362.405	SPOT
5915	458237.65	2595408.278	1355.986	SPOT
5916	458236.938	2595427.006	1351.186	SPOT
5917	458237.162	2595438.204	1348.017	SPOT
5918	458236.73	2595443.988	1346.063	SPOT
5919	458235.81	2595448.94	1345.077	SPOT
5920	458234.436	2595457.232	1345.074	SPOT
5921	458235.442	2595462.108	1345.44	SPOT
5922	458234.346	2595472.644	1346.222	SPOT
5923	458235.022	2595512.42	1346.049	SPOT
5924	458234.21	2595550.472	1345.905	SPOT
5925	458231.785	2595587.673	1345.65	SPOT
5926	458232.351	2595624.632	1345.024	SPOT
5927	458232.42	2595659.73	1345.339	SPOT
5928	458231.454	2595731.774	1345.104	SPOT
5929	458234.872	2595771.967	1345.891	SPOT
5930	458234.39	2595808.602	1345.678	SPOT
5931	458236.307	2595846.703	1346.086	SPOT
5932	458238.855	2595870.492	1345.814	SPOT
5933	458238.535	2595878.744	1346.257	SPOT
5934	458240.626	2595899.137	1347.149	SPOT
5935	458240.482	2595913.623	1348.438	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
5936	458240.385	2595931.759	1353.236	SPOT
5937	458240.986	2595946.958	1357.309	SPOT
5938	458242.866	2595959.541	1360.016	SPOT
5939	458242.737	2595970.069	1361.851	SPOT
5940	458242.659	2595976.707	1361.811	SPOT
5941	458241.838	2595991.429	1362.123	SPOT
5942	458287.75	2596002.076	1360.734	SPOT
5943	458287.796	2595985.409	1358.654	SPOT
5944	458287.597	2595969.175	1355.725	SPOT
5945	458288.768	2595945.985	1352.516	SPOT
5946	458288.295	2595930.542	1350.595	SPOT
5947	458287.484	2595919.9	1349.145	SPOT
5948	458287.429	2595903.927	1348.695	SPOT
5949	458287.414	2595899.806	1349.046	SPOT
5950	458286.977	2595862.828	1347.842	SPOT
5951	458284.578	2595830.673	1347.619	SPOT
5952	458281.2	2595793.949	1347.356	SPOT
5953	458279.62	2595756.05	1346.85	SPOT
5954	458278.317	2595692.786	1346.185	SPOT
5955	458280.84	2595655.745	1346.21	SPOT
5956	458279.783	2595619.659	1346.479	SPOT
5957	458281.222	2595579.028	1346.649	SPOT
5958	458279.792	2595539.424	1346.741	SPOT
5959	458281.268	2595500.41	1347.219	SPOT
5960	458279.966	2595476.389	1346.287	SPOT
5961	458279.896	2595470.308	1346.033	SPOT
5962	458280.151	2595461.038	1346.347	SPOT
5963	458281.13	2595454.045	1348.064	SPOT
5964	458280.543	2595443.075	1351.044	SPOT
5965	458278.726	2595427.102	1354.446	SPOT
5966	458279.559	2595415.919	1357.218	SPOT
5967	458279.358	2595390.546	1363.255	SPOT
5968	458279.933	2595380.979	1365.734	SPOT
5969	458277.846	2595366.6	1368.089	SPOT
5970	458276.867	2595352.184	1368.618	SPOT
5971	458276.088	2595336.666	1368.952	SPOT
5972	458292.144	2595715.983	1346.803	SPOT
5973	458295.944	2595717.008	1347.935	SPOT
5974	458300.147	2595718.228	1348.036	SPOT
5975	458301.941	2595718.415	1347.32	SPOT
5976	458307.456	2595718.748	1346.699	SPOT
5977	458312.152	2595719.267	1347.093	SPOT
5978	458320.023	2595720.067	1347.457	SPOT
5979	458323.919	2595708.47	1347.425	SPOT
5980	458327.01	2595683.249	1347.082	SPOT
5981	458330.275	2595655.251	1347.217	SPOT
5982	458334.761	2595631.531	1347.396	SPOT
5983	458330.362	2595630.924	1347.279	SPOT
5984	458326.927	2595630.303	1346.688	SPOT
5985	458321.178	2595629.067	1346.875	SPOT
5986	458314.845	2595627.731	1347.581	SPOT
5987	458340.918	2595598.533	1347.841	SPOT
5988	458347.897	2595569.197	1348.081	SPOT
5989	458352.525	2595548.154	1348.303	SPOT

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5990	458354.608	2595531.552	1348.699	SPOT
5991	458355.982	2595520.389	1349.052	SPOT
5992	458351.35	2595518.753	1347.804	SPOT
5993	458340.263	2595517.046	1347.566	SPOT
5994	458335.328	2595516.836	1348.495	SPOT
5995	458322.795	2595514.507	1348.908	SPOT
5996	458314.625	2595514.958	1348.36	SPOT
5997	458313.513	2595533.756	1347.861	SPOT
5998	458314.864	2595547.622	1347.883	SPOT
5999	458311.212	2595566.768	1347.277	SPOT
6000	458306.768	2595587.798	1347.201	SPOT
6001	458305.198	2595616.543	1347.09	SPOT
6002	458304.097	2595624.747	1347.155	SPOT
6003	458309.072	2595626.169	1347.809	SPOT
6004	458302.845	2595628.541	1346.932	SPOT
6005	458297.802	2595657.287	1346.532	SPOT
6006	458294.707	2595681.174	1346.561	SPOT
6007	458291.826	2595703.764	1346.689	SPOT
6008	458298.963	2595701.393	1347.976	SPOT
6009	458305.124	2595677.005	1347.871	SPOT
6010	458309.698	2595654.099	1347.884	SPOT
6011	458315.731	2595609.766	1348.172	SPOT
6012	458320.381	2595578.127	1348.131	SPOT
6013	458325.265	2595545.127	1348.438	SPOT
6014	458327.243	2595531.045	1348.95	SPOT
6015	458290.215	2595729.752	1346.943	SPOT
6016	458288.913	2595746.478	1347.161	SPOT
6017	458283.507	2595771.098	1347.066	SPOT
6018	458277.456	2595802.315	1347.199	SPOT
6019	458275.677	2595811.177	1347.327	SPOT
6020	458269.347	2595843.047	1347.648	SPOT
6021	458264.497	2595873.001	1347.323	SPOT
6022	458261.515	2595883.866	1347.316	SPOT
6023	458269.388	2595886.75	1348.325	SPOT
6024	458274.037	2595888.361	1348.039	SPOT
6025	458281.299	2595889.487	1348.117	SPOT
6026	458289.29	2595893.091	1348.567	SPOT
6027	458302.551	2595859.686	1349.125	SPOT
6028	458290.277	2595854.595	1347.881	SPOT
6029	458287.305	2595853.24	1347.664	SPOT
6030	458283.689	2595851.479	1347.891	SPOT
6031	458277.756	2595849.116	1348.592	SPOT
6032	458282.209	2595809.294	1347.793	SPOT
6033	458289.78	2595811.667	1347.239	SPOT
6034	458294.592	2595812.917	1347.03	SPOT
6035	458301.759	2595816.131	1347.755	SPOT
6036	458310.41	2595820.253	1348.51	SPOT
6037	458320.588	2595774.707	1347.983	SPOT
6038	458302.279	2595769.987	1347.115	SPOT
6039	458297.196	2595768.284	1347.228	SPOT
6040	458291.051	2595766.883	1347.819	SPOT
6041	458333.434	2596000.467	1359.033	SPOT
6042	458332.854	2595992.203	1357.956	SPOT
6043	458332.492	2595980.557	1356.255	SPOT
6044	458332.998	2595966.475	1352.998	SPOT
6045	458333.491	2595961.51	1352.365	SPOT
6046	458333.389	2595944.336	1351.698	SPOT
6047	458334.873	2595932.891	1351.192	SPOT

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6048	458334.715	2595917.552	1350.943	SPOT
6049	458334.719	2595912.033	1351.498	SPOT
6050	458334.426	2595888.42	1351.275	SPOT
6051	458337.611	2595862.687	1350.077	SPOT
6052	458341.49	2595827.85	1349.161	SPOT
6053	458340.945	2595796.288	1348.793	SPOT
6054	458341.013	2595755.398	1348.245	SPOT
6055	458342.981	2595715.212	1347.858	SPOT
6056	458344.037	2595678.04	1347.308	SPOT
6057	458345.432	2595636.397	1347.471	SPOT
6058	458351.101	2595490.518	1348.856	SPOT
6059	458349.889	2595474.323	1351.567	SPOT
6060	458350.575	2595468.893	1352.581	SPOT
6061	458350.455	2595463.638	1353.804	SPOT
6062	458350.387	2595449.306	1356.159	SPOT
6063	458350.868	2595439.231	1358.179	SPOT
6064	458349.919	2595420.24	1361.869	SPOT
6065	458348.327	2595398.891	1364.791	SPOT
6066	458349.473	2595383.317	1366.104	SPOT
6067	458349.574	2595366.423	1367.502	SPOT
6068	458317.301	2595352.636	1368.481	SPOT
6069	458315.784	2595367.36	1367.779	SPOT
6070	458318.74	2595386.39	1365.918	SPOT
6071	458320.12	2595398.703	1364.449	SPOT
6072	458319.685	2595406.138	1362.961	SPOT
6073	458319.551	2595411.332	1361.397	SPOT
6074	458321.381	2595438.453	1356.073	SPOT
6075	458322.505	2595451.024	1353.648	SPOT
6076	458322.137	2595463.781	1350.794	SPOT
6077	458321.742	2595473.166	1348.337	SPOT
6078	458322.462	2595479.232	1347.381	SPOT
6079	458388.946	2595389.39	1365.395	SPOT
6080	458387.148	2595404.909	1364.528	SPOT
6081	458387.561	2595418.223	1363.661	SPOT
6082	458388.069	2595430.62	1362.353	SPOT
6083	458386.459	2595445.907	1360.119	SPOT
6084	458386.783	2595459.745	1357.883	SPOT
6085	458386.23	2595468.264	1356.805	SPOT
6086	458385.571	2595472.646	1356.113	SPOT
6087	458385.788	2595481.072	1354.533	SPOT
6088	458385.277	2595496.882	1351.356	SPOT
6089	458385.533	2595505.93	1349.456	SPOT
6090	458384.335	2595524.773	1349.036	SPOT
6091	458384.574	2595534.898	1350.247	SPOT
6092	458384.817	2595539.679	1350.093	SPOT
6093	458384.71	2595545.405	1349.4	SPOT
6094	458385.471	2595577.493	1349.03	SPOT
6095	458384.917	2595613.216	1348.436	SPOT
6096	458383.331	2595648.199	1348.002	SPOT
6097	458382.239	2595685.514	1348.051	SPOT
6098	458382.418	2595725.253	1348.376	SPOT
6099	458377.765	2595756.923	1349.067	SPOT
6100	458377.412	2595815.41	1349.804	SPOT
6101	458375.372	2595857.232	1350.872	SPOT
6102	458372.985	2595894.552	1351.911	SPOT
6103	458372.743	2595914.567	1352.611	SPOT
6104	458372.516	2595924.624	1352.438	SPOT
6105	458371.202	2595940.267	1352.683	SPOT

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6106	458370.414	2595959.837	1352.952	SPOT
6107	458370.436	2595967.988	1353.264	SPOT
6108	458370.343	2595980.97	1355.142	SPOT
6109	458372.382	2595997.267	1357.925	SPOT
6110	458372.35	2595999.743	1358.437	SPOT
6111	458410.052	2595996.47	1357.7	SPOT
6112	458409.924	2595993.679	1357.316	SPOT
6113	458410.106	2595984.278	1355.552	SPOT
6114	458410.03	2595974.897	1354.308	SPOT
6115	458409.708	2595952.439	1353.936	SPOT
6116	458409.164	2595931.56	1353.482	SPOT
6117	458408.96	2595923.489	1352.851	SPOT
6118	458408.917	2595891.068	1352.311	SPOT
6119	458409.101	2595862.472	1351.604	SPOT
6120	458412.463	2595833.268	1351.023	SPOT
6121	458413.368	2595794.381	1349.903	SPOT
6122	458417.061	2595756.345	1349.448	SPOT
6123	458418.464	2595725.153	1349.295	SPOT
6124	458419.465	2595694.799	1348.772	SPOT
6125	458420.922	2595658.663	1348.874	SPOT
6126	458422.988	2595625.196	1349.005	SPOT
6127	458420.587	2595597.167	1349.461	SPOT
6128	458421.171	2595572.279	1349.738	SPOT
6129	458422.122	2595560.618	1349.826	SPOT
6130	458422.563	2595554.412	1349.45	SPOT
6131	458424.845	2595532.776	1349.712	SPOT
6132	458424.563	2595526.688	1351.169	SPOT
6133	458426.716	2595511.883	1354.291	SPOT
6134	458427.3	2595501.541	1356.403	SPOT
6135	458429.038	2595480.473	1359.418	SPOT
6136	458428.122	2595465.816	1360.769	SPOT
6137	458426.302	2595444.157	1362.444	SPOT
6138	458426.391	2595433.251	1362.922	SPOT
6139	458425.509	2595412.806	1363.864	SPOT
6140	458424.01	2595389.465	1365.251	SPOT
6141	458465.455	2595442.874	1362.89	SPOT
6142	458463.769	2595460.872	1362.443	SPOT
6143	458462.211	2595474.615	1361.542	SPOT
6144	458462.808	2595495.06	1360.222	SPOT
6145	458461.03	2595511.909	1358.468	SPOT
6146	458460.339	2595525.14	1356.913	SPOT
6147	458458.348	2595535.106	1354.852	SPOT
6148	458459.521	2595550.495	1352.018	SPOT
6149	458458.908	2595557.63	1349.774	SPOT
6150	458454.211	2595573.398	1349.188	SPOT
6151	458454.583	2595585.852	1349.682	SPOT
6152	458453.453	2595606.338	1349.981	SPOT
6153	458455.414	2595648.007	1349.634	SPOT
6154	458454.58	2595685.409	1349.771	SPOT
6155	458452.901	2595726.533	1349.838	SPOT
6156	458451.879	2595768.119	1349.933	SPOT
6157	458449.646	2595809.704	1350.636	SPOT
6158	458446.853	2595847.658	1351.562	SPOT
6159	458445.761	2595884.56	1352.498	SPOT
6160	458448.785	2595927.773	1353.734	SPOT
6161	458448.977	2595937.506	1355.154	SPOT
6162	458450.136	2595951.311	1355.838	SPOT
6163	458449.974	2595976.495	1356.668	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
6164	458449.427	2595990.658	1357.4	SPOT
6165	458476.991	2595973.704	1356.798	SPOT
6166	458495.983	2595974.726	1356.005	SPOT
6167	458511.115	2595974.731	1355.001	SPOT
6168	458548.509	2595975.327	1355.351	SPOT
6169	458549.282	2595985.509	1357.026	SPOT
6170	458549.034	2595994.322	1357.958	SPOT
6171	458581.609	2595973.875	1355.648	SPOT
6172	458581.834	2595984.32	1357.62	SPOT
6173	458581.299	2595993.863	1358.601	SPOT
6174	458630.795	2595972.597	1356.183	SPOT
6175	458629.097	2595982.539	1358.072	SPOT
6176	458629.244	2595993.25	1359.902	SPOT
6177	458664.51	2595968.866	1356.837	SPOT
6178	458665.217	2595977.073	1359.243	SPOT
6179	458665.494	2595988.73	1360.994	SPOT
6180	458668.836	2595967.544	1357.237	SPOT
6181	458677.385	2595966.638	1358.312	SPOT
6182	458688.104	2595966.558	1359.768	SPOT
6183	458701.473	2595965.788	1361.488	SPOT
6184	458714.085	2595964.463	1362.739	SPOT
6185	458719.938	2595964.147	1363.314	SPOT
6186	458741.897	2595962.039	1364.317	SPOT
6187	458731.926	2595912.078	1362.471	SPOT
6188	458723.879	2595914.414	1362.595	SPOT
6189	458707.771	2595917.1	1361.875	SPOT
6190	458693.359	2595918.96	1360.495	SPOT
6191	458680.168	2595920.638	1358.605	SPOT
6192	458667.526	2595922.457	1356.435	SPOT
6193	458658.854	2595923.528	1355.059	SPOT
6194	458655.71	2595924.142	1355.171	SPOT
6195	458651.141	2595924.388	1355.556	SPOT
6196	458627.799	2595926.801	1355.604	SPOT
6197	458581.973	2595929.668	1354.994	SPOT
6198	458545.343	2595929.71	1354.805	SPOT
6199	458480.806	2595934.313	1353.842	SPOT
6200	458466.991	2595936.98	1354.528	SPOT
6201	458455.051	2595939.55	1355.184	SPOT
6202	458481.662	2595915.224	1353.351	SPOT
6203	458478.851	2595869.111	1352.169	SPOT
6204	458481.108	2595834.528	1351.455	SPOT
6205	458486.498	2595792.747	1350.884	SPOT
6206	458492.479	2595756.279	1350.635	SPOT
6207	458493.502	2595712.472	1350.523	SPOT
6208	458490.613	2595669.493	1350.393	SPOT
6209	458493.333	2595630.969	1350.864	SPOT
6210	458493.677	2595619.131	1350.37	SPOT
6211	458497.909	2595600.897	1350.144	SPOT
6212	458497.237	2595590.831	1351.838	SPOT
6213	458496.653	2595574.527	1354.421	SPOT
6214	458497.608	2595558.012	1357.032	SPOT
6215	458499.939	2595542.767	1359.618	SPOT
6216	458500.339	2595518.921	1360.989	SPOT
6217	458498.682	2595495.957	1362.036	SPOT
6218	458501.676	2595476.416	1362.811	SPOT
6219	458532.227	2595515.759	1361.6	SPOT
6220	458531.447	2595538.43	1361.477	SPOT
6221	458530.918	2595563.121	1360.479	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
6222	458532.264	2595587.295	1359.058	SPOT
6223	458531.984	2595599.23	1357.144	SPOT
6224	458530.936	2595620.798	1353.999	SPOT
6225	458527.535	2595637	1351.414	SPOT
6226	458526.313	2595666.503	1351.006	SPOT
6227	458526.185	2595679.308	1351.539	SPOT
6228	458526.092	2595711.515	1351.172	SPOT
6229	458524.926	2595757.036	1351.319	SPOT
6230	458524.784	2595794.785	1351.578	SPOT
6231	458520.979	2595846.397	1352.307	SPOT
6232	458518.982	2595892.201	1353.387	SPOT
6233	458518.174	2595930.45	1353.961	SPOT
6234	458516.936	2595958.147	1354.429	SPOT
6235	458514.398	2595981.459	1355.996	SPOT
6236	458560.038	2595974.037	1355.414	SPOT
6237	458561.552	2595950.24	1355.206	SPOT
6238	458559.929	2595919.383	1354.904	SPOT
6239	458560.398	2595879.72	1353.914	SPOT
6240	458561.979	2595844.821	1353.072	SPOT
6241	458567.396	2595805.93	1352.432	SPOT
6242	458568.447	2595770.415	1352.136	SPOT
6243	458568.372	2595751.082	1352.481	SPOT
6244	458569.134	2595742.124	1352.088	SPOT
6245	458569.903	2595733.426	1352.029	SPOT
6246	458572.874	2595710.872	1351.479	SPOT
6247	458573.707	2595700.665	1352.586	SPOT
6248	458573.454	2595681.462	1355.274	SPOT
6249	458575.326	2595673.57	1357.057	SPOT
6250	458574.178	2595652.016	1358.995	SPOT
6251	458576.857	2595635.578	1360.047	SPOT
6252	458577.973	2595615.083	1360.703	SPOT
6253	458581	2595590.035	1361.3	SPOT
6254	458609.422	2595629.529	1361.179	SPOT
6255	458608.422	2595651.341	1360.91	SPOT
6256	458608.779	2595669.871	1360.722	SPOT
6257	458607.94	2595695.52	1360.074	SPOT
6258	458607.66	2595709.524	1358.451	SPOT
6259	458607.607	2595723.676	1356.457	SPOT
6260	458607.354	2595732.321	1354.966	SPOT
6261	458605.404	2595744.07	1353.242	SPOT
6262	458604.465	2595752.149	1352.393	SPOT
6263	458603.606	2595782.063	1352.66	SPOT
6264	458602.883	2595790.493	1352.85	SPOT
6265	458602.071	2595828.717	1353.437	SPOT
6266	458604.282	2595862.057	1354.244	SPOT
6267	458605.704	2595893.706	1354.932	SPOT
6268	458607.69	2595925.003	1355.359	SPOT
6269	458606.575	2595949.539	1355.487	SPOT
6270	458604.983	2595973.2	1355.923	SPOT
6271	458605.013	2595985.479	1358.286	SPOT
6272	458604.829	2595993.304	1359.204	SPOT
6273	458654.522	2595991.021	1360.721	SPOT
6274	458654.452	2595982.93	1359.36	SPOT
6275	458654.434	2595974.563	1357.381	SPOT
6276	458654.38	2595971.38	1356.006	SPOT
6277	458653.893	2595964.406	1355.911	SPOT
6278	458652.208	2595941.943	1355.733	SPOT
6279	458647.699	2595904.836	1355.392	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
6280	458648.97	2595863.816	1354.737	SPOT
6281	458648.377	2595838.957	1354.656	SPOT
6282	458647.991	2595822.326	1354.901	SPOT
6283	458650.204	2595806.26	1356.59	SPOT
6284	458649.993	2595789.506	1358.13	SPOT
6285	458649.101	2595765.244	1359.572	SPOT
6286	458648.927	2595744.379	1360.484	SPOT
6287	458650.582	2595721.073	1361.027	SPOT
6288	458649.785	2595711.579	1361.18	SPOT
6289	458652.434	2595688.97	1361.581	SPOT
6290	458676.965	2595732.502	1362.165	SPOT
6291	458673.899	2595757.785	1361.378	SPOT
6292	458678.053	2595796.739	1360.721	SPOT
6293	458680.095	2595828.464	1360.222	SPOT
6294	458680.777	2595857.704	1359.72	SPOT
6295	458682.428	2595885.824	1359.684	SPOT
6296	458684.575	2595906.41	1359.498	SPOT
6297	458724.996	2595910.951	1362.462	SPOT
6298	458720.307	2595886.119	1362.521	SPOT
6299	458716.512	2595861.4	1362.542	SPOT
6300	458711.208	2595834.856	1362.296	SPOT
6301	458704.624	2595806.368	1362.265	SPOT
6302	458696.989	2595782.029	1361.98	SPOT
6303	458750.95	2596023.468	1365.158	SPOT
6304	458733.252	2596022.656	1364.55	SPOT
6305	458703.819	2596022.093	1363.027	SPOT
6306	458681.465	2596022.048	1361.992	SPOT
6307	458647.578	2596022.958	1360.439	SPOT
6308	458622.771	2596023.394	1359.683	SPOT
6309	458581.938	2596024.505	1358.79	SPOT
6310	458537.351	2596025.744	1358.05	SPOT
6311	458502.417	2596026.285	1357.903	SPOT
6312	458470.14	2596027.67	1357.875	SPOT
6313	458428.63	2596029.407	1358.011	SPOT
6314	458377.681	2596030.773	1358.385	SPOT
6315	458332.045	2596031.767	1359.181	SPOT
6316	458287.45	2596033.589	1360.806	SPOT
6317	458287.273	2596041.595	1359.441	SPOT
6318	458324.894	2596042.503	1357.93	SPOT
6319	458349.209	2596041.468	1356.652	SPOT
6320	458376.132	2596040.791	1356.631	SPOT
6321	458427.329	2596039.344	1357.055	SPOT
6322	458470.434	2596038.741	1356.616	SPOT
6323	458539.068	2596037.977	1356.603	SPOT
6324	458580.76	2596038.539	1356.726	SPOT
6325	458620.052	2596037.874	1357.524	SPOT
6326	458647.334	2596037.8	1357.821	SPOT
6327	458667.36	2596039.936	1358.999	SPOT
6328	458667.241	2596022.369	1361.31	SPOT
6329	458680.087	2596040.596	1360.342	SPOT
6330	458698.127	2596037.317	1362.253	SPOT
6331	458711.431	2596037.483	1363.333	SPOT
6332	458738.254	2596037.138	1364.766	SPOT
6333	458732.426	2596078.492	1364.679	SPOT
6334	458717.184	2596078.659	1365.189	SPOT
6335	458702.272	2596079.17	1365.9	SPOT
6336	458691.189	2596078.683	1364.664	SPOT
6337	458676.268	2596077.779	1361.573	SPOT

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6338	458658.809	2596080.153	1357.228	SPOT
6339	458653.811	2596079.881	1356.768	SPOT
6340	458619.132	2596079.707	1356.626	SPOT
6341	458582.155	2596081.077	1357.077	SPOT
6342	458546.549	2596081.761	1356.917	SPOT
6343	458512.252	2596080.591	1356.803	SPOT
6344	458471.702	2596080.19	1357.112	SPOT
6345	458437.062	2596080.132	1357.006	SPOT
6346	458401.906	2596080.117	1357.005	SPOT
6347	458365.688	2596080.528	1356.895	SPOT
6348	458324.588	2596082.132	1357.272	SPOT
6349	458303.129	2596083.353	1357.948	SPOT
6350	458280.539	2596081.497	1362.938	SPOT
6351	458260.243	2596079.29	1367.753	SPOT
6352	458249.115	2596079.291	1369.934	SPOT
6353	458244.088	2596134.518	1369.704	SPOT
6354	458256.621	2596132.783	1367.949	SPOT
6355	458272.002	2596130.573	1364.037	SPOT
6356	458293.318	2596127.9	1358.881	SPOT
6357	458304.566	2596127.576	1358.346	SPOT
6358	458335.734	2596125.502	1357.899	SPOT
6359	458372.617	2596123.692	1357.769	SPOT
6360	458408.842	2596123.337	1357.682	SPOT
6361	458445.555	2596124.155	1357.339	SPOT
6362	458483.641	2596123.786	1357.405	SPOT
6363	458521.653	2596123.534	1357.036	SPOT
6364	458558.617	2596125.074	1356.848	SPOT
6365	458596.493	2596126.346	1357.009	SPOT
6366	458636.029	2596126.9	1356.945	SPOT
6367	458659.986	2596125.085	1357.986	SPOT
6368	458674.287	2596124.26	1361.623	SPOT
6369	458690.137	2596124.156	1365.247	SPOT
6370	458695.782	2596124.05	1366.408	SPOT
6371	458709.737	2596124.246	1366.123	SPOT
6372	458725.657	2596125.289	1365.68	SPOT
6373	458720.008	2596168.345	1366.896	SPOT
6374	458706.099	2596167.54	1367.499	SPOT
6375	458691.215	2596167.839	1367.386	SPOT
6376	458675.517	2596167.391	1363.335	SPOT
6377	458657.594	2596166.033	1358.555	SPOT
6378	458633.147	2596164.103	1357.387	SPOT
6379	458602.197	2596164.448	1357.141	SPOT
6380	458563.124	2596164.219	1357.344	SPOT
6381	458523.191	2596163.378	1357.254	SPOT
6382	458492.037	2596162.26	1357.376	SPOT
6383	458456.289	2596160.994	1357.643	SPOT
6384	458415.908	2596161.26	1358.085	SPOT
6385	458375.478	2596163.476	1358.305	SPOT
6386	458340.631	2596160.029	1358.421	SPOT
6387	458298.969	2596160.642	1358.646	SPOT
6388	458280.608	2596160.191	1359.554	SPOT
6389	458265.424	2596159.947	1362.042	SPOT
6390	458246.837	2596160.472	1364.569	SPOT
6391	458243.256	2596144.695	1368.291	SPOT
6392	458248.038	2596167.156	1362.653	SPOT
6393	458246.607	2596181.695	1360.221	SPOT
6394	458251.166	2596213.029	1360.189	SPOT
6395	458252.58	2596248.815	1360.526	SPOT

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6396	458254.146	2596286.662	1360.627	SPOT
6397	458254.36	2596323.185	1360.557	SPOT
6398	458255.232	2596352.256	1360.499	SPOT
6399	458255.282	2596388.948	1360.808	SPOT
6400	458254.759	2596421.656	1361.354	SPOT
6401	458256.07	2596457.752	1361.598	SPOT
6402	458257.966	2596496.235	1361.654	SPOT
6403	458257.737	2596531.061	1361.853	SPOT
6404	458259.896	2596562.939	1362.25	SPOT
6405	458259.128	2596577.567	1365.118	SPOT
6406	458259.501	2596585.505	1366.777	SPOT
6407	458259.865	2596590.955	1367.017	SPOT
6408	458261.894	2596606.76	1367.702	SPOT
6409	458264.565	2596622.127	1367.81	SPOT
6410	458303.996	2596601.365	1368.15	SPOT
6411	458304.792	2596583.24	1368.066	SPOT
6412	458303.901	2596571.775	1367.194	SPOT
6413	458303.273	2596559.177	1364.599	SPOT
6414	458302.947	2596548.524	1362.395	SPOT
6415	458301.625	2596540.316	1361.827	SPOT
6416	458301.811	2596503.358	1361.373	SPOT
6417	458299.044	2596469.466	1361.413	SPOT
6418	458296.939	2596427.352	1361.176	SPOT
6419	458297.014	2596390.927	1360.394	SPOT
6420	458294.925	2596314.938	1359.753	SPOT
6421	458293.789	2596275.912	1359.834	SPOT
6422	458294.821	2596240.826	1359.663	SPOT
6423	458294.848	2596203.932	1359.36	SPOT
6424	458337.336	2596204.032	1358.885	SPOT
6425	458338.425	2596246.666	1358.821	SPOT
6426	458337.66	2596284.406	1359.285	SPOT
6427	458337.658	2596321.138	1359.383	SPOT
6428	458337.802	2596360.223	1359.739	SPOT
6429	458337.124	2596396.707	1359.856	SPOT
6430	458338.13	2596435.865	1360.596	SPOT
6431	458339.415	2596475.659	1360.994	SPOT
6432	458340.357	2596513.673	1361.586	SPOT
6433	458342.307	2596536.819	1362.09	SPOT
6434	458344.268	2596548.163	1364.712	SPOT
6435	458345.043	2596558.976	1367.41	SPOT
6436	458346.94	2596572.071	1367.982	SPOT
6437	458348.295	2596585.868	1367.865	SPOT
6438	458381.973	2596576.533	1368.108	SPOT
6439	458381.605	2596561.11	1368.264	SPOT
6440	458381.67	2596548.362	1367.394	SPOT
6441	458381.167	2596536.308	1364.865	SPOT
6442	458380.87	2596525.602	1362.378	SPOT
6443	458380.853	2596519.568	1361.728	SPOT
6444	458382.035	2596486.013	1360.958	SPOT
6445	458380.629	2596449.382	1360.367	SPOT
6446	458378.379	2596411.995	1359.814	SPOT
6447	458380.471	2596374.208	1359.457	SPOT
6448	458378.835	2596333.57	1359.497	SPOT
6449	458376.734	2596291.97	1359.206	SPOT
6450	458375.232	2596263.354	1359.26	SPOT
6451	458379.525	2596225.282	1358.738	SPOT
6452	458379.586	2596197.778	1358.437	SPOT
6453	458414.33	2596201.757	1358.375	SPOT

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6454	458411.503	2596244.671	1358.686	SPOT
6455	458405.932	2596319.505	1359.203	SPOT
6456	458405.974	2596353.523	1359.393	SPOT
6457	458406.518	2596387.858	1359.399	SPOT
6458	458406.112	2596421.685	1360.154	SPOT
6459	458408.077	2596454.915	1360.355	SPOT
6460	458409.854	2596486.483	1360.946	SPOT
6461	458411.467	2596509.418	1362.134	SPOT
6462	458411.655	2596525.415	1365.145	SPOT
6463	458413.135	2596537.855	1367.798	SPOT
6464	458414.715	2596551.892	1368.537	SPOT
6465	458413.29	2596566.757	1368.48	SPOT
6466	458445.972	2596555.062	1368.67	SPOT
6467	458446.637	2596538.3	1368.774	SPOT
6468	458447.125	2596524.449	1368.426	SPOT
6469	458447.362	2596509.898	1365.734	SPOT
6470	458447.871	2596495.865	1362.349	SPOT
6471	458448.389	2596482.237	1361.371	SPOT
6472	458450.068	2596444.022	1360.476	SPOT
6473	458450.521	2596409.995	1360.219	SPOT
6474	458447.112	2596379.306	1359.575	SPOT
6475	458447.813	2596350.967	1359.234	SPOT
6476	458449.722	2596319.726	1358.853	SPOT
6477	458448.882	2596291.486	1358.61	SPOT
6478	458447.879	2596265.438	1358.682	SPOT
6479	458448.102	2596240.278	1358.645	SPOT
6480	458448.142	2596215.655	1358.218	SPOT
6481	458448.145	2596193.487	1357.734	SPOT
6482	458492.698	2596199.629	1357.839	SPOT
6483	458488.711	2596236.129	1358.155	SPOT
6484	458488.441	2596278.594	1358.331	SPOT
6485	458485.487	2596317.461	1358.727	SPOT
6486	458485.454	2596357.136	1359.062	SPOT
6487	458486.82	2596391.565	1359.928	SPOT
6488	458487.019	2596431.803	1360.66	SPOT
6489	458487.362	2596466.137	1362.144	SPOT
6490	458487.733	2596480.696	1364.569	SPOT
6491	458487.991	2596501.217	1368.164	SPOT
6492	458488.947	2596517.379	1368.924	SPOT
6493	458489.982	2596534.689	1368.738	SPOT
6494	458529.229	2596508.663	1368.881	SPOT
6495	458530.464	2596491.729	1368.986	SPOT
6496	458531.023	2596473.632	1368.294	SPOT
6497	458529.104	2596455.822	1365.712	SPOT
6498	458528.399	2596434.534	1361.744	SPOT
6499	458527.697	2596413.201	1360.752	SPOT
6500	458529.99	2596374.058	1359.962	SPOT
6501	458526.568	2596337.907	1359.062	SPOT
6502	458524.934	2596305.18	1358.887	SPOT
6503	458527.253	2596263.269	1358.2	SPOT
6504	458524.142	2596225.299	1357.896	SPOT
6505	458524.47	2596193.713	1357.582	SPOT
6506	458564.22	2596202.19	1357.526	SPOT
6507	458565.086	2596236.469	1357.805	SPOT
6508	458566.743	2596270.393	1358.1	SPOT
6509	458566.85	2596303.242	1358.286	SPOT
6510	458565.136	2596345.394	1359.216	SPOT
6511	458563.872	2596384.635	1360.421	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
6512	458564.919	2596397.099	1361.215	SPOT
6513	458564.731	2596415.199	1364.63	SPOT
6514	458565.266	2596431.238	1367.549	SPOT
6515	458565.304	2596440.781	1368.745	SPOT
6516	458564.813	2596462.145	1369.248	SPOT
6517	458563.771	2596481.17	1368.983	SPOT
6518	458565.033	2596489.23	1368.895	SPOT
6519	458598.6	2596448.48	1369.522	SPOT
6520	458599.541	2596423.401	1369.643	SPOT
6521	458601.861	2596400.196	1368.964	SPOT
6522	458601.669	2596386.64	1367.009	SPOT
6523	458601.751	2596370.415	1364.075	SPOT
6524	458601.202	2596352.358	1360.881	SPOT
6525	458600.754	2596330.756	1359.238	SPOT
6526	458602.541	2596294.488	1358.42	SPOT
6527	458603	2596263.514	1357.981	SPOT
6528	458603.319	2596230.69	1357.739	SPOT
6529	458601.502	2596198.732	1357.582	SPOT
6530	458635.558	2596200.344	1357.423	SPOT
6531	458633.057	2596239.37	1358.064	SPOT
6532	458634.122	2596260.33	1358.962	SPOT
6533	458634.687	2596279.831	1360.004	SPOT
6534	458637.493	2596297.831	1363.117	SPOT
6535	458636.438	2596319.072	1364.741	SPOT
6536	458634.793	2596340.632	1367.226	SPOT
6537	458634.995	2596353.712	1368.841	SPOT
6538	458634.864	2596361.503	1369.297	SPOT
6539	458633.99	2596380.761	1369.667	SPOT
6540	458635.911	2596398.809	1369.779	SPOT
6541	458636.936	2596411.941	1369.67	SPOT
6542	458655.393	2596387.416	1369.841	SPOT
6543	458653.928	2596381.429	1369.862	SPOT
6544	458654.111	2596346.988	1369.476	SPOT
6545	458655.488	2596316.809	1368.947	SPOT
6546	458655.89	2596292.444	1367.165	SPOT
6547	458656.447	2596262.897	1364.832	SPOT
6548	458655.571	2596235.243	1361.959	SPOT
6549	458654.655	2596198.073	1358.929	SPOT
6550	458674.41	2596201.131	1365.117	SPOT
6551	458672.166	2596234.547	1366.953	SPOT
6552	458668.014	2596261.06	1367.935	SPOT
6553	458669.302	2596276.349	1368.977	SPOT
6554	458678.51	2596281.369	1368.986	SPOT
6555	458693.275	2596288.267	1369.087	SPOT
6556	458701.872	2596260.387	1368.635	SPOT
6557	458709.665	2596225.801	1368.256	SPOT
6558	458717.41	2596190.583	1367.465	SPOT
6559	458702.714	2596187.667	1367.921	SPOT
6560	458695.214	2596224.22	1368.398	SPOT
6561	458684.071	2596267.43	1368.739	SPOT
6562	458673.672	2596262.514	1368.948	SPOT
6563	458681.023	2596231.39	1368.679	SPOT
6564	458688.912	2596192.419	1367.957	SPOT
6565	458691.432	2596299.119	1369.086	SPOT
6566	458680.743	2596329.837	1369.445	SPOT
6567	458667.037	2596359.734	1369.871	SPOT
6568	458661.686	2596329.181	1369.229	SPOT
6569	458672.262	2596304.923	1369.009	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
6570	458204.365	2596160.18	1367.827	SPOT
6571	458206.786	2596178.195	1363.646	SPOT
6572	458207.103	2596190.76	1361.221	SPOT
6573	458208.378	2596213.476	1360.782	SPOT
6574	458210.867	2596254.274	1360.669	SPOT
6575	458211.671	2596296.329	1361.25	SPOT
6576	458215.633	2596338.586	1360.636	SPOT
6577	458213.218	2596376.798	1360.795	SPOT
6578	458211.105	2596415.164	1361.107	SPOT
6579	458214.167	2596454.225	1361.494	SPOT
6580	458215.588	2596491.204	1362.108	SPOT
6581	458219.988	2596533.861	1362.245	SPOT
6582	458221.68	2596577.827	1362.527	SPOT
6583	458222.459	2596587.257	1364.76	SPOT
6584	458223.208	2596595.793	1366.595	SPOT
6585	458224.512	2596625.682	1367.079	SPOT
6586	458226.528	2596644.131	1367.323	SPOT
6587	458231.275	2596664.192	1367.305	SPOT
6588	458187.083	2596669.354	1367.455	SPOT
6589	458185.399	2596648.652	1366.951	SPOT
6590	458183.785	2596617.382	1366.374	SPOT
6591	458183.603	2596610.574	1366.037	SPOT
6592	458181.631	2596594.769	1361.634	SPOT
6593	458181.07	2596590.412	1360.969	SPOT
6594	458178.075	2596555.001	1361.394	SPOT
6595	458172.157	2596518.189	1361.794	SPOT
6596	458167.313	2596480.771	1362.106	SPOT
6597	458167.469	2596437.899	1362.469	SPOT
6598	458166.691	2596399.235	1362.077	SPOT
6599	458164.564	2596361.32	1361.838	SPOT
6600	458164.51	2596326.898	1361.367	SPOT
6601	458163.778	2596283.833	1361.25	SPOT
6602	458162.011	2596244.461	1361.485	SPOT
6603	458159.336	2596199.773	1362.211	SPOT
6604	458156.589	2596186.335	1365.37	SPOT
6605	458153.089	2596173.158	1368.779	SPOT
6606	458106.984	2596189.609	1368.013	SPOT
6607	458111.207	2596209.645	1362.575	SPOT
6608	458118.32	2596241.121	1362.081	SPOT
6609	458116.735	2596282.463	1361.749	SPOT
6610	458119.541	2596334.563	1361.401	SPOT
6611	458123.548	2596378.087	1361.165	SPOT
6612	458124.598	2596420.76	1360.301	SPOT
6613	458132.932	2596462.764	1360.055	SPOT
6614	458142.847	2596506.294	1359.561	SPOT
6615	458155.118	2596559.198	1359.154	SPOT
6616	458161.97	2596595.626	1359.278	SPOT
6617	458165.191	2596613.785	1363.868	SPOT
6618	458166.871	2596622.083	1366.262	SPOT
6619	458170.812	2596644.376	1366.825	SPOT
6620	458175.773	2596664.467	1367.213	SPOT
6621	458028.709	2595243.746	1367.836	SPOT
6622	458030.329	2595223.311	1367.975	SPOT
6623	458033.649	2595198.44	1367.623	SPOT
6624	458031.818	2595184.478	1367.137	SPOT
6625	458073.606	2595187.462	1366.92	SPOT
6626	458072.173	2595205.591	1367.13	SPOT
6627	458072.188	2595228.326	1367.917	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
6628	458070.417	2595250.302	1367.894	SPOT
6629	458111.714	2595270.359	1368.116	SPOT
6630	458115.71	2595244.708	1367.636	SPOT
6631	458114.964	2595213.975	1366.69	SPOT
6632	458113.334	2595193.986	1366.571	SPOT
6633	458112.845	2595186.775	1366.953	SPOT
6634	458152.449	2595195.282	1366.576	SPOT
6635	458152.267	2595224.207	1366.423	SPOT
6636	458150.285	2595250.832	1367.497	SPOT
6637	458151.121	2595277.543	1367.952	SPOT
6638	458188.508	2595292.298	1368.03	SPOT
6639	458191.615	2595258.064	1367.255	SPOT
6640	458191.332	2595228.598	1366.42	SPOT
6641	458189.813	2595210.274	1366.161	SPOT
6642	458190.767	2595195.04	1366.653	SPOT
6643	458239.053	2595197.358	1367.444	SPOT
6644	458238.102	2595217.84	1367.189	SPOT
6645	458237.405	2595247.806	1366.318	SPOT
6646	458236.221	2595277.459	1367.293	SPOT
6647	458233.452	2595306.541	1368.196	SPOT
6648	458274.723	2595327.18	1368.789	SPOT
6649	458274.559	2595297.771	1367.406	SPOT
6650	458277.528	2595268.816	1366.495	SPOT
6651	458279.385	2595239.339	1367.198	SPOT
6652	458280.431	2595208.915	1367.611	SPOT
6653	458279.642	2595197.71	1367.605	SPOT
6654	458320.237	2595199.025	1367.55	SPOT
6655	458320.301	2595225.255	1367.259	SPOT
6656	458320.044	2595257.723	1367.126	SPOT
6657	458318.513	2595289.425	1366.948	SPOT
6658	458316.924	2595318.565	1367.955	SPOT
6659	458316.656	2595330.818	1368.684	SPOT
6660	458348.281	2595351.95	1367.917	SPOT
6661	458347.833	2595325.446	1367.66	SPOT
6662	458347.582	2595284.736	1366.676	SPOT
6663	458348.303	2595250.902	1367.082	SPOT
6664	458349.352	2595228.484	1367.208	SPOT
6665	458349.98	2595201.006	1367.512	SPOT
6666	458387.485	2595202.767	1367.987	SPOT
6667	458387.44	2595230.995	1367.668	SPOT
6668	458387.574	2595262.121	1367.082	SPOT
6669	458388.78	2595295.956	1366.915	SPOT
6670	458388.185	2595327.792	1366.877	SPOT
6671	458387.731	2595359.287	1367.36	SPOT
6672	458423.54	2595384.434	1365.639	SPOT
6673	458423.579	2595359.909	1366.587	SPOT
6674	458423.232	2595325.771	1367.026	SPOT
6675	458423.4	2595289.746	1367.702	SPOT
6676	458423.762	2595256.893	1367.733	SPOT
6677	458425.666	2595227.122	1368.185	SPOT
6678	458426.91	2595203.644	1368.622	SPOT
6679	458476.423	2595203.771	1369.983	SPOT
6680	458473.718	2595233.085	1368.861	SPOT
6681	458472.629	2595267.334	1367.606	SPOT
6682	458470.866	2595303.399	1367.497	SPOT
6683	458468.377	2595336.143	1367.127	SPOT
6684	458467.611	2595366.193	1366.518	SPOT
6685	458465.109	2595400.682	1364.478	SPOT

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6686	458463.656	2595421.813	1363.475	SPOT
6687	458502.859	2595458.999	1363.173	SPOT
6688	458502.547	2595426.272	1364.178	SPOT
6689	458502.108	2595391.678	1366.148	SPOT
6690	458502.11	2595364.578	1367.774	SPOT
6691	458504.903	2595331.982	1367.986	SPOT
6692	458505.966	2595305.066	1368.303	SPOT
6693	458507.776	2595276.002	1368.521	SPOT
6694	458508.887	2595247.133	1369.457	SPOT
6695	458510.154	2595222.884	1370.166	SPOT
6696	458510.28	2595204.184	1370.89	SPOT
6697	458562.319	2595206.425	1373.305	SPOT
6698	458560.084	2595240.877	1371.959	SPOT
6699	458556.223	2595276.647	1370.714	SPOT
6700	458554.885	2595312.183	1369.277	SPOT
6701	458552.763	2595340.133	1369.142	SPOT
6702	458549.629	2595373.371	1367.741	SPOT
6703	458546.753	2595404.903	1365.82	SPOT
6704	458545.231	2595437.249	1364.546	SPOT
6705	458542.758	2595471.759	1363.542	SPOT
6706	458538.643	2595492.839	1362.541	SPOT
6707	458583.341	2595564.713	1361.79	SPOT
6708	458580.88	2595535.488	1362.182	SPOT
6709	458585.038	2595506.403	1363.35	SPOT
6710	458588.98	2595469.34	1365.33	SPOT
6711	458588.83	2595433.675	1366.743	SPOT
6712	458592.145	2595398.954	1368.525	SPOT
6713	458592.851	2595365.551	1370.092	SPOT
6714	458597.929	2595328.51	1371.583	SPOT
6715	458601.305	2595295.624	1373.144	SPOT
6716	458604.941	2595266.953	1374.495	SPOT
6717	458609.833	2595241.012	1375.13	SPOT
6718	458615.401	2595204.635	1375.611	SPOT
6719	458634.622	2595206.242	1375.645	SPOT
6720	458668.389	2595205.466	1376.282	SPOT
6721	458702.194	2595208.33	1377.53	SPOT
6722	458699.44	2595208.441	1376.672	SPOT
6723	458691.529	2595207.992	1376.295	SPOT
6724	458708.809	2595213.979	1377.398	SPOT
6725	458729.96	2595227.228	1376.711	SPOT
6726	458733.558	2595247.28	1377.003	SPOT
6727	458732.608	2595263.929	1377.269	SPOT
6728	458731.04	2595293.118	1377.712	SPOT
6729	458731.165	2595329.339	1377.553	SPOT
6730	458732.646	2595360.413	1377.547	SPOT
6731	458731.503	2595396.807	1377.799	SPOT
6732	458729.684	2595436.136	1377.545	SPOT
6733	458731.235	2595474.409	1377.184	SPOT
6734	458732.793	2595509.329	1376.193	SPOT
6735	458734.539	2595545.407	1374.929	SPOT
6736	458736.632	2595581.589	1373.222	SPOT
6737	458737.503	2595623.274	1371.38	SPOT
6738	458742.06	2595668.42	1369.003	SPOT
6739	458745.263	2595707.821	1367.253	SPOT
6740	458746.703	2595749.716	1365.294	SPOT
6741	458745.659	2595781.878	1364.449	SPOT
6742	458746.32	2595825.357	1364.223	SPOT
6743	458747.824	2595860.848	1363.789	SPOT

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6744	458750.485	2595895.079	1363.475	SPOT
6745	458753.098	2595931.314	1362.89	SPOT
6746	458754.274	2595955.797	1363.599	SPOT
6747	458755.555	2595972.751	1364.78	SPOT
6748	458745.117	2595944.906	1363.518	SPOT
6749	458742.34	2595916.908	1362.41	SPOT
6750	458742.069	2595895.562	1362.956	SPOT
6751	458740.519	2595859.193	1363.746	SPOT
6752	458737.495	2595812.365	1364.153	SPOT
6753	458736.466	2595768.015	1364.125	SPOT
6754	458734.378	2595732.992	1365.276	SPOT
6755	458731.873	2595700.614	1366.743	SPOT
6756	458730.765	2595665.643	1368.464	SPOT
6757	458728.341	2595634.201	1370.208	SPOT
6758	458725.828	2595596.342	1372.172	SPOT
6759	458724.287	2595560.347	1373.825	SPOT
6760	458721.658	2595525.342	1375.003	SPOT
6761	458720.316	2595488.229	1376.451	SPOT
6762	458718.907	2595449.638	1377.126	SPOT
6763	458717.933	2595409.899	1377.372	SPOT
6764	458720.279	2595370.933	1377.575	SPOT
6765	458720.063	2595337.454	1377.367	SPOT
6766	458717.362	2595302.006	1377.52	SPOT
6767	458715.62	2595267.214	1377.474	SPOT
6768	458707.625	2595230.194	1377.944	SPOT
6769	458658.946	2595224.431	1376.078	SPOT
6770	458663.484	2595269.873	1376.641	SPOT
6771	458670.365	2595306.116	1376.349	SPOT
6772	458673.01	2595348.228	1375.142	SPOT
6773	458675.231	2595394.485	1374.168	SPOT
6774	458680.064	2595438.126	1373.869	SPOT
6775	458681.077	2595474.851	1372.952	SPOT
6776	458683.235	2595510.222	1371.407	SPOT
6777	458683.238	2595551.419	1369.183	SPOT
6778	458689.066	2595593.404	1367.88	SPOT
6779	458692.031	2595633.343	1366.154	SPOT
6780	458695.292	2595675.604	1364.321	SPOT
6781	458701.209	2595713.864	1363.565	SPOT
6782	458708.806	2595753.351	1362.901	SPOT
6783	458653.804	2595674.303	1361.423	SPOT
6784	458654.448	2595642.503	1362.351	SPOT
6785	458655.179	2595604.971	1363.544	SPOT
6786	458654.537	2595553.497	1365.506	SPOT
6787	458653.475	2595517.343	1367.047	SPOT
6788	458652.098	2595483.459	1369.066	SPOT
6789	458651.295	2595446.172	1370.549	SPOT
6790	458649.217	2595413.36	1371.607	SPOT
6791	458650.228	2595376.562	1372.753	SPOT
6792	458647.049	2595343.447	1373.624	SPOT
6793	458643.233	2595302.467	1375.154	SPOT
6794	458639.6	2595250.502	1376.207	SPOT
6795	458620.256	2595278.613	1374.987	SPOT
6796	458617.216	2595318.846	1372.865	SPOT
6797	458617.714	2595359.692	1371.641	SPOT
6798	458617.332	2595400.96	1369.993	SPOT
6799	458617.762	2595448.316	1368.008	SPOT
6800	458616.234	2595491.825	1365.798	SPOT
6801	458617.104	2595534.852	1363.404	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
6802	458617.417	2595575.236	1362.852	SPOT
6803	458615.237	2595598.962	1361.872	SPOT
6804	458441.706	2595466.517	1359.457	DRN
6805	458442.781	2595454.158	1359.331	CMP B 18
6806	458453.063	2595432.037	1360.989	CMP E 18
6807	458442.638	2595454.615	1360.324	DRN B
6808	458439.293	2595481.917	1358.522	DRN
6809	458432.415	2595488.738	1357.713	DRN
6810	458431.859	2595489.22	1356.247	DRN
6811	458430.388	2595491.294	1354.315	DRN
6812	458429.769	2595491.859	1353.482	DRN
6813	458425.946	2595496.07	1354.003	DRN
6814	458424.902	2595495.963	1356.021	DRN
6815	458420.297	2595500.777	1355.606	DRN
6816	458417.981	2595502.826	1354.477	DRN
6817	458417.607	2595503.262	1353.906	DRN
6818	458416.179	2595504.633	1351.077	DRN
6819	458413.662	2595507.028	1351.148	DRN
6820	458411.419	2595510.467	1352.496	DRN
6821	458407.262	2595521.291	1350.631	DRN E
6822	458415.177	2595513.605	1352.576	SPOT
6823	458422.514	2595506.21	1355.115	SPOT
6824	458439.74	2595489.83	1359.256	SPOT
6825	458446.664	2595476.017	1360.598	SPOT
6826	458449.367	2595461.483	1361.859	SPOT
6827	458445.631	2595451.785	1362.127	SPOT
6828	458439.39	2595452.209	1361.976	SPOT
6829	458433.664	2595462.205	1361.185	SPOT
6830	458432.716	2595475.272	1359.813	SPOT
6831	458427.317	2595488.872	1357.633	SPOT
6832	458420.574	2595495.241	1356.442	SPOT
6833	458415.13	2595501.646	1354.582	SPOT
6834	458408.822	2595504.807	1353.06	SPOT
6835	458405.709	2595512.151	1351.543	SPOT
6836	458403.373	2595519.696	1350.548	SPOT
6837	458401.139	2595525.091	1350.086	SPOT
6838	458408.218	2595525.812	1350.371	SPOT
6839	458506.779	2595469.044	1363.085	CHK3
6839-1	458506.779	2595469.044	1363.085	CHK3
6840	457516.019	2596397.496	1292.23	SPOT
6841	457505.796	2596398.108	1291.161	SPOT
6842	457498.098	2596397.844	1289.411	SPOT
6843	457496.084	2596397.172	1288.026	SPOT
6844	457492.798	2596397.103	1286.097	SPOT
6845	457489.271	2596397.543	1284.913	SPOT
6846	457486.879	2596397.276	1284.526	SPOT
6847	457481.072	2596396.285	1284.924	SPOT
6848	457475.673	2596396.998	1284.788	SPOT CL
6849	457465.532	2596396.935	1284.903	SPOT
6850	457462.959	2596396.89	1284.119	SPOT
6851	457455.615	2596395.53	1284.085	SPOT
6852	457453.035	2596395.499	1285.033	SPOT
6853	457451.545	2596395.478	1286.483	SPOT
6854	457449.885	2596395.568	1287.122	SPOT
6855	457445.212	2596396.103	1288.869	SPOT
6856	457437.688	2596395.382	1291.4	SPOT
6857	457421.613	2596393.701	1293.374	SPOT
6858	457419.793	2596452.839	1292.198	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
6859	457429.73	2596452.453	1291.239	SPOT
6860	457444.655	2596452.67	1287.733	SPOT
6861	457453.449	2596452.843	1286.243	SPOT
6862	457454.994	2596453.074	1285.885	SPOT
6863	457455.742	2596453.022	1284.493	SPOT
6864	457462.057	2596453.757	1284.041	SPOT
6865	457464.72	2596453.95	1284.155	SPOT
6866	457469.788	2596453.641	1284.416	SPOT
6867	457475.411	2596453.277	1283.977	SPOT CL
6868	457482.08	2596453.132	1284.137	SPOT
6869	457490.996	2596453.413	1283.785	SPOT
6870	457494.858	2596453.35	1284.704	SPOT
6871	457496.046	2596453.381	1286.198	SPOT
6872	457504.11	2596452.285	1287.262	SPOT
6873	457516.273	2596450.95	1289.949	SPOT
6874	457530.226	2596449.574	1291.064	SPOT
6875	457525.896	2596509.742	1289.653	SPOT
6876	457513.863	2596509.868	1289.058	SPOT
6877	457503.919	2596509.831	1287.563	SPOT
6878	457494.193	2596509.869	1285.502	SPOT
6879	457490.684	2596509.517	1284.957	SPOT
6880	457489.52	2596509.102	1283.924	SPOT
6881	457486.05	2596508.729	1282.962	SPOT
6882	457479.995	2596508.355	1282.984	SPOT
6883	457475.905	2596508.436	1283.207	SPOT CL
6884	457471.529	2596507.786	1283.342	SPOT
6885	457466.096	2596507.254	1283.017	SPOT
6886	457460.17	2596505.913	1283.578	SPOT
6887	457452.436	2596504.054	1283.848	SPOT
6888	457451.349	2596503.673	1284.942	SPOT
6889	457440.863	2596500.752	1287.504	SPOT
6890	457432.789	2596498.598	1289.669	SPOT
6891	457407.325	2596491.762	1292.294	SPOT
6892	457397.433	2596548.23	1294.341	SPOT
6893	457406.938	2596550.032	1291.87	SPOT
6894	457421.438	2596552.82	1290.194	SPOT
6895	457433.84	2596556.311	1287.259	SPOT
6896	457440.766	2596557.415	1284.901	SPOT
6897	457443.558	2596558.034	1281.766	SPOT
6898	457454.973	2596560.974	1279.074	SPOT
6899	457461.929	2596562.376	1278.322	SPOT CL
6900	457449.526	2596559.65	1279.782	SPOT
6901	457469.372	2596563.384	1278.536	SPOT
6902	457475.743	2596564.327	1280.494	SPOT
6903	457476.62	2596564.604	1281.033	SPOT
6904	457477.84	2596565.016	1283.361	SPOT
6905	457480.902	2596566.004	1284.459	SPOT
6906	457486.538	2596566.976	1285.836	SPOT
6907	457492.768	2596569.471	1287.572	SPOT
6908	457508.638	2596573.542	1288.334	SPOT
6909	457498.165	2596622.905	1288.573	SPOT
6910	457489.318	2596620.274	1287.909	SPOT
6911	457483.432	2596618.638	1285.94	SPOT
6912	457472.894	2596614.773	1284.991	SPOT
6913	457467.963	2596613.566	1284.682	SPOT
6914	457465.981	2596613.367	1282.202	SPOT
6915	457462.535	2596611.845	1281.317	SPOT
6916	457456.161	2596610.066	1280.18	SPOT
6917	457448.503	2596608.109	1279.895	SPOT CL
6918	457442.173	2596606.164	1279.91	SPOT
6919	457436.121	2596605.025	1281.499	SPOT
6920	457434.995	2596604.516	1283.731	SPOT
6921	457430.434	2596603.669	1285.408	SPOT
6922	457420.249	2596601.851	1289.242	SPOT
6923	457401.186	2596597.43	1292.235	SPOT
6924	457383.104	2596590.956	1296.268	SPOT
6925	457369.98	2596635.286	1297.067	SPOT
6926	457385.784	2596638.662	1293.248	SPOT
6927	457405.081	2596644.401	1290.121	SPOT
6928	457412.892	2596646.864	1288.916	SPOT
6929	457415.153	2596647.999	1287.975	SPOT
6930	457415.791	2596648.143	1285.974	SPOT
6931	457418.87	2596648.923	1285.593	SPOT
6932	457420.102	2596649.401	1284.203	SPOT
6933	457422.47	2596650.875	1283.404	SPOT
6934	457423.628	2596651.247	1281.159	SPOT
6935	457431.59	2596652.049	1279.95	SPOT
6936	457437	2596653.529	1279.306	SPOT CL
6937	457445.423	2596655.345	1279.612	SPOT
6938	457455.177	2596656.67	1279.748	SPOT
6939	457461.036	2596657.225	1281.706	SPOT
6940	457465.085	2596658.239	1282.365	SPOT
6941	457466.766	2596658.746	1284.016	SPOT
6942	457475.311	2596661.657	1286.955	SPOT
6943	457488.591	2596665.833	1287.172	SPOT
6944	457484.06	2596705.415	1286.655	SPOT
6945	457470.428	2596703.126	1286.04	SPOT
6946	457454.881	2596701.268	1284.525	SPOT
6947	457448.21	2596700.155	1283.623	SPOT
6948	457446.813	2596700.013	1282.617	SPOT
6949	457446.146	2596699.998	1282.378	SPOT
6950	457442.532	2596699.846	1280.535	SPOT
6951	457438.459	2596699.191	1279.96	SPOT
6952	457432.912	2596698.047	1279.726	SPOT CL
6953	457428.104	2596696.799	1279.92	SPOT
6954	457423.137	2596697.054	1280.482	SPOT
6955	457421.54	2596696.543	1283.047	SPOT
6956	457419.127	2596695.798	1283.552	SPOT
6957	457415.79	2596694.791	1285.201	SPOT
6958	457403.03	2596690.777	1288.378	SPOT
6959	457387.645	2596685.98	1287.598	SPOT
6960	457385.95	2596685.34	1286.674	SPOT
6961	457384.965	2596685.231	1286.551	SPOT
6962	457383.405	2596684.932	1287.672	SPOT
6963	457374.908	2596684.587	1288.892	SPOT
6964	457364.486	2596681.462	1291.797	SPOT
6965	457351.963	2596801.614	1289.201	SPOT
6966	457365.201	2596803.413	1288.723	SPOT
6967	457375.684	2596805.256	1287.767	SPOT
6968	457385.8	2596806.401	1285.669	SPOT
6969	457389.077	2596806.871	1281.367	SPOT
6970	457392.254	2596807.511	1279.927	SPOT
6971	457396.525	2596807.673	1279.493	SPOT
6972	457404.137	2596808.349	1279.98	SPOT CL
6973	457410.174	2596809.274	1280.179	SPOT
6974	457414.873	2596809.543	1281.861	SPOT
6975	457415.734	2596809.647	1282.893	SPOT
6976	457419.067	2596810.185	1283.469	SPOT
6977	457436.793	2596811.647	1284.062	SPOT
6978	457445.851	2596812.369	1286.727	SPOT
6979	457452.492	2596812.295	1288.087	SPOT
6980	457464.275	2596813.5	1288.921	SPOT
6981	457450.065	2596858.112	1290.611	SPOT
6982	457446.797	2596857.94	1289.733	SPOT
6983	457437.693	2596857.24	1287.435	SPOT
6984	457427.398	2596855.982	1284.433	SPOT
6985	457414.769	2596854.443	1283.673	SPOT
6986	457413.51	2596854.496	1283.697	SPOT
6987	457412.203	2596854.566	1282.612	SPOT
6988	457410.772	2596854.327	1281.986	SPOT
6989	457408.816	2596854.486	1281.428	SPOT
6990	457402.727	2596853.403	1280.04	SPOT
6991	457397.326	2596852.438	1279.874	SPOT CL
6992	457392.219	2596851.963	1279.482	SPOT
6993	457384.638	2596850.011	1281.075	SPOT
6994	457383.906	2596849.675	1282.12	SPOT
6995	457382.648	2596849.436	1284.174	SPOT
6996	457375.152	2596849.39	1286.112	SPOT
6997	457367.761	2596847.968	1288.056	SPOT
6998	457354.09	2596844.467	1288.967	SPOT
6999	457337.373	2596841.689	1289.324	SPOT
7000	457335.423	2596897.192	1290.757	SPOT
7001	457351.786	2596904.64	1288.787	SPOT
7002	457359.625	2596907.559	1286.07	SPOT
7003	457362.365	2596909.084	1283.432	SPOT
7004	457365.527	2596910.446	1282.018	SPOT
7005	457371.326	2596912.929	1281.129	SPOT
7006	457375.13	2596914.669	1281.004	SPOT CL
7007	457378.503	2596916.45	1281.276	SPOT
7008	457386.699	2596921.154	1281.998	SPOT
7009	457389.759	2596923.158	1283.941	SPOT
7010	457398.711	2596925.312	1283.723	SPOT
7011	457414.668	2596932.112	1284.371	SPOT
7012	457423.971	2596935.981	1286.276	SPOT
7013	457381.869	2597019.391	1283.441	SPOT
7014	457369.266	2597014.046	1283.18	SPOT
7015	457361.707	2597010.274	1282.57	SPOT
7016	457352.366	2597005.534	1283.047	SPOT
7017	457345.472	2597003.086	1282.591	SPOT
7018	457343.728	2597002.334	1281.173	SPOT
7019	457337.463	2596999.301	1280.746	SPOT
7020	457332.44	2596997.191	1279.385	SPOT
7021	457323.062	2596993.744	1276.87	SPOT CL
7022	457313.445	2596989.36	1276.768	SPOT
7023	457307.359	2596986.441	1277.958	SPOT
7024	457304.603	2596984.741	1279.261	SPOT
7025	457302.688	2596983.885	1280.147	SPOT
7026	457299.813	2596981.96	1281.926	SPOT
7027	457297.479	2596979.807	1284.357	SPOT
7028	457292.889	2596976.764	1287.424	SPOT
7029	457282.695	2596967.215	1288.302	SPOT
7030	458742.183	2595951.838	1364.114	CHK HECP2
7030-1	458742.183	2595951.838	1364.114	CHK HECP2
7031	457468.435	2597479.321	1288.777	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
7032	457455.96	2597492.543	1288.384	SPOT
7033	457453.284	2597495.373	1287.409	SPOT
7034	457445.432	2597503.669	1286.003	SPOT
7035	457441.725	2597506.968	1283.499	SPOT
7036	457438.495	2597509.288	1280.353	SPOT
7037	457431.298	2597516.737	1278.968	SPOT
7038	457429.629	2597518.354	1278.548	SPOT
7039	457425.753	2597521.649	1278.298	SPOT
7040	457419.171	2597526.227	1277.654	SPOT CL
7041	457416.916	2597527.993	1277.465	SPOT
7042	457412.609	2597531.278	1276.979	SPOT
7043	457411.311	2597532.699	1277.354	SPOT
7044	457409.946	2597534.36	1278.039	SPOT
7045	457408.9	2597535.528	1280.31	SPOT
7046	457399.368	2597543.213	1281.547	SPOT
7047	457385.239	2597555.522	1281.644	SPOT
7048	457627.215	2597909.309	1285.547	SPOT
7049	457598.412	2597918.86	1285.365	SPOT
7050	457585.986	2597921.976	1285.087	SPOT
7051	457582.752	2597922.659	1284.519	SPOT
7052	457579.559	2597923.623	1283.229	SPOT
7053	457573.22	2597925.421	1280.822	SPOT
7054	457570.824	2597926.087	1279.626	SPOT
7055	457569.47	2597926.491	1276.91	SPOT
7056	457565.629	2597927.609	1276.973	SPOT
7057	457560.098	2597928.14	1275.185	SPOT
7058	457554.24	2597929.807	1273.941	SPOT CL
7059	457548.203	2597931.116	1275.401	SPOT
7060	457543.127	2597933.17	1276.027	SPOT
7061	457540.107	2597933.868	1277.795	SPOT
7062	457538.004	2597934.438	1279.74	SPOT
7063	457533.482	2597936.864	1280.85	SPOT
7064	457527.581	2597937.876	1282.897	SPOT
7065	457511.232	2597945.348	1283.528	SPOT
7066	457488.81	2598386.844	1283.013	SPOT
7067	457506.948	2598385.463	1283.001	SPOT
7068	457514.228	2598385.235	1282.567	SPOT
7069	457518.805	2598384.705	1280.949	SPOT
7070	457522.601	2598384.301	1279.113	SPOT
7071	457524.862	2598384.237	1277.639	SPOT
7072	457527.768	2598383.973	1273.811	SPOT
7073	457537.368	2598382.448	1270.358	SPOT
7074	457547.789	2598381.361	1269.63	SPOT
7075	457558.224	2598380.92	1272.397	SPOT CL
7076	457570.704	2598379.583	1275.377	SPOT
7077	457580.59	2598379.274	1274.418	SPOT
7078	457586.074	2598379.263	1276.298	SPOT
7079	457588.965	2598379.967	1276.561	SPOT
7080	457590.16	2598380.144	1279.128	SPOT
7081	457592.223	2598380.171	1279.64	SPOT
7082	457603.511	2598379.405	1279.908	SPOT
7083	457621.955	2598377.235	1282.623	SPOT
7084	457793.772	2598471.228	1281.628	SPOT
7085	457790.954	2598487.067	1280.456	SPOT
7086	457788.804	2598499.826	1279.355	SPOT
7087	457787.934	2598504.259	1278.853	SPOT
7088	457786.142	2598515.009	1278.309	SPOT
7089	457785.848	2598517.219	1276.581	SPOT
7090	457786.247	2598520.818	1275.441	SPOT
7091	457785.183	2598527.801	1274.329	SPOT
7092	457783.753	2598534.639	1274.756	SPOT CL
7093	457782.738	2598541.863	1275.572	SPOT
7094	457781.473	2598549.389	1276.151	SPOT
7095	457781.483	2598549.757	1277.815	SPOT
7096	457781.137	2598553.319	1278.687	SPOT
7097	457780.274	2598564.959	1279.483	SPOT
7098	457779.747	2598583.268	1281.69	SPOT
7099	457777.639	2598597.989	1282.044	SPOT
7100	457780.596	2599083.334	1277.941	SPOT
7101	457799.438	2599081.732	1277.301	SPOT
7102	457800.388	2599081.713	1276.831	SPOT
7103	457819.092	2599080.208	1275.905	SPOT
7104	457822.737	2599080.015	1274.971	SPOT
7105	457825.161	2599079.843	1274.525	SPOT
7106	457827.287	2599079.649	1274.115	SPOT
7107	457828.095	2599079.874	1273.297	SPOT
7108	457831.614	2599080.8	1271.744	SPOT
7109	457838.518	2599081.713	1271.109	SPOT
7110	457844.767	2599082.856	1269.881	SPOT CL
7111	457851.706	2599084.219	1271.181	SPOT
7112	457860.347	2599085.143	1272.081	SPOT
7113	457865.771	2599087.07	1272.419	SPOT
7114	457867.032	2599087.099	1274.185	SPOT
7115	457870.319	2599087.841	1274.702	SPOT
7116	457875.048	2599089.174	1275.849	SPOT
7117	457880.504	2599090.504	1277.62	SPOT
7118	457902.239	2599095.372	1279.237	SPOT
7119	458047.722	2599413.945	1281.401	SPOT
7120	458036.347	2599421.699	1277.138	SPOT
7121	458020.391	2599432.174	1276.454	SPOT
7122	458013.942	2599436.01	1274.565	SPOT
7123	458010.1	2599438.401	1272.315	SPOT
7124	458008.53	2599440.017	1271.089	SPOT
7125	458003.903	2599444.366	1272.586	SPOT
7126	457998.248	2599447.721	1270.646	SPOT
7127	457993.794	2599451.169	1271.151	SPOT CL
7128	457986.708	2599455.67	1270.094	SPOT
7129	457979.412	2599460.285	1269.646	SPOT
7130	457976.816	2599461.746	1271.191	SPOT
7131	457975.22	2599463.205	1272.994	SPOT
7132	457974.45	2599463.792	1273.486	SPOT
7133	457972.264	2599465.404	1274.312	SPOT
7134	457967.213	2599469.033	1275.961	SPOT
7135	457957.026	2599477.396	1277.521	SPOT
7136	457943.577	2599487.214	1277.456	SPOT
7137	458126.932	2599811.202	1279.726	SPOT
7138	458132.351	2599806.647	1278.54	SPOT
7139	458140.473	2599799.418	1274.959	SPOT
7140	458144.464	2599795.319	1275.078	SPOT
7141	458148.088	2599792.22	1275.606	SPOT
7142	458153.039	2599787.185	1275.12	SPOT
7143	458157.631	2599782.611	1273.128	SPOT
7144	458159.331	2599781.153	1271.876	SPOT
7145	458160.056	2599780.349	1270.581	SPOT
7146	458162.076	2599778.72	1270.092	SPOT
7147	458165.508	2599775.497	1269.787	SPOT
7148	458169.389	2599772.382	1269.448	SPOT CL
7149	458174.298	2599768.325	1270.194	SPOT
7150	458179.045	2599764.507	1270.062	SPOT
7151	458181.426	2599762.806	1270.386	SPOT
7152	458182.959	2599761.476	1271.309	SPOT
7153	458185.183	2599759.52	1272.092	SPOT
7154	458191.083	2599755.246	1272.498	SPOT
7155	458194.316	2599751.813	1274.272	SPOT
7156	458201.143	2599745.052	1275.066	SPOT
7157	458211.609	2599735.072	1275.995	SPOT
7158	458332.343	2600109.672	1272.937	SPOT
7159	458350.848	2600090.635	1272.826	SPOT
7160	458355.219	2600087.666	1271.558	SPOT
7161	458358.81	2600085.121	1268.328	SPOT
7162	458361.175	2600083.459	1268.072	SPOT
7163	458366.064	2600079.962	1267.343	SPOT
7164	458372.787	2600074.172	1267.038	SPOT CL
7165	458379.242	2600069.059	1267.256	SPOT
7166	458382.945	2600064.942	1267.851	SPOT
7167	458384.435	2600062.632	1266.968	SPOT
7168	458385.699	2600061.63	1269.062	SPOT
7169	458393.798	2600056.515	1270.376	SPOT
7170	458409.474	2600043.887	1271.832	SPOT
7171	458424.462	2600032.551	1273.622	SPOT
7172	458372.161	2600387.461	1271.397	SPOT
7173	458390.409	2600383.345	1271.654	SPOT
7174	458395.164	2600382.485	1270.846	SPOT
7175	458401.759	2600381.146	1268.611	SPOT
7176	458410.954	2600378.887	1267.89	SPOT
7177	458413.688	2600378.243	1266.579	SPOT
7178	458415.221	2600377.608	1265.078	SPOT
7179	458417.273	2600377.581	1264.42	SPOT
7180	458424.087	2600376.043	1264.001	SPOT
7181	458431.332	2600373.848	1261.804	SPOT CL
7182	458438.928	2600371.807	1262.919	SPOT
7183	458446.557	2600369.753	1263.789	SPOT
7184	458448.505	2600369.406	1265.767	SPOT
7185	458462.933	2600367.694	1266.907	SPOT
7186	458469.683	2600366.77	1268.846	SPOT
7187	458485.413	2600363.646	1270.141	SPOT
7188	458805.154	2600481.486	1267.385	SPOT
7189	458806.505	2600485.9	1267.241	SPOT
7190	458808.612	2600491.607	1265.211	SPOT
7191	458814.156	2600505.165	1264.826	SPOT
7192	458820.66	2600521.474	1263.744	SPOT
7193	458821.516	2600523.585	1263.471	SPOT
7194	458821.852	2600524.489	1261.445	SPOT
7195	458823.644	2600526.988	1259.713	SPOT
7196	458826.011	2600533.47	1259.552	SPOT
7197	458830.35	2600542.441	1258.994	SPOT CL
7198	458833.961	2600551.55	1259.542	SPOT
7199	458837	2600560.008	1259.948	SPOT
7200	458838.301	2600562.658	1261.575	SPOT
7201	458838.337	2600563.412	1263.19	SPOT
7202	458840.494	2600569.357	1264.694	SPOT
7203	458842.881	2600576.37	1265.94	SPOT
7204	458843.701	2600578.277	1266.692	SPOT
7205	458846.3	2600586.439	1267.796	SPOT

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7206	458850.936	2600597.363	1268.604	SPOT
7207	458859.117	2600625.995	1271.005	SPOT
7208	459149.629	2600914.725	1264.355	SPOT
7209	459166.646	2600909.543	1264.244	SPOT
7210	459174.787	2600906.814	1263.24	SPOT
7211	459179.926	2600905.24	1261.807	SPOT
7212	459185.503	2600903.555	1261.055	SPOT
7213	459189.25	2600902.375	1259.635	SPOT
7214	459191.431	2600901.763	1256.573	SPOT
7215	459193.8	2600901.27	1256.534	SPOT
7216	459200.128	2600899.933	1255.659	SPOT CL
7217	459208.622	2600897.308	1256.522	SPOT
7218	459212.739	2600896.987	1257.103	SPOT
7219	459214.385	2600896.515	1257.744	SPOT
7220	459215.484	2600896.101	1259.403	SPOT
7221	459224.646	2600893.499	1260.423	SPOT
7222	459242.549	2600889.441	1263.126	SPOT
7223	459263.988	2600884.312	1266.225	SPOT
7224	459216.66	2601371.423	1262.329	SPOT
7225	459247.461	2601370.05	1262.98	SPOT
7226	459255.607	2601369.517	1259.22	SPOT
7227	459268.394	2601369.45	1257.788	SPOT
7228	459271.433	2601369.59	1257.038	SPOT
7229	459275.001	2601369.714	1255.838	SPOT
7230	459280.242	2601369.573	1256.106	SPOT
7231	459287.169	2601368.832	1256.014	SPOT CL
7232	459294.482	2601367.904	1255.351	SPOT
7233	459304.53	2601367.548	1255.128	SPOT
7234	459306.053	2601367.494	1256.693	SPOT
7235	459307.175	2601367.571	1258.922	SPOT
7236	459317.545	2601366.771	1261.428	SPOT
7237	459340.873	2601367.274	1262.439	SPOT
7238	458961.565	2601463.155	1257.288	SPOT
7239	458963.428	2601474.834	1256.778	SPOT
7240	458963.364	2601481.836	1255.024	SPOT
7241	458965.396	2601499.205	1254.436	SPOT
7242	458965.723	2601501.401	1253.148	SPOT
7243	458966.411	2601505.543	1252.217	SPOT
7244	458966.357	2601509.723	1252.416	SPOT CL
7245	458966.458	2601514.812	1251.821	SPOT
7246	458965.848	2601519.471	1252.891	SPOT
7247	458966.087	2601520.8	1253.905	SPOT
7248	458966.344	2601525.15	1254.738	SPOT
7249	458966.23	2601527.939	1256.194	SPOT
7250	458965.443	2601539.526	1257.748	SPOT
7251	458584.886	2601685.669	1255.872	SPOT
7252	458566.344	2601688.184	1255.225	SPOT
7253	458562.454	2601688.753	1254.782	SPOT
7254	458559.502	2601689.113	1253.25	SPOT
7255	458555.498	2601689.624	1251.569	SPOT
7256	458550.993	2601689.861	1250.796	SPOT
7257	458549.924	2601689.963	1248.594	SPOT
7258	458546.213	2601690.545	1248.175	SPOT
7259	458540.888	2601690.872	1247.616	SPOT
7260	458536.479	2601690.876	1247.159	SPOT CL
7261	458531.931	2601690.884	1247.496	SPOT
7262	458525.334	2601690.598	1249.358	SPOT
7263	458521.009	2601690.957	1249.891	SPOT

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7264	458519.75	2601690.962	1250.96	SPOT
7265	458510.082	2601691.455	1251.759	SPOT
7266	458497.37	2601690.475	1252.163	SPOT
7267	458485.099	2601689.915	1257.184	SPOT
7268	458523.951	2601690.535	1249.725	SPOT
7269	458527.573	2601691.014	1248.563	SPOT
7270	458585.729	2602095.444	1253.358	SPOT
7271	458571.488	2602093.625	1251.885	SPOT
7272	458563.315	2602092.458	1249.484	SPOT
7273	458560.377	2602092.25	1248.356	SPOT
7274	458557.846	2602092.037	1247.19	SPOT
7275	458555.122	2602091.668	1245.66	SPOT
7276	458548.906	2602091.62	1245.27	SPOT
7277	458542.69	2602091.34	1245.029	SPOT CL
7278	458534.764	2602091.159	1245.834	SPOT
7279	458530.239	2602091.048	1246.163	SPOT
7280	458527.683	2602090.837	1246.848	SPOT
7281	458526.55	2602090.555	1248.685	SPOT
7282	458521.981	2602090.349	1249.048	SPOT
7283	458513.489	2602089.73	1252.315	SPOT
7284	458496.749	2602088.841	1253.062	SPOT
7285	458390.807	2602557.567	1251.056	SPOT
7286	458379.804	2602555.284	1249.316	SPOT
7287	458364.252	2602551.713	1246.46	SPOT
7288	458348.11	2602548.075	1246.13	SPOT
7289	458341.174	2602546.531	1246.046	SPOT
7290	458340.053	2602546.36	1245.4	SPOT
7291	458337.978	2602545.777	1244.409	SPOT
7292	458337.341	2602545.836	1244.14	SPOT
7293	458335.146	2602545.49	1243.134	SPOT
7294	458312.722	2602539.097	1244.56	SPOT
7295	458310.723	2602538.323	1247.713	SPOT
7296	458299.047	2602537.104	1252.083	SPOT
7297	458290.818	2602536.216	1257.481	SPOT
7298	458312.851	2602539.409	1243.865	SPOT
7299	458319.215	2602541.601	1242.776	SPOT
7300	458327.112	2602543.759	1241.765	SPOT CL
7301	458505.639	2602953.719	1248.748	SPOT
7302	458496.816	2602954.791	1248.217	SPOT
7303	458493.206	2602955.1	1247.144	SPOT
7304	458486.62	2602955.898	1245.51	SPOT
7305	458482.515	2602956.321	1244.707	SPOT
7306	458481.834	2602956.308	1243.713	SPOT
7307	458476.155	2602957.192	1242.573	SPOT
7308	458474.923	2602957.213	1241.409	SPOT
7309	458474.18	2602957.329	1240.54	SPOT
7310	458469.357	2602958.33	1239.72	SPOT
7311	458464.123	2602959.75	1239.314	SPOT CL
7312	458457.749	2602961.235	1240.134	SPOT
7313	458451.376	2602961.377	1241.476	SPOT
7314	458446.617	2602963.015	1242.324	SPOT
7315	458432.107	2602967.117	1244.122	SPOT
7316	458428.31	2602967.15	1246.035	SPOT
7317	458135.892	2602932.517	1248.675	SPOT
7318	458134.004	2602956.692	1248.239	SPOT
7319	458133.373	2602965.128	1247.55	SPOT
7320	458132.558	2602984.108	1243.28	SPOT
7321	458132.22	2602995.534	1240.502	SPOT

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7322	458131.672	2603002.536	1239.517	SPOT
7323	458130.866	2603008.4	1238.328	SPOT
7324	458130.629	2603011.756	1238.329	SPOT CL
7325	458128.772	2603018.288	1238.661	SPOT
7326	458128.962	2603026.213	1239.842	SPOT
7327	458127.555	2603036.531	1241.371	SPOT
7328	458126.294	2603045.512	1243.483	SPOT
7329	458125.281	2603050.715	1245.096	SPOT
7330	458123.597	2603064.615	1245.364	SPOT
7331	457653.44	2602987.234	1246.847	SPOT
7332	457666.404	2603012.321	1246.204	SPOT
7333	457668.596	2603016.799	1244.551	SPOT
7334	457671.731	2603022.187	1240.424	SPOT
7335	457673.852	2603026.519	1239.326	SPOT
7336	457681.462	2603040.323	1238.217	SPOT
7337	457684.016	2603045.109	1237.646	SPOT
7338	457685.613	2603049.61	1237.324	SPOT
7339	457687.662	2603054.25	1237.697	SPOT CL
7340	457689.214	2603061.713	1237.899	SPOT
7341	457692.533	2603067.561	1238.44	SPOT
7342	457696.547	2603075.211	1241.448	SPOT
7343	457699.074	2603079.428	1243.997	SPOT
7344	457708.76	2603096.872	1244.58	SPOT
7345	435160.277	2654875.62	1104.661	CHK HECP8
7346	442363.647	2665162.699	980.286	RD B
7347	442420.136	2665161.541	976.434	RD
7348	442481.132	2665159.872	972.222	RD
7349	442541.26	2665158.076	968.652	RD
7350	442602.348	2665156.041	965.89	RD
7351	442662.449	2665154.803	964.081	RD
7352	442723.537	2665153.256	962.911	RD
7353	442785.008	2665152.078	962.298	RD
7354	442844.891	2665150.53	962.146	RD
7355	442901.128	2665148.92	962.327	RD
7356	442958.906	2665147.549	962.575	RD
7357	443014.624	2665145.648	962.809	RD
7358	443064.18	2665144.145	962.889	RD
7359	443116.81	2665143.07	963.028	RD
7360	443170.076	2665142.089	963.368	RD
7361	443224.491	2665141.595	965.547	RD
7362	443277.079	2665140.478	968.977	RD
7363	443333.058	2665140.701	973.509	RD
7364	443396.465	2665139.115	978.707	RD
7365	443459.236	2665138.273	983.279	RD
7366	443519.283	2665136.059	987.008	RD
7367	443577.768	2665131.517	989.531	RD E
7368	443062.625	2665155.75	962.573	BR B
7369	443116.96	2665155.64	961.076	PIER B
7370	443118.386	2665155.626	961.072	PIER
7371	443184.662	2665168.392	959.368	WING B
7372	443171.06	2665155.014	962.499	WING E ABUT B
7373	443172.767	2665152.912	962.766	BR
7374	443171.935	2665127.041	962.802	BR
7375	443170.311	2665125.059	962.473	WING B ABUT E
7376	443183.712	2665111.577	959.299	WING E
7377	443170.342	2665126.545	960.854	LB
7378	443117.435	2665127.922	961.059	PIER
7379	443116.048	2665127.885	961.082	PIER CLOSE

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7380	443116.613	2665127.92	961.049	LB
7381	443063.756	2665129.402	960.765	LB
7382	443049.845	2665114.755	959.769	WING B
7383	443063.617	2665127.966	962.411	WING E ABUT B
7384	443064.95	2665157.913	962.405	WING B ABUT E
7385	443052.382	2665172.171	959.686	WING E
7386	443061.878	2665130.122	962.619	BR CLOSE
7387	443043.637	2665034.232	954.135	SPOT
7388	443068.376	2665030.33	953.938	SPOT
7389	443075.978	2665029.041	953.474	SPOT
7390	443082.163	2665028.284	952.251	SPOT
7391	443083.612	2665028.249	949.964	SPOT
7392	443087.306	2665028.785	948.447	SPOT
7393	443089.193	2665028.513	946.222	SPOT
7394	443090.44	2665028.296	944.484	SPOT
7395	443107.898	2665029.562	943.261	SPOT CL
7396	443116.124	2665029.31	943.329	SPOT
7397	443122.622	2665028.78	944.354	SPOT
7398	443128.226	2665029.7	944.525	SPOT
7399	443100.915	2665029.219	943.273	SPOT
7400	443094.033	2665028.879	943.362	SPOT
7401	443129.241	2665029.967	945.78	SPOT
7402	443133.281	2665029.801	948.515	SPOT
7403	443157.626	2665030.118	948.793	SPOT
7404	443175.703	2665029.987	949.784	SPOT
7405	443169.412	2665029.199	949.114	SPOT
7406	443055.642	2665278.717	948.229	SPOT
7407	443071.049	2665278.248	947.794	SPOT
7408	443086.539	2665278.284	946.8	SPOT
7409	443093.056	2665278.469	946.392	SPOT
7410	443095.41	2665278.435	944.83	SPOT
7411	443096.632	2665278.539	943.852	SPOT
7412	443100.103	2665278.143	943.716	SPOT
7413	443106.875	2665278.332	942.077	SPOT
7414	443113.109	2665277.574	942.118	SPOT CL
7415	443120.838	2665277.323	942.111	SPOT
7416	443128.873	2665276.824	942.073	SPOT
7417	443134.491	2665277.931	943.508	SPOT
7418	443136.312	2665277.056	945.373	SPOT
7419	443138.485	2665276.46	947.003	SPOT
7420	443139.98	2665276.756	949.432	SPOT
7421	443152.583	2665276.55	950.455	SPOT
7422	443182.147	2665277.092	951.61	SPOT
7423	443206.767	2665276.812	951.141	SPOT
7424	443063.764	2665129.446	950.641	H20 Opening
7425	443068.247	2665129.297	949.98	H20 Opening
7426	443070.975	2665129.265	947.206	H20 Opening
7427	443074.291	2665129.215	945.092	H20 Opening
7428	443078.489	2665129.156	943.89	H20 Opening
7429	443084.53	2665128.854	942.838	H20 Opening
7430	443095.859	2665128.458	942.523	H20 Opening
7431	443104.098	2665128.253	943.545	H20 Opening
7432	443112.001	2665127.979	942.65	H20 Opening
7433	443121.172	2665127.84	943.934	H20 Opening
7434	443125.558	2665127.571	947.89	H20 Opening
7435	443130.94	2665127.445	948.153	H20 Opening
7436	443138.298	2665127.449	946.949	H20 Opening
7437	443144.655	2665127.149	947.114	H20 Opening

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7438	443150.782	2665126.948	948.103	H20 Opening
7439	443156.838	2665126.94	948.315	H20 Opening
7440	443164.26	2665126.691	948.629	H20 Opening
7441	443169.979	2665126.432	949.814	H20 Opening
7442	444143.686	2670265.891	956.116	RD B
7443	444081.719	2670261.801	955.357	RD
7444	444024.59	2670258.165	954.612	RD
7445	443963.598	2670254.42	953.91	RD
7446	443900.981	2670249.831	953.124	RD
7447	443843.104	2670246.336	952.476	RD
7448	443783.004	2670242.412	952.047	RD
7449	443724.407	2670238.81	951.584	RD
7450	443666.04	2670234.703	951.577	RD
7451	443608.355	2670230.908	951.657	RD
7452	443548.868	2670227.141	952.055	RD
7453	443480.735	2670222.786	952.49	RD
7454	443421.657	2670219.097	952.862	RD
7455	443362.547	2670215.983	953.51	RD
7456	443307.287	2670213.517	954.527	RD
7457	443242.022	2670210.996	955.415	RD E
7458	443731.551	2670270.361	948.334	WING B
7459	443739.087	2670259.289	951.274	WING E ABUT B
7460	443737.527	2670257.731	951.501	BR B
7461	443760.896	2670223.172	951.565	BR
7462	443764.104	2670221.664	951.424	WING B ABUT E
7463	443770.673	2670211.786	948.456	WING E
7464	443811.986	2670225.405	949.16	PIER B
7465	443811.294	2670225.376	949.154	LB
7466	443861.257	2670228.52	949.627	LB
7467	443862.012	2670228.701	949.628	PIER1 B
7468	443918.145	2670220.333	949.725	WING B
7469	443911.475	2670230.23	952.776	WING E ABUT B
7470	443912.063	2670233.01	952.914	BR
7471	443889.134	2670267.415	952.621	BR CLOSE
7472	443885.77	2670269.054	952.628	ABUT E WING B
7473	443879.031	2670278.975	949.476	WING E
7474	443838.257	2670264.737	949.429	PIER1 E
7475	443910.178	2670231.848	950.22	LB
7476	443788.489	2670261.574	949.051	PIER E
7477	443763.633	2670222.14	948.878	LB
7478	443909.423	2670087.99	937.355	SPOT
7479	443896.829	2670075.065	937.614	SPOT
7480	443914.899	2670094.828	937.169	SPOT
7481	443919.444	2670100.215	935.96	SPOT
7482	443922.336	2670102.631	931.121	SPOT
7483	443924.138	2670104.507	929.818	SPOT
7484	443926.922	2670107.937	929.014	SPOT
7485	443930.169	2670112.338	929.012	SPOT
7486	443934.621	2670117.677	929.026	SPOT CL
7487	443938.907	2670122.483	929.228	SPOT
7488	443942.822	2670127.017	929.236	SPOT
7489	443947.26	2670132.088	929.21	SPOT
7490	443948.359	2670133.05	931.746	SPOT
7491	443952.189	2670138.391	933.68	SPOT
7492	443964.86	2670154.051	935.229	SPOT
7493	443967.843	2670157.771	938.708	SPOT
7494	443973.436	2670164.653	942.696	SPOT
7495	443815.559	2670225.941	929.765	H20 Opening

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
7496	443824.144	2670226.984	929.33	H20 Opening
7497	443833.359	2670227.766	929.979	H20 Opening
7498	443847.066	2670227.763	929.324	H20 Opening
7499	443857.276	2670228.553	929.637	H20 Opening
7500	443674.684	2670343.168	938.319	SPOT
7501	443689.935	2670348.71	937.711	SPOT
7502	443700.677	2670353.215	936.053	SPOT
7503	443707.705	2670356.702	933.611	SPOT
7504	443713.702	2670359.724	931.19	SPOT
7505	443715.678	2670360.69	930.154	SPOT
7506	443717.182	2670361.429	929.519	SPOT
7507	443721.784	2670363.126	928.966	SPOT
7508	443727.508	2670365.069	927.729	SPOT
7509	443732.95	2670367.01	928.269	SPOT CL
7510	443740.269	2670370.345	928.488	SPOT
7511	443750.519	2670373.869	928.548	SPOT
7512	443751.846	2670374.635	930.642	SPOT
7513	443754.522	2670376.001	931.867	SPOT
7514	443757.968	2670377.694	933.076	SPOT
7515	443764.106	2670380.63	932.94	SPOT
7516	443769.835	2670383.798	936.335	SPOT
7517	443777.175	2670387.601	939.011	SPOT
7518	443784.338	2670390.98	940.432	SPOT
7519	443791.798	2670394.996	944.625	SPOT
7520	443808.615	2670403.33	948.829	SPOT
7521	443820.939	2670408.622	949.217	SPOT
7522	443910.122	2670231.733	945.336	H20 Opening
7523	443903.287	2670231.295	944.563	H20 Opening
7524	443896.631	2670230.692	942.185	H20 Opening
7525	443886.32	2670230.143	938.133	H20 Opening
7526	443873.944	2670229.257	934.18	H20 Opening
7527	443866.86	2670228.781	932.707	H20 Opening
7528	443864.442	2670228.319	930.499	H20 Opening
7529	443808.578	2670225.111	930.984	H20 Opening
7530	443802.508	2670224.483	933.318	H20 Opening
7531	443794.316	2670224.6	934.983	H20 Opening
7532	443781.957	2670223.345	939.108	H20 Opening
7533	443774.39	2670222.806	941.258	H20 Opening
7534	443769.61	2670222.55	943.826	H20 Opening
7535	443763.78	2670221.949	943.79	H20 Opening
7536	458192.838	2596616.09	1366.651	CHK HECP 1
7537	457415.796	2596218.15	1315.015	SB 6
7538	457589.636	2596172.982	1327.02	SB 5
7539	458356.986	2596060.357	1356.737	SB 1
7540	457586.315	2596058.971	1367.492	SB 4
7541	458147.134	2596243.631	1361.644	SB 2
7542	458249.401	2596557.896	1362	SB 3
7543	457579.519	2596055.588	1371.023	POST TOP
7544	457592.26	2596055.197	1370.925	POST TOP
7545	457592.109	2596054.757	1368.25	GROUND AT POST
7546	457586.163	2596054.991	1368.272	SPOT AT GUARDRAIL
7547	457579.54	2596054.952	1368.447	GROUND AT POST
7548	457585.965	2596055.021	1370.569	TOP GUARDRAIL
7549	457585.993	2596052.617	1368.824	EDGE PAVEMENT
7550	457586.048	2596055.001	1369.894	BOTTOM GUARDRAIL
7551	456999.38	2603666.592	1245.009	SPOT
7552	456985.339	2603662.896	1243.977	SPOT

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7553	456976.002	2603659.57	1239.552	SPOT
7554	456968.131	2603657.144	1238.645	SPOT
7555	456963.835	2603655.702	1238.249	SPOT
7556	456962.481	2603655.272	1236.654	SPOT
7557	456961.615	2603654.991	1235.68	SPOT
7558	456958.094	2603654.038	1234.823	SPOT
7559	456953.695	2603652.941	1234.578	SPOT
7560	456949.721	2603651.191	1235.385	SPOT CL
7561	456943.755	2603649.244	1234.876	SPOT
7562	456939.031	2603648.15	1234.877	SPOT
7563	456936.136	2603647.665	1235.719	SPOT
7564	456934.978	2603647.568	1237.638	SPOT
7565	456932.966	2603646.987	1238.542	SPOT
7566	456924.575	2603645.924	1239.639	SPOT
7567	456913.283	2603643.68	1240.286	SPOT
7568	456896.428	2603640.721	1240.635	SPOT
7569	456630.843	2603840.105	1241.61	SPOT
7570	456649.238	2603842.833	1241.836	SPOT
7571	456651.795	2603843.273	1241.058	SPOT
7572	456653.198	2603843.466	1240.581	SPOT
7573	456654.347	2603843.645	1239.598	SPOT
7574	456657.981	2603844.22	1235.855	SPOT
7575	456659.795	2603844.445	1235.16	SPOT
7576	456660.821	2603844.54	1234.636	SPOT
7577	456665.345	2603845.079	1234.174	SPOT
7578	456672.876	2603847.688	1232.994	SPOT CL
7579	456679.23	2603849.24	1233.543	SPOT
7580	456685.67	2603851.273	1233.528	SPOT
7581	456688.545	2603851.504	1234.414	SPOT
7582	456691.276	2603853.006	1237.997	SPOT
7583	456699.486	2603853.768	1238.107	SPOT
7584	456711.778	2603855.17	1239.071	SPOT
7585	456697.492	2603853.835	1237.895	SPOT
7586	456194.881	2603943.496	1240.405	SPOT
7587	456194.381	2603952.568	1240.131	SPOT
7588	456194.042	2603957.996	1238.527	SPOT
7589	456193.468	2603962.311	1236.443	SPOT
7590	456193.262	2603967	1235.903	SPOT
7591	456192.15	2603975.168	1234.796	SPOT
7592	456191.445	2603979.507	1233.574	SPOT
7593	456190.978	2603982.807	1233.006	SPOT
7594	456191.034	2603986.825	1232.473	SPOT
7595	456191.169	2603992.395	1232.174	SPOT
7596	456183.026	2604092.233	1258.974	SPOT
7597	456182.899	2604085.768	1246.728	SPOT
7598	456184.074	2604075.738	1246.465	SPOT
7599	456184.986	2604065.543	1242.565	SPOT
7600	456186.014	2604054.867	1237.948	SPOT
7601	456187.01	2604052.26	1234.912	SPOT
7602	456187.607	2604049.395	1234.857	SPOT
7603	456188.441	2604045.425	1235.451	SPOT
7604	456189.81	2604030.964	1235.635	SPOT
7605	456190.914	2604022.472	1234.741	SPOT
7606	456191.505	2604019.626	1233.373	SPOT
7607	456191.52	2604017.978	1232.674	SPOT
7608	456191.432	2604000.516	1229.678	SPOT CL
7609	456191.662	2604008.505	1230.383	SPOT
7610	456191.478	2604014.698	1231.347	SPOT

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7611	455875.072	2604240.69	1237.486	SPOT
7612	455865.103	2604209.234	1237.76	SPOT
7613	455858.926	2604186.509	1237.772	SPOT
7614	455858.203	2604184.344	1235.13	SPOT
7615	455857.789	2604181.829	1232.393	SPOT
7616	455856.581	2604176.823	1232.103	SPOT
7617	455840.837	2604085.077	1237.528	SPOT
7618	455843.909	2604104.499	1236.922	SPOT
7619	455845.518	2604115.383	1235.204	SPOT
7620	455849.004	2604135.803	1235.155	SPOT
7621	455850.621	2604145.05	1234.516	SPOT
7622	455850.967	2604146.999	1233.654	SPOT
7623	455852.676	2604155.436	1232.476	SPOT
7624	455853.554	2604160.307	1232.189	SPOT
7625	455855.778	2604169.066	1231.612	SPOT CL
7626	455558.098	2604514.489	1239.405	SPOT
7627	455549.326	2604501.727	1237.652	SPOT
7628	455545.108	2604494.838	1234.857	SPOT
7629	455542.171	2604490.821	1231.46	SPOT
7630	455535.33	2604480.061	1231.879	SPOT
7631	455532.649	2604475.961	1230.914	SPOT
7632	455531.68	2604474.083	1230.281	SPOT
7633	455530.838	2604472.235	1229.531	SPOT
7634	455527.92	2604468.683	1227.902	SPOT
7635	455523.556	2604462.561	1225.065	SPOT CL
7636	455519	2604454.664	1224.563	SPOT
7637	455516.09	2604449.646	1225.325	SPOT
7638	455514.111	2604446.192	1228.748	SPOT
7639	455513.137	2604444.803	1230.169	SPOT
7640	455512.611	2604443.092	1231.884	SPOT
7641	455509.441	2604436.748	1233.811	SPOT
7642	455503.476	2604426.642	1235.287	SPOT
7643	455490.307	2604402.944	1235.816	SPOT
7644	455148.839	2604696.88	1233.493	SPOT
7645	455165.053	2604706.722	1234.13	SPOT
7646	455172.752	2604711.37	1234.604	SPOT
7647	455174.627	2604712.516	1234.635	SPOT
7648	455175.326	2604713.076	1233.839	SPOT
7649	455177.822	2604714.604	1233.22	SPOT
7650	455179.258	2604715.756	1228.018	SPOT
7651	455180.831	2604716.12	1227.483	SPOT
7652	455182.066	2604717.295	1226.698	SPOT
7653	455186.985	2604720.067	1225.285	SPOT
7654	455192.757	2604722.683	1225.661	SPOT CL
7655	455198.591	2604725.322	1226.623	SPOT
7656	455204.91	2604728.357	1227.37	SPOT
7657	455206.947	2604729.527	1227.772	SPOT
7658	455211.345	2604732.169	1229.139	SPOT
7659	455229.653	2604745.525	1229.679	SPOT
7660	455244.474	2604754.054	1231.01	SPOT
7661	455262.445	2604764.886	1231.157	SPOT
7662	455269.005	2604768.543	1231.66	SPOT
7663	454489.775	2605979.1	1231.575	SPOT
7664	454479.223	2605985.297	1230.824	SPOT
7665	454474.457	2605987.944	1230.191	SPOT
7666	454467.103	2605991.979	1228.721	SPOT
7667	454457.569	2605997.567	1227.695	SPOT
7668	454449.744	2606002.227	1226.049	SPOT

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7669	454443.507	2606005.624	1225.336	SPOT
7670	454442.179	2606006.478	1223.672	SPOT
7671	454440.295	2606007.639	1222.737	SPOT
7672	454439.589	2606008.082	1221.54	SPOT
7673	454437.695	2606009.2	1219.182	SPOT
7674	454433.992	2606011.262	1219.336	SPOT
7675	454429.467	2606013.563	1221.06	SPOT CL
7676	454424.202	2606016.277	1222.008	SPOT
7677	454419.771	2606019.023	1222.468	SPOT
7678	454418.653	2606020.005	1223.16	SPOT
7679	454416.663	2606021.088	1224.107	SPOT
7680	454409.91	2606025.309	1225.293	SPOT
7681	454399.26	2606032.659	1227.009	SPOT
7682	454380.363	2606045.92	1227.966	SPOT
7683	452866.364	2612602.348	1193.041	SPOT
7684	452848.785	2612592.526	1191.271	SPOT
7685	452840.232	2612588.217	1190.704	SPOT
7686	452836.054	2612585.743	1189.094	SPOT
7687	452830.913	2612583.183	1189.694	SPOT
7688	452821.638	2612577.506	1190.205	SPOT
7689	452809.333	2612570.576	1190.498	SPOT
7690	452805.88	2612568.737	1190.228	SPOT
7691	452803.186	2612567.018	1189.638	SPOT
7692	452801.426	2612566.145	1188.327	SPOT
7693	452800.178	2612565.587	1187.743	SPOT
7694	452718.858	2612517.011	1190.194	SPOT
7695	452730.142	2612524.386	1191.09	SPOT
7696	452745.231	2612533.646	1191.305	SPOT
7697	452760.278	2612542.468	1192.452	SPOT
7698	452762.006	2612543.27	1191.701	SPOT
7699	452763.896	2612544.503	1190.878	SPOT
7700	452765.28	2612545.611	1188.997	SPOT
7701	452795.147	2612562.813	1187.32	SPOT
7702	452789.263	2612558.979	1187.202	SPOT
7703	452782.721	2612555.503	1186.969	SPOT CL
7704	452775.731	2612551.074	1187.551	SPOT
7705	452767.434	2612546.537	1187.503	SPOT
7706	452766.539	2612546.007	1187.909	SPOT
7707	453110.864	2612899.706	1195.574	SPOT
7708	453098.839	2612905.163	1193.425	SPOT
7709	453088.939	2612909.159	1192.262	SPOT
7710	453082.319	2612911.386	1192.169	SPOT
7711	453072.981	2612915.153	1192.427	SPOT
7712	453071.392	2612915.622	1192.314	SPOT
7713	453070.297	2612916.141	1191.5	SPOT
7714	453066.773	2612917.525	1189.053	SPOT
7715	453064.903	2612918.42	1187.818	SPOT
7716	453061.332	2612919.769	1187.69	SPOT
7717	453059.048	2612921.232	1187.238	SPOT
7718	453057.962	2612921.627	1186.836	SPOT
7719	453056.779	2612922.198	1185.32	SPOT
7720	453055.291	2612923.295	1184.223	SPOT
7721	453049.582	2612924.635	1182.242	SPOT
7722	452992.55	2612942.768	1190.19	SPOT
7723	452999.748	2612940.816	1189.165	SPOT
7724	453010.664	2612938.141	1188.259	SPOT
7725	453018.348	2612936.047	1188.136	SPOT
7726	453022.133	2612934.925	1187.91	SPOT

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7727	453023.688	2612934.583	1187.191	SPOT
7728	453025.611	2612934.021	1186.683	SPOT
7729	453027.038	2612933.811	1185.709	SPOT
7730	453043.308	2612927.533	1182.486	SPOT CL
7731	453037.738	2612929.251	1183.605	SPOT
7732	453032.788	2612931.91	1184.534	SPOT
7733	453028.615	2612933.599	1185.008	SPOT
7734	452910.177	2613020.174	1214.388	BULKHEAD B
7735	452904.574	2613047.707	1215.041	BULKHEAD E
7736	452820.906	2613015.729	1219.483	RAIL B
7737	452865.414	2613025.386	1219.226	RAIL
7738	452906.853	2613034.172	1218.8	RAIL
7739	452909.777	2613030.336	1218.755	PIER1 B
7740	452907.947	2613039.39	1218.786	PIER1 E
7741	452920.216	2613042.081	1218.639	PIER2 B
7742	452922.204	2613032.673	1218.64	PIER2 E
7743	452909.913	2613029.412	1216.506	LB
7744	452907.737	2613039.935	1216.444	LB
7745	452919.934	2613042.549	1216.267	LB
7746	452921.885	2613032.14	1216.444	LB
7747	452931.111	2613039.576	1218.553	RAIL
7748	452933.624	2613044.927	1218.529	PIER3 B
7749	452933.43	2613045.565	1216.219	LB
7750	452935.683	2613035.719	1218.501	PIER3 E
7751	452935.613	2613035.015	1216.204	LB
7752	452948.28	2613043.204	1218.422	RAIL
7753	452949.118	2613038.307	1218.359	PIER4 B
7754	452949.141	2613037.881	1216.142	LB
7755	452947.223	2613047.92	1218.409	PIER4 E
7756	452947.208	2613048.239	1216.13	LB
7757	452962.341	2613041.256	1218.25	PIER5 B
7758	452962.011	2613040.98	1215.96	LB
7759	452962.73	2613046.339	1218.25	RAIL
7760	452960.621	2613050.846	1218.328	PIER5 E
7761	452960.595	2613051.153	1216.001	LB
7762	452974.984	2613049.17	1218.178	RAIL
7763	452975.944	2613044.222	1218.163	PIER6 B
7764	452975.855	2613043.905	1215.897	LB
7765	452973.888	2613053.715	1218.168	PIER6 E
7766	452973.798	2613054.131	1215.9	LB
7767	452989.349	2613047.245	1218.061	PIER7 B
7768	452989.092	2613046.73	1215.79	LB
7769	452987.356	2613056.742	1218.104	PIER7 E
7770	452987.247	2613056.993	1215.794	LB
7771	453002.583	2613049.934	1217.972	PIER8 B
7772	453002.382	2613049.756	1215.698	LB
7773	453001.033	2613059.381	1217.971	PIER8 E
7774	453000.794	2613059.777	1215.66	LB
7775	453015.865	2613053.163	1217.874	PIER9 B
7776	453015.99	2613052.575	1215.557	LB
7777	453014.207	2613062.471	1217.838	PIER9 E
7778	453014.138	2613062.892	1215.59	LB
7779	453027.403	2613060.512	1217.783	RAIL
7780	453029.504	2613055.816	1217.744	PIER10 B
7781	453029.239	2613055.617	1215.497	LB
7782	453027.577	2613065.535	1217.736	PIER10 E
7783	453027.687	2613065.877	1215.457	LB
7784	453042.353	2613058.665	1217.673	PIER11 B
7785	453042.574	2613058.541	1215.347	LB
7786	453041.23	2613068.146	1217.645	PIER11 E
7787	453041.148	2613068.556	1215.378	LB
7788	453056.365	2613061.726	1217.572	PIER12 B
7789	453056.299	2613061.299	1215.288	LB
7790	453054.205	2613071.135	1217.568	PIER12 E
7791	453053.987	2613071.447	1215.275	LB
7792	453062.81	2613067.976	1217.45	RAIL
7793	453067.608	2613074.175	1217.443	PIER13 B
7794	453069.73	2613064.732	1217.409	PIER13 E
7795	453069.632	2613064.337	1215.136	LB
7796	453067.527	2613074.203	1215.159	LB
7797	453081.035	2613077.032	1217.327	PIER14 B
7798	453081.085	2613077.384	1215.066	LB
7799	453082.882	2613067.494	1217.323	PIER14 E
7800	453082.985	2613067.193	1215.026	LB
7801	453095.292	2613070.155	1217.211	PIER15 B
7802	453095.289	2613070.028	1214.95	LB
7803	453093.383	2613079.742	1217.175	PIER15 E
7804	453093.381	2613080.382	1214.891	LB
7805	453095.432	2613075.146	1217.097	RAIL
7806	453093.092	2613088.551	1213.546	BULKHEAD B
7807	453098.376	2613061.665	1213.32	BULKHEAD E
7808	453119.04	2613080.373	1216.725	RAIL
7809	453164.588	2613090.323	1216.553	RAIL
7810	453202.126	2613098.387	1216.256	RAIL E
7811	453096.319	2613061.447	1210.669	SPOT
7812	453094.756	2613066.405	1211.767	SPOT
7813	453085.151	2613063.389	1210.429	SPOT
7814	453077.266	2613061.098	1209.018	SPOT
7815	453070.882	2613059.204	1207.09	SPOT
7816	453065.317	2613057.182	1204.448	SPOT
7817	453062.292	2613056.037	1202.871	SPOT
7818	453047.302	2613052.608	1189.104	SPOT
7819	453040.372	2613049.847	1186.472	SPOT
7820	453036.248	2613048.277	1185.457	SPOT
7821	453033.636	2613047.846	1185.212	SPOT
7822	453022.143	2613046.097	1184.464	SPOT
7823	453008.588	2613043.303	1184.366	SPOT
7824	452994.406	2613039.301	1184.396	SPOT
7825	452981.779	2613036.905	1183.84	SPOT
7826	452969.317	2613034.482	1185.25	SPOT
7827	452968.028	2613033.048	1185.457	SPOT
7828	452963.932	2613032.321	1186.317	SPOT
7829	452944.018	2613030.763	1195.831	SPOT
7830	452933.664	2613028.071	1202.182	SPOT
7831	452923.647	2613026.766	1207.292	SPOT
7832	452912.954	2613025.778	1211.635	SPOT
7833	452992.344	2613262.728	1216.301	SPOT
7834	452999.593	2613252.448	1213.366	SPOT
7835	453005.153	2613243.376	1210.003	SPOT
7836	453012.886	2613232.679	1204.251	SPOT
7837	453021.494	2613221.885	1200.114	SPOT
7838	453026.794	2613214.449	1196.844	SPOT
7839	453033.092	2613205.754	1193.741	SPOT
7840	453035.109	2613202.993	1193.28	SPOT
7841	453036.569	2613200.823	1192.618	SPOT
7842	453038.039	2613199.429	1187.247	SPOT
7843	453039.017	2613196.994	1184.666	SPOT
7844	453042.634	2613191.803	1183.614	SPOT
7845	453044.938	2613187.029	1183.265	SPOT
7846	453046.833	2613182.906	1183.632	SPOT CL
7847	453048.743	2613177.631	1183.629	SPOT
7848	453053.09	2613167.144	1186.923	SPOT
7849	453056.272	2613160.062	1187.969	SPOT
7850	453065.449	2613147.573	1188.368	SPOT
7851	453069.304	2613138.383	1189.202	SPOT
7852	453073.558	2613128.877	1190.119	SPOT
7853	453052.388	2613168.207	1185.189	SPOT
7854	453052.073	2613169.071	1184.14	SPOT
7855	453384.766	2613377.03	1190.801	SPOT
7856	453386.883	2613382.362	1190.43	SPOT
7857	453388.255	2613387.139	1189.356	SPOT
7858	453389.915	2613394.899	1187.511	SPOT
7859	453391.537	2613401.259	1187.449	SPOT
7860	453392.858	2613405.006	1186.595	SPOT
7861	453393.531	2613405.876	1185.102	SPOT
7862	453393.761	2613406.681	1184.713	SPOT
7863	453394.922	2613410.832	1184.121	SPOT
7864	453407.496	2613474.31	1193.689	SPOT
7865	453402.442	2613452.713	1194.577	SPOT
7866	453400.807	2613445.141	1193.996	SPOT
7867	453400.033	2613441.614	1191.916	SPOT
7868	453400.303	2613443.076	1193.186	SPOT
7869	453398.072	2613438.73	1187.123	SPOT
7870	453397.49	2613436.009	1185.84	SPOT
7871	453397.565	2613435.333	1185.355	SPOT
7872	453397.774	2613433.911	1184.96	SPOT
7873	453397.373	2613430.822	1183.62	SPOT
7874	453396.919	2613427.778	1182.227	SPOT
7875	453395.716	2613424.537	1180.232	SPOT CL
7876	453396.493	2613420.799	1181.452	SPOT
7877	453395.487	2613415.718	1182.685	SPOT
7878	453881.072	2613448.618	1185.495	SPOT
7879	453887.365	2613439.859	1185.682	SPOT
7880	453894.099	2613430.343	1185.31	SPOT
7881	453896.466	2613427.407	1184.621	SPOT
7882	453897.929	2613425.397	1184.302	SPOT
7883	453900.436	2613421.938	1183.646	SPOT
7884	453900.128	2613422.388	1183.71	SPOT
7885	453901.692	2613419.928	1179.989	SPOT
7886	453938.385	2613367.031	1192.305	SPOT
7887	453932.662	2613374.443	1191.266	SPOT
7888	453929.213	2613379.906	1189.606	SPOT
7889	453924.625	2613385.155	1188.898	SPOT
7890	453920.745	2613390.799	1188.39	SPOT
7891	453919.434	2613392.938	1187.65	SPOT
7892	453918.928	2613393.625	1187.242	SPOT
7893	453917.271	2613395.658	1184.689	SPOT
7894	453915.115	2613398.757	1183.319	SPOT
7895	453913.604	2613401.165	1182.773	SPOT
7896	453912.944	2613401.951	1182.133	SPOT
7897	453912.66	2613402.569	1181.47	SPOT
7898	453903.574	2613416.952	1178.53	SPOT
7899	453905.371	2613414.194	1178.26	SPOT
7900	453907.243	2613411.273	1178.37	SPOT CL

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
7901	453909.386	2613407.551	1179.101	SPOT
7902	453911.917	2613404.392	1180.416	SPOT
7903	453716.952	2613818.367	1187.5	SPOT
7904	453721.666	2613822.937	1186.28	SPOT
7905	453730.495	2613830.539	1186.384	SPOT
7906	453737.075	2613837.24	1185.391	SPOT
7907	453745.994	2613846.796	1185.163	SPOT
7908	453750.39	2613851.165	1184.988	SPOT
7909	453755.97	2613856.616	1183.513	SPOT
7910	453756.952	2613857.432	1183.199	SPOT
7911	453757.918	2613858.452	1181.978	SPOT
7912	453759.403	2613859.573	1181.062	SPOT
7913	453761.547	2613861.178	1180.081	SPOT
7914	453764.363	2613863.472	1179.339	SPOT
7915	453814.116	2613913.329	1191.326	SPOT
7916	453801.998	2613898.863	1190.357	SPOT
7917	453799.801	2613896.346	1189.406	SPOT
7918	453797.232	2613893.813	1187.672	SPOT
7919	453793.534	2613890.189	1184.529	SPOT
7920	453791.041	2613887.428	1183.181	SPOT
7921	453787.261	2613884.01	1182.661	SPOT
7922	453783.558	2613880.378	1181.919	SPOT
7923	453783.099	2613879.785	1180.71	SPOT
7924	453767.931	2613866.205	1178.073	SPOT
7925	453771.614	2613869.415	1177.341	SPOT CL
7926	453775.561	2613873.391	1177.549	SPOT
7927	453778.816	2613876.537	1178.544	SPOT
7928	453782.158	2613878.773	1180.435	SPOT
7929	453385.595	2614076.75	1187.837	SPOT
7930	453383.751	2614070.827	1187.657	SPOT
7931	453381.973	2614066.57	1186.835	SPOT
7932	453380.566	2614062.682	1185.899	SPOT
7933	453379.097	2614059.484	1184.906	SPOT
7934	453376.821	2614052.848	1184.508	SPOT
7935	453376.306	2614051.051	1183.908	SPOT
7936	453374.958	2614047.441	1180.839	SPOT
7937	453372.665	2614042.386	1179.678	SPOT
7938	453371.215	2614038.711	1179.614	SPOT
7939	453368.974	2614034.908	1180.089	SPOT
7940	453368.842	2614034.629	1180.006	SPOT
7941	453368.74	2614034.087	1178.73	SPOT
7942	453367.799	2614032.761	1178.209	SPOT
7943	453366.546	2614029.4	1177.895	SPOT
7944	453364.98	2614025.689	1177.532	SPOT
7945	453340.045	2613963.737	1184.808	SPOT
7946	453345.095	2613975.035	1184.263	SPOT
7947	453349.507	2613986.994	1183.648	SPOT
7948	453353.002	2613997.682	1183.172	SPOT
7949	453353.518	2613999.189	1181.588	SPOT
7950	453353.649	2614000.905	1181.302	SPOT
7951	453353.782	2614001.801	1179.074	SPOT
7952	453363.204	2614021.774	1177.263	SPOT CL
7953	453359.986	2614014.71	1177.828	SPOT
7954	453357.287	2614009.344	1177.499	SPOT
7955	453354.439	2614003.866	1178.283	SPOT
7956	452982.673	2614292.509	1185.6	SPOT
7957	452968.889	2614283.051	1185.628	SPOT
7958	452957.916	2614273.553	1185.647	SPOT

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7959	452956.214	2614271.91	1184.36	SPOT
7960	452953.546	2614269.455	1183.115	SPOT
7961	452952.83	2614268.689	1182.773	SPOT
7962	452950.552	2614266.958	1180.466	SPOT
7963	452945.996	2614262.096	1180.089	SPOT
7964	452942.603	2614258.722	1179.905	SPOT
7965	452941.594	2614257.921	1179.545	SPOT
7966	452940.531	2614256.928	1178.119	SPOT
7967	452939.363	2614256.461	1177.83	SPOT
7968	452935.991	2614254.16	1177.203	SPOT
7969	452930.191	2614249.534	1176.47	SPOT CL
7970	452923.412	2614242.835	1176.284	SPOT
7971	452916.653	2614237.362	1176.546	SPOT
7972	452915.932	2614236.841	1177.616	SPOT
7973	452913.861	2614235.566	1181.621	SPOT
7974	452908.605	2614230.733	1182.74	SPOT
7975	452892.878	2614217.92	1185.517	SPOT
7976	452910.255	2614233.332	1182.682	SPOT
7977	452684.643	2614562.996	1183.412	SPOT
7978	452665.589	2614552.248	1183.313	SPOT
7979	452659.574	2614549.082	1182.308	SPOT
7980	452654.17	2614546.097	1181.871	SPOT
7981	452651.202	2614544.195	1181.024	SPOT
7982	452648.31	2614542.934	1180.22	SPOT
7983	452645.427	2614541.513	1179.47	SPOT
7984	452644.09	2614541.087	1179.012	SPOT
7985	452643.139	2614540.624	1177.719	SPOT
7986	452642.598	2614540.252	1176.54	SPOT
7987	452638.482	2614538.226	1176.19	SPOT
7988	452587.712	2614514.486	1186.501	SPOT
7989	452582.191	2614511.653	1187.901	SPOT
7990	452593.021	2614516.89	1184.926	SPOT
7991	452597.313	2614519.146	1182.815	SPOT
7992	452603.848	2614521.895	1180.967	SPOT
7993	452607.634	2614523.618	1179.975	SPOT
7994	452609.338	2614524.441	1179.332	SPOT
7995	452609.847	2614524.696	1177.965	SPOT
7996	452632.613	2614534.854	1176.787	SPOT
7997	452627.317	2614532.065	1175.461	SPOT CL
7998	452621.203	2614529.472	1175.136	SPOT
7999	452616.858	2614527.589	1175.545	SPOT
8000	452612.321	2614526.119	1176.98	SPOT
8001	450603.803	2622026.736	1128.038	SPOT
8002	450607.646	2622028.175	1127.146	SPOT
8003	450612.182	2622030.328	1125.658	SPOT
8004	450619.172	2622033.022	1125.521	SPOT
8005	450622.338	2622034.169	1124.802	SPOT
8006	450626.982	2622036.467	1122.813	SPOT
8007	450630.714	2622038.21	1121.493	SPOT
8008	450632.392	2622038.541	1119.043	SPOT
8009	450634.792	2622039.616	1117.528	SPOT
8010	450637.587	2622040.844	1116.579	SPOT
8011	450642.785	2622042.977	1116.005	SPOT CL
8012	450647.026	2622043.895	1116.387	SPOT
8013	450654.052	2622047.171	1118.326	SPOT
8014	450655.567	2622048.391	1119.11	SPOT
8015	450656.856	2622049.239	1120.349	SPOT
8016	450662.762	2622051.675	1122.2	SPOT

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8017	450664.427	2622052.703	1123.947	SPOT
8018	450684.327	2622063.513	1124.411	SPOT
8019	451013.643	2621921.28	1126.186	SPOT
8020	451024.942	2621932.687	1126.335	SPOT
8021	451033.296	2621943.386	1125.544	SPOT
8022	451038.135	2621949.383	1124.908	SPOT
8023	451038.915	2621950.331	1124.22	SPOT
8024	451040.995	2621952.179	1120.546	SPOT
8025	451043.26	2621954.422	1119.057	SPOT
8026	451045.201	2621956.462	1118.547	SPOT
8027	451049.529	2621961.241	1118.24	SPOT
8028	451078.194	2621997.985	1123.115	SPOT
8029	451070.408	2621988.021	1122.85	SPOT
8030	451064.822	2621981.13	1122.35	SPOT
8031	451062.288	2621978.054	1121.248	SPOT
8032	451060.834	2621976.251	1120.291	SPOT
8033	451060.014	2621974.77	1119.593	SPOT
8034	451052.57	2621965.905	1119.183	SPOT
8035	451057.099	2621971.778	1118.649	SPOT
8036	451322.691	2621638.177	1127.583	SPOT
8037	451316.895	2621643.593	1127.645	SPOT
8038	451314.635	2621645.427	1126.919	SPOT
8039	451308.279	2621650.289	1123.092	SPOT
8040	451306.615	2621651.761	1122.754	SPOT
8041	451302.514	2621656.327	1122.577	SPOT
8042	451300.248	2621658.787	1121.059	SPOT
8043	451298.716	2621660.453	1120.56	SPOT
8044	451297.308	2621661.953	1120.02	SPOT
8045	451296.297	2621662.862	1119.31	SPOT
8046	451292.582	2621667.294	1118.059	SPOT CL
8047	451288.195	2621672.753	1117.655	SPOT
8048	451285.32	2621675.658	1119.956	SPOT
8049	451283.736	2621677.767	1121.411	SPOT
8050	451273.791	2621687.643	1124.073	SPOT
8051	451278.404	2621683.148	1123.787	SPOT
8052	451712.476	2621372.162	1126.663	SPOT
8053	451708.412	2621365.806	1126.622	SPOT
8054	451706.407	2621363.255	1125.839	SPOT
8055	451703.296	2621358.611	1125.144	SPOT
8056	451700.079	2621353.882	1124.663	SPOT
8057	451699.026	2621352.703	1124.539	SPOT
8058	451698.153	2621351.718	1123.669	SPOT
8059	451697.055	2621349.976	1121.538	SPOT
8060	451694.367	2621346.742	1120.722	SPOT
8061	451690.363	2621341.457	1121.217	SPOT
8062	451687.508	2621337.046	1120.643	SPOT CL
8063	451683.265	2621332.477	1120.566	SPOT
8064	451680.253	2621328.003	1120.667	SPOT
8065	451677.891	2621324.251	1120.372	SPOT
8066	451675.324	2621321.566	1120.424	SPOT
8067	451674.248	2621320.356	1124.565	SPOT
8068	451671.747	2621316.046	1126.147	SPOT
8069	451666.28	2621308.323	1128.035	SPOT
8070	451658.786	2621298.25	1128.225	SPOT
8071	451798.747	2620891.007	1129.503	SPOT
8072	451788.423	2620887.659	1128.341	SPOT
8073	451779.518	2620883.989	1127.522	SPOT
8074	451774.385	2620882.537	1125.958	SPOT

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8075	451770.411	2620881.237	1124.632	SPOT
8076	451769.192	2620881.085	1122.48	SPOT
8077	451766.203	2620879.835	1121.633	SPOT
8078	451761.205	2620878.218	1121.624	SPOT CL
8079	451756.882	2620876.644	1121.555	SPOT
8080	451752.329	2620875.212	1123.008	SPOT
8081	451751.156	2620874.707	1123.577	SPOT
8082	451749.935	2620873.816	1125.23	SPOT
8083	451748.786	2620873.552	1126.113	SPOT
8084	451748.18	2620873.258	1127.211	SPOT
8085	451744.599	2620871.913	1128.793	SPOT
8086	451737.366	2620868.542	1131.204	SPOT
8087	451730.513	2620865.746	1135.176	SPOT
8088	452048.535	2620522.081	1131.585	SPOT
8089	452050.447	2620524.103	1130.877	SPOT
8090	452053.39	2620527.325	1126.773	SPOT
8091	452055.407	2620529.681	1127.415	SPOT
8092	452063.9	2620538.21	1127.766	SPOT
8093	452073.776	2620548.105	1127.365	SPOT
8094	452077.802	2620551.759	1124.034	SPOT
8095	452076.868	2620550.572	1125.823	SPOT
8096	452079.955	2620554.969	1122.272	SPOT
8097	452082.366	2620557.743	1122.73	SPOT CL
8098	452085.371	2620560.651	1123.986	SPOT
8099	452089.191	2620563.982	1124.081	SPOT
8100	452091.895	2620566.708	1124.512	SPOT
8101	452094.302	2620569.129	1126.701	SPOT
8102	452097.627	2620572.084	1128.479	SPOT
8103	452105.578	2620578.134	1129.421	SPOT
8104	452224.833	2620404.414	1132.13	SPOT
8105	452236.654	2620398.165	1131.983	SPOT
8106	452244.294	2620394.235	1131.944	SPOT
8107	452245.252	2620393.672	1130.02	SPOT
8108	452247.238	2620392.372	1127.716	SPOT
8109	452248.504	2620391.337	1126.539	SPOT
8110	452250.663	2620390.437	1124.53	SPOT
8111	452254.045	2620389.129	1124.483	SPOT
8112	452287.139	2620365.657	1130.365	SPOT
8113	452272.002	2620375.847	1129.155	SPOT
8114	452267.942	2620378.512	1128.924	SPOT
8115	452265.317	2620379.895	1126.553	SPOT
8116	452264.661	2620380.405	1126.177	SPOT
8117	452261.749	2620383.225	1125.477	SPOT
8118	452257.787	2620386.518	1125.061	SPOT CL
8119	452673.951	2620200.634	1130.426	SPOT
8120	452683.071	2620208.678	1129.427	SPOT
8121	452688.211	2620213.398	1128.452	SPOT
8122	452689.439	2620214.683	1128.755	SPOT
8123	452690.474	2620215.482	1127.087	SPOT
8124	452691.609	2620216.546	1126.74	SPOT
8125	452694.151	2620218.516	1126.376	SPOT
8126	452697.413	2620221.189	1125.526	SPOT CL
8127	452700.45	2620223.731	1125.462	SPOT
8128	452703.512	2620226.403	1125.909	SPOT
8129	452706.856	2620229.244	1128.964	SPOT
8130	452709.515	2620231.053	1130.658	SPOT
8131	452709.7	2620231.524	1132.04	SPOT
8132	452715.93	2620236.717	1132.255	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8133	452719.351	2620239.066	1132.619	SPOT
8134	452472.57	2619839.653	1136.873	SPOT
8135	452490.979	2619838.099	1136.27	SPOT
8136	452494.825	2619837.581	1135.198	SPOT
8137	452498.579	2619837.62	1134.37	SPOT
8138	452499.533	2619837.783	1131.585	SPOT
8139	452502.472	2619838.151	1129.913	SPOT
8140	452504.61	2619837.849	1130.157	SPOT
8141	452505.411	2619837.554	1128.645	SPOT
8142	452508.498	2619836.883	1128.361	SPOT
8143	452512.274	2619836.55	1127.95	SPOT
8144	452515.916	2619835.803	1127.824	SPOT CL
8145	452568.898	2619820.424	1133.561	SPOT
8146	452557.786	2619823.371	1132.933	SPOT
8147	452553.459	2619824.485	1132.124	SPOT
8148	452541.431	2619827.764	1131.398	SPOT
8149	452534.063	2619830.163	1130.491	SPOT
8150	452527.54	2619832.086	1129.675	SPOT
8151	452524.142	2619833.312	1128.908	SPOT
8152	452520.165	2619834.82	1128.434	SPOT
8153	452596.026	2619411.479	1135.567	SPOT
8154	452586.135	2619409.529	1135.869	SPOT
8155	452580.097	2619408.869	1134.958	SPOT
8156	452573.471	2619408.192	1132.784	SPOT
8157	452565.585	2619406.019	1132.845	SPOT
8158	452562.306	2619405.387	1132.141	SPOT
8159	452560.056	2619404.789	1130.356	SPOT
8160	452557.886	2619404.097	1129.198	SPOT
8161	452553.445	2619403.506	1128.729	SPOT
8162	452522.545	2619398.235	1136.224	SPOT
8163	452529.613	2619400.234	1134.444	SPOT
8164	452534.072	2619400.521	1132.947	SPOT
8165	452535.29	2619400.685	1130.771	SPOT
8166	452549.177	2619402.16	1129.072	SPOT
8167	452544.648	2619401.069	1128.067	SPOT CL
8168	452537.9	2619399.482	1128.949	SPOT
8169	452759.636	2619057.506	1136.646	SPOT
8170	452751.831	2619050.298	1136.104	SPOT
8171	452747.571	2619045.783	1134.787	SPOT
8172	452743.449	2619041.994	1132.81	SPOT
8173	452742.473	2619041.405	1130.581	SPOT
8174	452741.522	2619040.397	1129.795	SPOT
8175	452738.829	2619038.249	1129.56	SPOT
8176	452735.223	2619034.521	1129.323	SPOT CL
8177	452732.311	2619032.859	1130.402	SPOT
8178	452729.614	2619030.522	1130.392	SPOT
8179	452727.724	2619029.214	1133.429	SPOT
8180	452724.305	2619026.358	1134.358	SPOT
8181	452712.628	2619013.925	1135.497	SPOT
8182	452706.034	2619008.589	1136.485	SPOT
8183	452718.18	2619020.388	1135.029	SPOT
8184	453225.799	2619252.682	1140.003	SPOT
8185	453224.469	2619261.188	1139.236	SPOT
8186	453223.561	2619266.461	1138.34	SPOT
8187	453223.016	2619272.39	1137.849	SPOT
8188	453221.481	2619283.638	1137.362	SPOT
8189	453220.836	2619290.282	1136.62	SPOT
8190	453220.545	2619292.339	1135.757	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8191	453220.452	2619293.708	1135.139	SPOT
8192	453215.154	2619345.792	1144.153	SPOT
8193	453215.962	2619338.864	1142.205	SPOT
8194	453216.524	2619332.207	1140.823	SPOT
8195	453216.803	2619328.19	1139.435	SPOT
8196	453216.912	2619322.978	1138.474	SPOT
8197	453217.057	2619321.851	1136.369	SPOT
8198	453219.668	2619297.833	1134.648	SPOT
8199	453219.212	2619301.011	1134.403	SPOT
8200	453218.29	2619304.627	1133.748	SPOT CL
8201	453218.524	2619310.425	1132.926	SPOT
8202	453217.469	2619314.727	1132.383	SPOT
8203	453216.994	2619320.61	1134.092	SPOT
8204	453637.539	2619090.863	1140.658	SPOT
8205	453643.408	2619094.645	1140.129	SPOT
8206	453651.617	2619100.437	1138.497	SPOT
8207	453658.537	2619104.673	1138.268	SPOT
8208	453659.555	2619105.274	1137.346	SPOT
8209	453660.752	2619106.054	1136.855	SPOT
8210	453703.295	2619134.298	1141.442	SPOT
8211	453698.007	2619130.643	1138.707	SPOT
8212	453695.169	2619128.546	1137.843	SPOT
8213	453691.617	2619125.861	1137.102	SPOT
8214	453690.664	2619125.118	1135.78	SPOT
8215	453689.675	2619124.494	1135.811	SPOT
8216	453688.1	2619123.395	1135.885	SPOT
8217	453686.849	2619122.421	1137.505	SPOT
8218	453684.421	2619120.405	1137.363	SPOT
8219	453683.058	2619119.2	1135.313	SPOT
8220	453672.416	2619112.567	1133.34	SPOT CL
8221	453665.99	2619108.784	1134.44	SPOT
8222	453676.414	2619114.854	1133.718	SPOT
8223	453782.215	2618745.815	1143.501	SPOT
8224	453790.752	2618745.007	1143.064	SPOT
8225	453796.326	2618744.174	1142.304	SPOT
8226	453799.628	2618743.638	1140.913	SPOT
8227	453802.656	2618743.307	1139.572	SPOT
8228	453803.895	2618742.897	1137.938	SPOT
8229	453810.71	2618741.557	1137.242	SPOT
8230	453858.577	2618738.307	1140.278	SPOT
8231	453848.192	2618738.725	1139.864	SPOT
8232	453840.874	2618739.004	1140.009	SPOT
8233	453838.466	2618739.111	1138.407	SPOT
8234	453815.652	2618740.797	1136.889	SPOT
8235	453821.297	2618740.062	1136.433	SPOT CL
8236	453826.596	2618739.187	1137.183	SPOT
8237	453834.467	2618738.394	1137.378	SPOT
8238	450585.073	2622394.669	1123.232	SPOT
8239	450596.758	2622387.01	1122.272	SPOT
8240	450603.655	2622382.586	1122.961	SPOT
8241	450607.306	2622380.055	1122.782	SPOT
8242	450608.697	2622379.215	1121.51	SPOT
8243	450611.647	2622377.957	1120.068	SPOT
8244	450614.666	2622375.747	1117.134	SPOT
8245	450615.626	2622375.137	1116.004	SPOT
8246	450618.559	2622372.605	1115.888	SPOT
8247	450653.759	2622343.906	1122.411	SPOT
8248	450642.557	2622352.77	1121.357	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8249	450636.755	2622357.548	1120.765	SPOT
8250	450633.439	2622360.113	1119.621	SPOT
8251	450631.797	2622361.306	1118.467	SPOT
8252	450622.541	2622368.986	1116.008	SPOT CL
8253	450625.829	2622366.078	1116.382	SPOT
8254	450629.788	2622362.353	1117.157	SPOT
8255	451024.206	2622532.574	1122.288	SPOT
8256	451024.949	2622542.114	1121.689	SPOT
8257	451025.648	2622550.127	1120.598	SPOT
8258	451025.807	2622553.042	1119.963	SPOT
8259	451025.861	2622555.371	1117.631	SPOT
8260	451026.019	2622557.617	1116.936	SPOT
8261	451026.524	2622559.884	1116.251	SPOT
8262	451030.075	2622604.421	1127.574	SPOT
8263	451029.643	2622596.1	1126.569	SPOT
8264	451028.769	2622586.112	1124.544	SPOT
8265	451028.3	2622582.747	1118.365	SPOT
8266	451028.261	2622581.282	1117.76	SPOT
8267	451027.679	2622575.957	1116.08	SPOT
8268	451027.503	2622574.298	1114.483	SPOT
8269	451027.244	2622568.352	1114.425	SPOT CL
8270	451026.758	2622563.759	1116.016	SPOT
8271	451254.475	2622361.67	1121.259	SPOT
8272	451252.291	2622378.247	1120.99	SPOT
8273	451250.416	2622390.295	1119.758	SPOT
8274	451250.196	2622392.118	1117.823	SPOT
8275	451249.8	2622397.042	1115.615	SPOT
8276	451249.904	2622397.715	1114.023	SPOT
8277	451248.412	2622412.382	1115.301	SPOT CL
8278	451247.594	2622419.152	1115.297	SPOT
8279	451247.756	2622423.722	1115.516	SPOT
8280	451247.504	2622425.734	1116.424	SPOT
8281	451246.901	2622430.174	1119.545	SPOT
8282	451246.149	2622433.531	1123.672	SPOT
8283	451246.184	2622447.943	1123.931	SPOT
8284	451246.648	2622439.994	1123.748	SPOT
8285	451249.771	2622404.554	1115.275	SPOT
8286	451588.157	2622341.129	1123.414	SPOT
8287	451589.191	2622349.493	1123.188	SPOT
8288	451589.716	2622357.086	1122.953	SPOT
8289	451590.182	2622361.061	1122.144	SPOT
8290	451590.405	2622364.235	1120.888	SPOT
8291	451590.798	2622366.718	1117.703	SPOT
8292	451590.857	2622369.555	1116.933	SPOT
8293	451590.94	2622370.454	1116.153	SPOT
8294	451591.071	2622372.286	1114.326	SPOT
8295	451590.891	2622376.783	1114.95	SPOT
8296	451592.055	2622384.47	1114.729	SPOT CL
8297	451601.417	2622443.234	1123.388	SPOT
8298	451598.133	2622425.712	1122.404	SPOT
8299	451596.702	2622418.217	1121.734	SPOT
8300	451596.031	2622414.415	1120.17	SPOT
8301	451594.956	2622407.544	1118.673	SPOT
8302	451594.889	2622405.792	1116.3	SPOT
8303	451594.29	2622401.345	1115.655	SPOT
8304	451592.935	2622392.728	1114.217	SPOT
8305	451949.883	2622212.746	1121.392	SPOT
8306	451947.951	2622204.967	1121.611	SPOT
8307	451947.243	2622199.341	1121.269	SPOT
8308	451947.071	2622197.77	1120.195	SPOT
8309	451945.557	2622189.618	1118.345	SPOT
8310	451944.073	2622181.186	1117.852	SPOT
8311	451943.299	2622177.734	1117.184	SPOT
8312	451941.401	2622170.399	1115.566	SPOT
8313	451940.857	2622166.039	1114.68	SPOT
8314	451914.543	2622072.726	1126.545	SPOT
8315	451916.085	2622078.731	1126.001	SPOT
8316	451917.668	2622084.781	1124.025	SPOT
8317	451919.602	2622091.334	1120.919	SPOT
8318	451923.888	2622106.282	1119.649	SPOT
8319	451928.649	2622123.492	1119.412	SPOT
8320	451932.457	2622136.378	1119.466	SPOT
8321	451934.213	2622142.942	1118.781	SPOT
8322	451934.689	2622145.617	1117.073	SPOT
8323	451935.093	2622147.016	1116.3	SPOT
8324	451938.298	2622159.895	1114.314	SPOT CL
8325	451937.021	2622154.044	1112.755	SPOT
8326	451935.751	2622148.666	1114.573	SPOT
8327	451974.841	2622493.684	1120.223	SPOT
8328	451979.316	2622499.373	1120.069	SPOT
8329	451985.068	2622506.328	1117.574	SPOT
8330	451986.502	2622508.427	1117.671	SPOT
8331	451987.464	2622509.776	1118.022	SPOT
8332	451997.555	2622522.984	1117.984	SPOT
8333	452002.137	2622528.529	1117.612	SPOT
8334	452004.573	2622532.293	1117.258	SPOT
8335	452006.728	2622534.568	1115.218	SPOT
8336	452005.625	2622533.812	1115.483	SPOT
8337	452008.482	2622537.293	1114.054	SPOT
8338	452046.465	2622580.521	1118.283	SPOT
8339	452038.848	2622572.378	1119.025	SPOT
8340	452031.752	2622563.919	1119.117	SPOT
8341	452026.35	2622557.517	1119.095	SPOT
8342	452025.054	2622556.214	1118.328	SPOT
8343	452023.882	2622555.108	1116.232	SPOT
8344	452013.575	2622543.33	1112.692	SPOT CL
8345	452017.125	2622547.238	1112.832	SPOT
8346	452019.56	2622550.658	1113.296	SPOT
8347	452022.074	2622553.184	1114.203	SPOT
8348	452515.056	2622555.853	1118.487	SPOT
8349	452516.267	2622563.726	1118.296	SPOT
8350	452516.339	2622567.984	1117.575	SPOT
8351	452516.518	2622570.097	1116.654	SPOT
8352	452516.891	2622572.292	1115.677	SPOT
8353	452517.278	2622575.294	1113.74	SPOT
8354	452519.126	2622633.368	1117.033	SPOT
8355	452518.442	2622618.902	1116.024	SPOT
8356	452518.068	2622613.007	1115.272	SPOT
8357	452517.798	2622604.475	1114.998	SPOT
8358	452517.847	2622601.242	1114.886	SPOT
8359	452518.018	2622600.049	1114.019	SPOT
8360	452517.466	2622577.316	1111.738	SPOT
8361	452518.137	2622584.995	1111.149	SPOT CL
8362	452519.124	2622598.518	1112.54	SPOT
8363	452518.542	2622594.214	1111.678	SPOT
8364	452868.272	2622558.305	1116.564	SPOT
8365	452879.961	2622555.011	1116.049	SPOT
8366	452887.764	2622552.908	1114.286	SPOT
8367	452897.935	2622550.375	1114.429	SPOT
8368	452901.844	2622549.619	1113.611	SPOT
8369	452905.317	2622548.529	1111.438	SPOT
8370	452910.119	2622547.784	1110.702	SPOT
8371	452918.098	2622545.459	1109.442	SPOT CL
8372	452961.778	2622531.493	1123.527	SPOT
8373	452950.623	2622535.265	1117.695	SPOT
8374	452945.21	2622536.888	1114.485	SPOT
8375	452941.403	2622537.832	1113.689	SPOT
8376	452939.162	2622538.412	1111.445	SPOT
8377	452935.223	2622539.663	1109.603	SPOT
8378	452929.697	2622540.568	1109.936	SPOT
8379	452925.66	2622542.875	1109.929	SPOT
8380	452918.728	2622999.671	1115.157	SPOT
8381	452933.569	2622997.239	1114.514	SPOT
8382	452939.604	2622996.396	1113.542	SPOT
8383	452948.664	2622995.225	1110.098	SPOT
8384	452954.895	2622994.185	1107.538	SPOT
8385	452957.182	2622993.605	1103.83	SPOT
8386	452961.078	2622992.522	1103.024	SPOT
8387	452965.68	2622991.239	1103.02	SPOT
8388	453012.592	2622978.136	1111.426	SPOT
8389	453001.972	2622981.096	1111.278	SPOT
8390	452997.609	2622981.999	1111.124	SPOT
8391	452994.963	2622982.447	1110.001	SPOT
8392	452991.68	2622983.148	1106.895	SPOT
8393	452977.718	2622986.999	1104.309	SPOT
8394	452971.673	2622989.122	1103.449	SPOT CL
8395	452984.843	2622984.824	1104.334	SPOT
8396	452988.918	2622983.787	1104.349	SPOT
8397	452995.859	2623474.423	1113.581	SPOT
8398	452997.681	2623499.052	1112.947	SPOT
8399	453002.258	2623516.154	1108.192	SPOT
8400	453005.447	2623528.855	1108.706	SPOT
8401	453006.235	2623532.557	1105.842	SPOT
8402	453007.841	2623538.374	1105.216	SPOT
8403	453008.352	2623541.141	1104.11	SPOT
8404	453008.482	2623542.805	1102.599	SPOT
8405	453008.673	2623546.869	1102.099	SPOT
8406	453009.43	2623554.957	1102.057	SPOT
8407	453009.575	2623561.802	1100.306	SPOT CL
8408	453011.502	2623626.997	1114.739	SPOT
8409	453010.754	2623615.204	1114.319	SPOT
8410	453010.814	2623611.405	1112.458	SPOT
8411	453009.942	2623604.335	1106.236	SPOT
8412	453009.457	2623595.979	1106.525	SPOT
8413	453009.172	2623588.356	1106.473	SPOT
8414	453008.6	2623582.247	1106.169	SPOT
8415	453008.804	2623580.919	1103.041	SPOT
8416	453008.823	2623578.049	1102.621	SPOT
8417	453009.471	2623571.415	1100.464	SPOT
8418	453008.615	2623575.362	1101.827	SPOT
8419	452944.944	2623980.57	1105.653	SPOT
8420	452946.404	2623988.057	1105.823	SPOT
8421	452948.076	2623994.124	1104.33	SPOT
8422	452949.393	2624001.523	1103.201	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8423	452949.926	2624005.036	1102.216	SPOT
8424	452950.46	2624007.809	1100.998	SPOT
8425	452951.25	2624011.886	1100.208	SPOT
8426	452952.783	2624017.69	1100.284	SPOT
8427	452955.052	2624024.81	1099.598	SPOT CL
8428	452954.735	2624029.979	1099.867	SPOT
8429	452954.599	2624032.913	1100.516	SPOT
8430	452956.398	2624036.272	1101.519	SPOT
8431	452958.834	2624042.077	1101.971	SPOT
8432	452961.034	2624045.483	1103.91	SPOT
8433	452964.368	2624051.551	1105.108	SPOT
8434	452967.626	2624060.018	1104.792	SPOT
8435	453181.182	2624315.543	1107.919	SPOT
8436	453182.243	2624307.621	1108.068	SPOT
8437	453182.933	2624302.14	1107.602	SPOT
8438	453183.411	2624298.124	1102.609	SPOT
8439	453183.909	2624292.399	1102.211	SPOT
8440	453184.757	2624286.054	1101.393	SPOT
8441	453183.429	2624225.374	1105.17	SPOT
8442	453183.995	2624232.663	1104.218	SPOT
8443	453183.084	2624245.512	1103.668	SPOT
8444	453183.128	2624253.145	1103.402	SPOT
8445	453183.25	2624255.347	1102.5	SPOT
8446	453183.163	2624256.066	1101.23	SPOT
8447	453183.308	2624258.091	1099.647	SPOT
8448	453185.414	2624283.872	1098.959	SPOT
8449	453185.459	2624278.941	1098.026	SPOT
8450	453184.82	2624271.98	1098.209	SPOT CL
8451	453183.646	2624259.095	1099.021	SPOT
8452	453184.712	2624265.109	1097.844	SPOT
8453	453614.859	2624368.75	1104.723	SPOT
8454	453623.943	2624362.926	1104.405	SPOT
8455	453637.297	2624353.79	1103.586	SPOT
8456	453640.731	2624351.846	1100.96	SPOT
8457	453644.133	2624349.495	1100.457	SPOT
8458	453650.573	2624345.321	1100.134	SPOT
8459	453651.52	2624344.856	1099.539	SPOT
8460	453680.88	2624325.366	1105.134	SPOT
8461	453678.249	2624327.106	1103.522	SPOT
8462	453674.124	2624329.74	1101.726	SPOT
8463	453672.217	2624330.734	1100.902	SPOT
8464	453671.297	2624331.135	1100.137	SPOT
8465	453670.946	2624331.572	1098.806	SPOT
8466	453655.515	2624341.593	1097.015	SPOT
8467	453652.505	2624343.93	1098.028	SPOT
8468	453659.22	2624339.758	1097.081	SPOT CL
8469	453664.194	2624336.818	1096.567	SPOT
8470	453667.248	2624334.57	1096.793	SPOT
8471	453669.683	2624332.482	1097.842	SPOT
8472	452041.192	2628235.152	1095.32	SPOT
8473	452043.768	2628241.246	1094.87	SPOT
8474	452048.842	2628252.146	1093.379	SPOT
8475	452049.605	2628253.563	1091.856	SPOT
8476	452050.489	2628256.105	1090.275	SPOT
8477	452051.21	2628257.82	1090.324	SPOT
8478	452058.266	2628272.249	1088.532	SPOT
8479	452055.29	2628266.253	1089.044	SPOT
8480	452061.365	2628279.283	1087.746	SPOT CL

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8481	452065.247	2628287.739	1088.028	SPOT
8482	452068.693	2628294.787	1088.117	SPOT
8483	452072.234	2628301.298	1089.265	SPOT
8484	452074.696	2628306.61	1089.271	SPOT
8485	452075.323	2628307.857	1089.895	SPOT
8486	452077.962	2628311.711	1094.865	SPOT
8487	452082.368	2628318.454	1096.059	SPOT
8488	452088.4	2628326.993	1097.246	SPOT
8489	452097.02	2628344.768	1098.214	SPOT
8490	452381.497	2628476.231	1099.766	SPOT
8491	452362.751	2628477.093	1098.845	SPOT
8492	452357.503	2628477.557	1094.802	SPOT
8493	452352.765	2628478.707	1093.536	SPOT
8494	452351.422	2628478.802	1092.146	SPOT
8495	452348.622	2628479.318	1090.619	SPOT
8496	452346.352	2628479.877	1087.269	SPOT
8497	452342.903	2628480.666	1087.458	SPOT
8498	452337.453	2628481.805	1088.403	SPOT
8499	452331.397	2628483.054	1088.245	SPOT CL
8500	452324.603	2628484.431	1087.901	SPOT
8501	452316.962	2628485.237	1088.546	SPOT
8502	452315.771	2628485.5	1089.288	SPOT
8503	452314.321	2628485.854	1090.001	SPOT
8504	452313.558	2628486.17	1092.188	SPOT
8505	452303.701	2628487.841	1092.976	SPOT
8506	452291.864	2628488.953	1093.395	SPOT
8507	452289.62	2628489.463	1094.537	SPOT
8508	452272.539	2628492.649	1096.207	SPOT
8509	452114.566	2628797.401	1098.755	SPOT
8510	452109.17	2628786.821	1098.804	SPOT
8511	452105.747	2628781.222	1098.532	SPOT
8512	452101.463	2628773.398	1095.645	SPOT
8513	452095.87	2628762.743	1091.971	SPOT
8514	452092.712	2628756.685	1092.035	SPOT
8515	452085.368	2628743.286	1092.452	SPOT
8516	452080.436	2628734.255	1091.485	SPOT
8517	452079.389	2628731.832	1090.959	SPOT
8518	452079.092	2628730.027	1088.897	SPOT
8519	452078.735	2628728.059	1088.525	SPOT
8520	452076.462	2628724.725	1087.769	SPOT
8521	452073.4	2628720.478	1087.494	SPOT
8522	452068.775	2628714.122	1086.664	SPOT CL
8523	452064.267	2628707.863	1087.005	SPOT
8524	452060.012	2628702.24	1087.801	SPOT
8525	452056.003	2628697.095	1087.908	SPOT
8526	452054.275	2628695.371	1089.229	SPOT
8527	452053.161	2628692.843	1090.195	SPOT
8528	452051.018	2628690.405	1092.317	SPOT
8529	452049.857	2628689.493	1094.28	SPOT
8530	452045.62	2628681.346	1095.076	SPOT
8531	452038.24	2628668.609	1094.34	SPOT
8532	451609.62	2628768.869	1086.33	SPOT CL
8533	451667.621	2628795.165	1094.576	SPOT
8534	451656.913	2628790.202	1093.576	SPOT
8535	451649.629	2628786.5	1092.92	SPOT
8536	451643.128	2628783.491	1090.81	SPOT
8537	451635.459	2628780.342	1090.55	SPOT
8538	451630.75	2628778.217	1090.42	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8539	451629.632	2628777.724	1089.214	SPOT
8540	451616.431	2628771.607	1086.456	SPOT
8541	451602.742	2628766.079	1087.022	SPOT
8542	451596.821	2628763.238	1086.004	SPOT
8543	451591.996	2628760.13	1088.181	SPOT
8544	451584.156	2628756.569	1093.66	SPOT
8545	451583.386	2628756.423	1097.21	SPOT
8546	451570.315	2628751.611	1096.572	SPOT
8547	451549.662	2628741.721	1095.764	SPOT
8548	451623.021	2628774.478	1087.617	SPOT
8549	451628.497	2628776.419	1087.989	SPOT
8550	451230.48	2629012.617	1085.593	SPOT CL
8551	451192.57	2628949.945	1095.688	SPOT
8552	451195.391	2628955.498	1095.418	SPOT
8553	451201.983	2628966.854	1090.38	SPOT
8554	451203.833	2628970.247	1090.424	SPOT
8555	451205.844	2628973.765	1091.062	SPOT
8556	451212.084	2628984.76	1091.179	SPOT
8557	451217.5	2628994.383	1091.115	SPOT
8558	451221.946	2629000.628	1090.219	SPOT
8559	451223.307	2629003.179	1086.937	SPOT
8560	451224.457	2629004.461	1086.318	SPOT
8561	451226.646	2629007.892	1085.568	SPOT
8562	451233.966	2629017.012	1085.492	SPOT
8563	451237.864	2629021.88	1086.339	SPOT
8564	451239.371	2629023.32	1087.409	SPOT
8565	451276.105	2629079.897	1094.337	SPOT
8566	451267.394	2629066.808	1093.287	SPOT
8567	451259.169	2629053.643	1093.041	SPOT
8568	451254.802	2629046.967	1093.592	SPOT
8569	451248.673	2629037.761	1093.236	SPOT
8570	451246.331	2629034.01	1091.255	SPOT
8571	451242.204	2629027.805	1090.642	SPOT
8572	451240.626	2629025.111	1089.343	SPOT
8573	451239.833	2629023.815	1089.068	SPOT
8574	451060.074	2629450.37	1099.34	SPOT
8575	451067.299	2629454.054	1097.228	SPOT
8576	451073.926	2629456.904	1095.325	SPOT
8577	451083.534	2629462.499	1090.734	SPOT
8578	451094.922	2629467.736	1091.106	SPOT
8579	451096.418	2629468.536	1091.717	SPOT
8580	451103.736	2629472.032	1091.329	SPOT
8581	451110.589	2629475.419	1090.675	SPOT
8582	451112.813	2629476.749	1088.818	SPOT
8583	451116.681	2629478.774	1088.442	SPOT
8584	451118.741	2629480.527	1085.982	SPOT
8585	451124.084	2629482.44	1085.975	SPOT
8586	451128.828	2629484.846	1085.699	SPOT
8587	451135.024	2629487.796	1085.059	SPOT CL
8588	451141.944	2629491.393	1084.911	SPOT
8589	451146.775	2629494.083	1085.347	SPOT
8590	451150.778	2629496.297	1085.98	SPOT
8591	451151.76	2629496.904	1087.366	SPOT
8592	451154.738	2629497.956	1088.667	SPOT
8593	451156.414	2629498.973	1091.474	SPOT
8594	451157.912	2629500.26	1090.566	SPOT
8595	451158.636	2629500.946	1092.344	SPOT
8596	451175.874	2629506.849	1093.163	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8597	451186.468	2629510.001	1094.983	SPOT
8598	451222.762	2629513.502	1096.482	SPOT
8599	451211.9	2629527.379	1095.995	SPOT
8600	451127.154	2629908.595	1092.318	SPOT
8601	451131.395	2629924.825	1090.154	SPOT
8602	451132.652	2629933.235	1090.69	SPOT
8603	451137.077	2629950.35	1090.67	SPOT
8604	451141.237	2629966.423	1090.218	SPOT
8605	451143.337	2629972.517	1090.993	SPOT
8606	451144.968	2629977.813	1089.868	SPOT
8607	451145.71	2629980.272	1088.62	SPOT
8608	451146.78	2629983.614	1088.783	SPOT
8609	451147.453	2629986.961	1089.176	SPOT
8610	451148.441	2629989.692	1087.637	SPOT
8611	451149.055	2629990.752	1083.983	SPOT
8612	451150.032	2629995.248	1083.761	SPOT
8613	451151.363	2629999.532	1083.814	SPOT
8614	451153.066	2630004.89	1084.071	SPOT CL
8615	451154.413	2630009.858	1084.653	SPOT
8616	451155.483	2630014.419	1084.5	SPOT
8617	451156.638	2630019.161	1083.258	SPOT
8618	451157.782	2630020.86	1085.233	SPOT
8619	451157.683	2630021.467	1087.663	SPOT
8620	451158.245	2630023.115	1087.758	SPOT
8621	451158.704	2630025.701	1089.806	SPOT
8622	451160.207	2630031.682	1091.766	SPOT
8623	451160.427	2630035.119	1096.01	SPOT
8624	451162.387	2630045.381	1096.49	SPOT
8625	450600.304	2629943.326	1097.703	SPOT
8626	450602.256	2629948.367	1096.361	SPOT
8627	450608.754	2629963.361	1087.848	SPOT
8628	450612.074	2629971.22	1088.403	SPOT
8629	450620.47	2629986.554	1087.834	SPOT
8630	450625.012	2629995.402	1087.151	SPOT
8631	450628.793	2630004.079	1088.233	SPOT
8632	450630.983	2630009.691	1086.898	SPOT
8633	450632.88	2630014.917	1086.508	SPOT
8634	450634.142	2630017.658	1084.67	SPOT
8635	450635.498	2630020.81	1084.387	SPOT
8636	450637.217	2630027.624	1084.274	SPOT
8637	450639.216	2630033.245	1083.279	SPOT CL
8638	450653.655	2630077.332	1093.999	SPOT
8639	450649.967	2630066.157	1093.783	SPOT
8640	450647.765	2630059.596	1093.516	SPOT
8641	450647.299	2630057.105	1091.374	SPOT
8642	450646.926	2630055.595	1090.893	SPOT
8643	450646.598	2630053.984	1087.939	SPOT
8644	450645.89	2630051.322	1086.945	SPOT
8645	450647.942	2630050.791	1083.814	SPOT
8646	450644.28	2630047.581	1082.978	SPOT
8647	450642.901	2630043.169	1082.679	SPOT
8648	450641.242	2630039.291	1083.21	SPOT
8649	450514.398	2630503.933	1091.25	SPOT
8650	450520.052	2630496.838	1089.473	SPOT
8651	450524.333	2630492.064	1087.263	SPOT
8652	450530.492	2630484.211	1086.951	SPOT
8653	450534.228	2630478.09	1085.429	SPOT
8654	450536.566	2630473.391	1084.895	SPOT

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8655	450538.348	2630471.321	1084.074	SPOT
8656	450540.292	2630468.507	1083.483	SPOT
8657	450543.411	2630464.098	1083.025	SPOT
8658	450547.954	2630457.442	1083.297	SPOT CL
8659	450552.008	2630451.767	1082.976	SPOT
8660	450556.216	2630444.948	1084.024	SPOT
8661	450557.872	2630441.813	1085.114	SPOT
8662	450558.749	2630440.371	1085.922	SPOT
8663	450561.186	2630436.856	1087.202	SPOT
8664	450564.446	2630432.724	1087.656	SPOT
8665	450569.687	2630425.642	1088.828	SPOT
8666	450576.199	2630417.358	1089.229	SPOT
8667	450586.509	2630405.444	1088.954	SPOT
8668	450593.765	2630396.981	1090.728	SPOT
8669	450302.492	2630662	1090.789	SPOT
8670	450296.735	2630669.016	1090.372	SPOT
8671	450285.811	2630680.874	1089.973	SPOT
8672	450278.439	2630690.861	1090.016	SPOT
8673	450275.447	2630695.405	1089.096	SPOT
8674	450274.733	2630696.531	1089.366	SPOT
8675	450271.872	2630701.307	1088.918	SPOT
8676	450270.9	2630702.613	1087.393	SPOT
8677	450269.854	2630704.502	1086.207	SPOT
8678	450268.233	2630707.268	1083.881	SPOT
8679	450267.839	2630707.445	1083.234	SPOT
8680	450240.241	2630762.566	1093.331	SPOT
8681	450240.976	2630759.867	1092.816	SPOT
8682	450240.606	2630751.964	1085.901	SPOT
8683	450244.293	2630747.411	1085.523	SPOT
8684	450245.596	2630745.303	1083.265	SPOT
8685	450256.333	2630727.997	1082.444	SPOT CL
8686	450261.445	2630719.242	1083.282	SPOT
8687	450266.051	2630711.33	1082.751	SPOT
8688	450250.346	2630736.531	1082.546	SPOT
8689	449810.5	2630394.953	1083.556	SPOT
8690	449807.564	2630390.189	1086.14	SPOT
8691	449804.264	2630384.584	1091.04	SPOT
8692	449801.498	2630379.236	1093.982	SPOT
8693	449798.818	2630373.693	1095.722	SPOT
8694	449797.379	2630370.314	1097.843	SPOT
8695	449794.604	2630364.575	1103.937	SPOT
8696	449791.87	2630361.067	1108.022	SPOT
8697	449787.935	2630354.917	1109.404	SPOT
8698	449778.321	2630340.105	1110.402	SPOT
8699	449812.151	2630397.523	1081.061	SPOT
8700	449815.826	2630404.173	1081.958	SPOT
8701	449819.252	2630409.737	1082.464	SPOT
8702	449824.232	2630418.585	1082.552	SPOT
8703	449826.511	2630422.912	1081.312	SPOT
8704	449827.6	2630425.282	1080.858	SPOT
8705	449829.014	2630428.185	1082.65	SPOT
8706	449830.108	2630430.09	1083.064	SPOT
8707	449829.989	2630430.382	1086.758	SPOT
8708	449834.901	2630439.374	1088.051	SPOT
8709	449839.745	2630448.46	1088.193	SPOT
8710	449842.707	2630452.032	1089.379	SPOT
8711	449845.317	2630456.035	1090.581	SPOT
8712	449453.69	2630879.034	1089.721	SPOT

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8713	449453.464	2630868.439	1088.763	SPOT
8714	449453.696	2630859.529	1088.442	SPOT
8715	449453.075	2630846.845	1088.07	SPOT
8716	449453.16	2630838.151	1088.561	SPOT
8717	449452.687	2630837.602	1086.161	SPOT
8718	449452.574	2630834.377	1084.679	SPOT
8719	449452.704	2630833.023	1082.298	SPOT
8720	449450.725	2630818.79	1079.859	SPOT
8721	449449.752	2630811.323	1081.074	SPOT CL
8722	449449.126	2630804.282	1081.377	SPOT
8723	449451.37	2630825.304	1079.171	SPOT
8724	449447.901	2630797.787	1081.266	SPOT
8725	449447.798	2630795.436	1083.584	SPOT
8726	449446.978	2630790.327	1084.945	SPOT
8727	449446.609	2630784.384	1084.62	SPOT
8728	449445.344	2630778.418	1085.909	SPOT
8729	449444.296	2630769.466	1086.855	SPOT
8730	449452.193	2630830.341	1080.885	SPOT
8731	449136.869	2630801.313	1082.641	SPOT
8732	449132.805	2630798.41	1085.238	SPOT
8733	449130.499	2630796.927	1085.079	SPOT
8734	449127.519	2630795.608	1087.557	SPOT
8735	449125.232	2630794.573	1090.025	SPOT
8736	449106.342	2630781.977	1089.581	SPOT
8737	449139.746	2630803.129	1080.803	SPOT
8738	449148.2	2630807.965	1080.281	SPOT
8739	449154.631	2630812.215	1080.555	SPOT
8740	449164.395	2630818.714	1080.534	SPOT
8741	449170.429	2630823.191	1081.238	SPOT
8742	449172.734	2630825.208	1082.02	SPOT
8743	449174.903	2630826.94	1083.363	SPOT
8744	449176.387	2630827.166	1085.374	SPOT
8745	449183.398	2630832.529	1087.021	SPOT
8746	449195.622	2630842.134	1087.308	SPOT
8747	449199.113	2630845.446	1089.184	SPOT
8748	449213.256	2630856.992	1088.015	SPOT
8749	448940.768	2630749.233	1087.249	SPOT
8750	448923.5	2630749.838	1086.984	SPOT
8751	448916.856	2630749.697	1086.823	SPOT
8752	448913.718	2630750.215	1085.716	SPOT
8753	448911.069	2630750.516	1082.764	SPOT
8754	448907.847	2630750.936	1082.34	SPOT
8755	448846.901	2630753.255	1089.807	SPOT
8756	448858.314	2630753.019	1089.927	SPOT
8757	448861.942	2630752.358	1089.665	SPOT
8758	448865.556	2630752.084	1087.961	SPOT
8759	448867.771	2630752.318	1085.224	SPOT
8760	448869.753	2630752.231	1083.781	SPOT
8761	448874.563	2630751.851	1082.409	SPOT
8762	448877.066	2630751.716	1080.299	SPOT
8763	448884.424	2630751.702	1080.17	SPOT
8764	448892.156	2630752.094	1079.388	SPOT CL
8765	448898.622	2630752.105	1079.211	SPOT
8766	448905.697	2630751.752	1078.954	SPOT
8767	448907.024	2630751.343	1081.152	SPOT
8768	449031.615	2630365.692	1087.828	SPOT
8769	449023.338	2630378.328	1088.545	SPOT
8770	449018.977	2630386.694	1088.813	SPOT

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8771	449018.143	2630387.421	1087.166	SPOT
8772	449015.905	2630390.27	1083.673	SPOT
8773	449013.441	2630392.724	1081.237	SPOT
8774	448950.609	2630461.792	1087.966	SPOT
8775	448964.345	2630448.445	1088.394	SPOT
8776	448969.866	2630441.592	1087.523	SPOT
8777	448976.217	2630435.554	1087.125	SPOT
8778	448980.901	2630430.53	1086.161	SPOT
8779	448987.172	2630422.873	1082.541	SPOT
8780	448984.922	2630425.78	1084.317	SPOT
8781	448989.051	2630420.378	1080.419	SPOT
8782	448997.478	2630408.869	1079.325	SPOT CL
8783	449003.829	2630402.769	1078.345	SPOT
8784	449011.005	2630395.27	1079.418	SPOT
8785	448992.666	2630414.983	1080.176	SPOT
8786	448645.712	2630587.054	1088.654	SPOT
8787	448638.223	2630564.406	1088.846	SPOT
8788	448637.253	2630553.363	1088.412	SPOT
8789	448636.919	2630552.069	1088.158	SPOT
8790	448637.085	2630551.259	1085.076	SPOT
8791	448636.612	2630548.713	1082.81	SPOT
8792	448636.415	2630547.644	1081.909	SPOT
8793	448635.849	2630546.42	1080.925	SPOT
8794	448635.361	2630542.801	1078.855	SPOT
8795	448634.326	2630533.441	1078.738	SPOT
8796	448633.796	2630527.117	1079.595	SPOT CL
8797	448633.799	2630520.408	1079.845	SPOT
8798	448633.932	2630514.793	1079.942	SPOT
8799	448633.746	2630513.229	1080.736	SPOT
8800	448633.104	2630508.139	1081.881	SPOT
8801	448633.183	2630504.227	1083.795	SPOT
8802	448633.052	2630501.943	1085.324	SPOT
8803	448632.732	2630495.563	1085.704	SPOT
8804	448631.863	2630487.612	1085.724	SPOT
8805	448629.966	2630478.402	1085.438	SPOT
8806	448626.546	2630455.339	1084.577	SPOT
8807	448625.791	2630448.065	1089.835	SPOT
8808	448573.849	2630745.448	1086.142	SPOT
8809	448558.248	2630749.461	1086.138	SPOT
8810	448541.042	2630752.916	1086.627	SPOT
8811	448527.664	2630756.156	1086.573	SPOT
8812	448523.621	2630757.097	1084.951	SPOT
8813	448521.292	2630757.77	1083.91	SPOT
8814	448515.391	2630759.393	1082.685	SPOT
8815	448512.209	2630760.231	1080.519	SPOT
8816	448509.849	2630761.459	1079.211	SPOT
8817	448481.388	2630773.249	1080.219	SPOT
8818	448478.423	2630774.966	1082.069	SPOT
8819	448473.621	2630776.728	1082.874	SPOT
8820	448465.399	2630780.404	1085.842	SPOT
8821	448484.815	2630771.895	1077.903	SPOT
8822	448496.348	2630766.999	1077.432	SPOT CL
8823	448490.105	2630769.437	1077.029	SPOT
8824	448502.777	2630764.085	1077.926	SPOT
8825	448462.336	2630781.182	1089.993	SPOT
8826	448461.237	2630781.813	1090.288	SPOT
8827	448451.897	2630784.309	1091.265	SPOT
8828	448445.93	2630786.6	1091.638	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8829	449949.11	2633184.288	1081.935	SPOT
8830	449955.529	2633189.891	1081.518	SPOT
8831	449959.358	2633193.424	1080.832	SPOT
8832	449959.914	2633194.142	1078.412	SPOT
8833	449963.709	2633196.886	1074.996	SPOT
8834	449965.435	2633198.105	1075.179	SPOT
8835	449967.37	2633199.016	1073.177	SPOT
8836	449967.928	2633199.359	1071.767	SPOT
8837	450048.98	2633260.44	1082.155	SPOT
8838	450036.609	2633252.628	1080.881	SPOT
8839	450030.85	2633248.714	1078.388	SPOT
8840	450022.022	2633242.602	1077.415	SPOT
8841	450016.181	2633238.512	1076.502	SPOT
8842	450016.134	2633238.553	1076.446	SPOT
8843	450014.561	2633237.25	1075.3	SPOT
8844	450010.3	2633234.228	1073.885	SPOT
8845	450005.881	2633230.486	1071.014	SPOT
8846	450007.705	2633232.482	1073.099	SPOT
8847	449969.461	2633200.382	1070.516	SPOT
8848	449978.14	2633207.789	1069.763	SPOT
8849	449985.208	2633213.297	1070.325	SPOT CL
8850	449991.554	2633219.394	1070.383	SPOT
8851	449998.988	2633225.862	1069.814	SPOT
8852	449960.305	2632910.345	1079.337	SPOT
8853	449968.495	2632904.697	1079.373	SPOT
8854	449970.76	2632902.84	1077.868	SPOT
8855	449975.208	2632899.824	1075.59	SPOT
8856	449976.775	2632898.563	1072.939	SPOT
8857	449979.058	2632897.252	1072.603	SPOT
8858	449981.858	2632895.466	1069.718	SPOT
8859	449989.101	2632891.202	1070.838	SPOT
8860	450001.544	2632882.735	1071.477	SPOT
8861	450007.804	2632879.142	1071.613	SPOT
8862	450010.765	2632877.541	1071.972	SPOT
8863	450011.94	2632876.448	1072.842	SPOT
8864	450016.761	2632874.036	1075.016	SPOT
8865	450024.019	2632868.032	1076.49	SPOT
8866	450033.166	2632860.713	1077.926	SPOT
8867	450048.043	2632848.704	1077.712	SPOT
8868	449994.722	2632887.241	1070.779	SPOT CL
8869	450032.317	2632518.129	1079.213	SPOT
8870	450038.387	2632509.886	1079.991	SPOT
8871	450048.91	2632500.492	1081.492	SPOT
8872	450053.086	2632496.425	1080.874	SPOT
8873	450059.287	2632489.716	1077.505	SPOT
8874	450063.964	2632484.107	1076.053	SPOT
8875	450064.983	2632482.525	1073.369	SPOT
8876	450065.876	2632480.807	1072.709	SPOT
8877	450084.342	2632458.921	1072.63	SPOT
8878	450092.266	2632447.145	1072.706	SPOT
8879	450094.168	2632444.425	1075.104	SPOT
8880	450095.724	2632442.929	1077.24	SPOT
8881	450096.945	2632441.589	1081.536	SPOT
8882	450107.838	2632427.252	1082.886	SPOT
8883	450126.457	2632402.878	1081.235	SPOT
8884	450082.842	2632461.495	1072.38	SPOT
8885	450079.903	2632465.959	1071.842	SPOT
8886	450076.203	2632470.408	1070.906	SPOT CL

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8887	450071.866	2632474.238	1070.617	SPOT
8888	450066.783	2632479.405	1071.95	SPOT
8889	450088.51	2632453.359	1073.083	SPOT
8890	449711.008	2632438.633	1077.585	SPOT
8891	449715.253	2632443.299	1078.07	SPOT
8892	449710.265	2632456.97	1077.884	SPOT
8893	449704.848	2632468.809	1077.011	SPOT
8894	449703.931	2632470.309	1075.596	SPOT
8895	449702.568	2632473.193	1075.104	SPOT
8896	449700.834	2632476.54	1074.913	SPOT
8897	449699.261	2632479.096	1073.563	SPOT
8898	449697.29	2632486.361	1071.31	SPOT
8899	449695.835	2632492.989	1071.414	SPOT CL
8900	449694.503	2632498.138	1071.954	SPOT
8901	449691.501	2632504.647	1072.784	SPOT
8902	449691.054	2632505.505	1074.54	SPOT
8903	449688.241	2632511.598	1076.117	SPOT
8904	449687.13	2632513.431	1077.544	SPOT
8905	449686.256	2632515.271	1078.246	SPOT
8906	449681.997	2632519.832	1079.054	SPOT
8907	449679.203	2632528.864	1079.414	SPOT
8908	449671.259	2632547.204	1080.828	SPOT
8909	449371.043	2632334.936	1104.131	SPOT
8910	449366.146	2632340.744	1103.661	SPOT
8911	449357.41	2632351.118	1103.135	SPOT
8912	449352.544	2632356.858	1102.517	SPOT
8913	449351.062	2632358.399	1101.784	SPOT
8914	449340.794	2632371.647	1090.814	SPOT
8915	449334.533	2632378.558	1085.142	SPOT
8916	449330.237	2632383.064	1081.338	SPOT
8917	449327.869	2632385.821	1076.978	SPOT
8918	449325.022	2632388.169	1076.062	SPOT
8919	449322.809	2632389.704	1074.066	SPOT
8920	449318.145	2632396.693	1072.769	SPOT
8921	449312.859	2632403.053	1072.515	SPOT CL
8922	449305.636	2632409.349	1073.643	SPOT
8923	449302.044	2632414.177	1073.962	SPOT
8924	449299.57	2632417.838	1074.276	SPOT
8925	449298.964	2632418.568	1074.869	SPOT
8926	449297.701	2632419.192	1076.56	SPOT
8927	449294.669	2632424.515	1077.162	SPOT
8928	449291.216	2632429.273	1077.896	SPOT
8929	449290.373	2632431.273	1080.495	SPOT
8930	449289.645	2632432.473	1081.602	SPOT
8931	449283.272	2632438.85	1082.991	SPOT
8932	449266.445	2632462.213	1081.653	SPOT
8933	448853.241	2632377.579	1083.401	SPOT
8934	448857.226	2632365.738	1082.344	SPOT
8935	448860.829	2632351.553	1080.9	SPOT
8936	448862.628	2632345.882	1079.872	SPOT
8937	448864.046	2632340.897	1079.187	SPOT
8938	448865.052	2632337.551	1077.124	SPOT
8939	448865.768	2632335.097	1074.777	SPOT
8940	448867.253	2632330.575	1073.642	SPOT
8941	448868.334	2632324.37	1073.843	SPOT
8942	448869.923	2632317.824	1072.509	SPOT CL
8943	448872.611	2632311.458	1072.474	SPOT
8944	448872.975	2632305.707	1073.704	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
8945	448873.515	2632303.893	1074.681	SPOT
8946	448874.434	2632298.879	1075.325	SPOT
8947	448874.934	2632297.074	1077.059	SPOT
8948	448877.147	2632289.824	1079.813	SPOT
8949	448879.472	2632283.695	1085.66	SPOT
8950	448879.726	2632282.726	1088.035	SPOT
8951	448898.084	2632247.417	1091.249	SPOT
8952	448889.342	2632264.485	1090.213	SPOT
8953	448882.176	2632274.545	1090.288	SPOT
8954	448723.172	2632579.618	1085.264	SPOT
8955	448730.127	2632583.49	1085.597	SPOT
8956	448752.226	2632600.147	1085.535	SPOT
8957	448768.487	2632613.787	1085.427	SPOT
8958	448722.118	2632578.946	1082.039	SPOT
8959	448719.095	2632577.38	1079.55	SPOT
8960	448685.626	2632561.851	1073.692	SPOT
8961	448683.621	2632560.801	1074.895	SPOT
8962	448682.446	2632559.915	1076.942	SPOT
8963	448680.696	2632559.137	1077.207	SPOT
8964	448680.153	2632558.457	1078.823	SPOT
8965	448679.151	2632557.933	1079.462	SPOT
8966	448675.002	2632554.924	1078.965	SPOT
8967	448673.595	2632552.945	1080.489	SPOT
8968	448666.997	2632551.931	1081.184	SPOT
8969	448648.931	2632540.114	1081.49	SPOT
8970	448689.463	2632563.858	1073.749	SPOT
8971	448694.75	2632566.274	1073.719	SPOT
8972	448699.861	2632568.015	1073.821	SPOT CL
8973	448705.329	2632570.846	1073.67	SPOT
8974	448710.655	2632572.661	1073.92	SPOT
8975	448713.987	2632574.766	1073.811	SPOT
8976	448714.747	2632575.011	1075.293	SPOT
8977	448594.687	2632609.513	1082.364	SPOT
8978	448584.34	2632606.482	1083.437	SPOT
8979	448572.378	2632603.369	1083.834	SPOT
8980	448569.961	2632602.374	1083.791	SPOT
8981	448568.394	2632601.66	1080.834	SPOT
8982	448564.711	2632600.598	1078.994	SPOT
8983	448562.176	2632600.087	1078.322	SPOT
8984	448561.065	2632599.587	1075.919	SPOT
8985	448558.75	2632598.653	1074.816	SPOT
8986	448552.073	2632596.331	1074.545	SPOT
8987	448544.779	2632594.529	1075.499	SPOT
8988	448550.112	2632596.41	1074.687	SPOT CL
8989	448541.22	2632593.355	1075.58	SPOT
8990	448537.254	2632592.294	1076.235	SPOT
8991	448523.738	2632588.748	1076.57	SPOT
8992	448513.733	2632583.906	1078.17	SPOT
8993	448501.736	2632580.402	1078.786	SPOT
8994	448495.953	2632577.145	1080.801	SPOT
8995	448464.765	2632569.065	1081.039	SPOT
8996	448201.503	2632422.172	1084.667	SPOT
8997	448212.758	2632399.006	1085.46	SPOT
8998	448217.775	2632384.285	1085.299	SPOT
8999	448218.243	2632383.325	1082.512	SPOT
9000	448219.076	2632381.084	1082.759	SPOT
9001	448219.565	2632380.26	1080.6	SPOT
9002	448220.449	2632378.074	1078.131	SPOT
9003	448221.133	2632376.085	1077.227	SPOT
9004	448221.595	2632374.27	1076.112	SPOT
9005	448223.226	2632366.785	1075.506	SPOT
9006	448225.412	2632360.432	1075.165	SPOT CL
9007	448227.029	2632356.883	1075.662	SPOT
9008	448229.946	2632351.037	1075.494	SPOT
9009	448231.716	2632345.55	1076.122	SPOT
9010	448232.106	2632343.757	1076.71	SPOT
9011	448232.799	2632341.905	1077.318	SPOT
9012	448234.167	2632339.92	1078.608	SPOT
9013	448238.32	2632330.199	1078.641	SPOT
9014	448240.326	2632322.896	1079.044	SPOT
9015	448242.16	2632316.599	1079.523	SPOT
9016	448242.871	2632309.057	1081.839	SPOT
9017	448251.103	2632293.951	1082.448	SPOT
9018	448071.96	2632057.134	1077.936	SPOT
9019	448071.704	2632060.935	1079.77	SPOT
9020	448071.333	2632073.331	1080.688	SPOT
9021	448072.631	2632091.635	1080.508	SPOT
9022	448072.478	2632046.307	1074.424	SPOT
9023	448072.719	2632038.735	1075.033	SPOT CL
9024	448074.059	2632028.85	1074.923	SPOT
9025	448074.862	2632020.671	1075.712	SPOT
9026	448074.884	2632019.048	1076.85	SPOT
9027	448075.671	2632016.908	1078.691	SPOT
9028	448075.413	2632015.265	1079.902	SPOT
9029	448074.925	2632008.942	1080.919	SPOT
9030	448075.702	2632002.121	1084.084	SPOT
9031	448075.102	2632000.1	1089.292	SPOT
9032	448076.36	2631991.083	1089.288	SPOT
9033	448075.745	2631979.347	1088.502	SPOT
9034	448071.929	2632055.155	1076.047	SPOT
9035	448496.768	2631761.301	1082.003	SPOT
9036	448497.39	2631765.569	1081.205	SPOT
9037	448498.062	2631770.578	1080.263	SPOT
9038	448498.351	2631777.968	1080.316	SPOT
9039	448499.437	2631789.209	1080.273	SPOT
9040	448499.51	2631791.639	1080.721	SPOT
9041	448500.515	2631799.969	1079.996	SPOT
9042	448500.72	2631807.585	1078.843	SPOT
9043	448501.696	2631817.375	1077.874	SPOT
9044	448502.034	2631820.74	1077.41	SPOT
9045	448502.08	2631824.86	1076.716	SPOT
9046	448503	2631829.842	1076.55	SPOT CL
9047	448505.32	2631837.675	1075.639	SPOT
9048	448510.987	2631867.716	1081.619	SPOT
9049	448509.287	2631862.023	1082.37	SPOT
9050	448509.515	2631856.848	1082.367	SPOT
9051	448509.25	2631854.264	1082.027	SPOT
9052	448509.329	2631852.37	1081.556	SPOT
9053	448508.469	2631850.589	1079.927	SPOT
9054	448508.153	2631848.232	1079.652	SPOT
9055	448507.657	2631846.788	1078.708	SPOT
9056	448507.645	2631845.801	1076.879	SPOT
9057	448501.876	2631475.928	1083.628	SPOT
9058	448510.555	2631465.544	1083.953	SPOT
9059	448514.362	2631461.415	1083.058	SPOT
9060	448518.376	2631456.968	1080.772	SPOT
9061	448521.614	2631453.417	1079.168	SPOT
9062	448524.04	2631450.184	1078.195	SPOT
9063	448538.754	2631427.361	1076.01	SPOT
9064	448571.352	2631393.381	1087.102	SPOT
9065	448562.502	2631402.637	1087.392	SPOT
9066	448555.494	2631410.436	1087.582	SPOT
9067	448551.977	2631413.902	1087.609	SPOT
9068	448551.17	2631414.669	1087.105	SPOT
9069	448550.017	2631415.306	1083.408	SPOT
9070	448549.109	2631416.089	1081.993	SPOT
9071	448546.389	2631418.811	1079.865	SPOT
9072	448542.436	2631421.888	1076.805	SPOT
9073	448544.563	2631420.053	1078.423	SPOT
9074	448535.496	2631433.21	1076.424	SPOT
9075	448533.802	2631438.092	1076.833	SPOT CL
9076	448531.72	2631442.446	1077.345	SPOT
9077	448528.126	2631447.07	1077.919	SPOT
9078	448062.282	2631324.65	1089.09	SPOT
9079	448087.417	2631325.966	1089.076	SPOT
9080	448089.348	2631326.58	1086.041	SPOT
9081	448094.052	2631325.356	1080.063	SPOT
9082	448098.221	2631323.608	1077.929	SPOT
9083	448106.551	2631325.321	1076.141	SPOT
9084	448111.957	2631324.984	1077.336	SPOT CL
9085	448117.189	2631324.94	1077.628	SPOT
9086	448122.7	2631324.812	1078.088	SPOT
9087	448125.921	2631324.725	1078.424	SPOT
9088	448134.557	2631323.82	1079.146	SPOT
9089	448138.118	2631323.445	1080.771	SPOT
9090	448141.937	2631323.071	1081.212	SPOT
9091	448146.225	2631323.054	1083.292	SPOT
9092	448155.791	2631321.566	1084.713	SPOT
9093	448175.699	2631321.42	1085.14	SPOT
9094	448165.747	2631321.985	1085.398	SPOT
9095	448100.821	2631324.764	1075.987	SPOT
9096	448398.145	2631183.084	1085.443	SPOT
9097	448408.923	2631171.489	1085.312	SPOT
9098	448416.544	2631162.419	1084.915	SPOT
9099	448419.557	2631158.606	1083.645	SPOT
9100	448421.772	2631155.264	1082.533	SPOT
9101	448422.62	2631154.12	1079.369	SPOT
9102	448423.628	2631151.833	1078.453	SPOT
9103	448428.021	2631142.959	1077.996	SPOT
9104	448431.679	2631137.616	1077.384	SPOT CL
9105	448435.492	2631130.376	1077.223	SPOT
9106	448440.274	2631125.523	1077.148	SPOT
9107	448442.815	2631121.875	1078.259	SPOT
9108	448444.371	2631119.798	1079.086	SPOT
9109	448446.615	2631117.11	1080.625	SPOT
9110	448448.919	2631114.142	1082.469	SPOT
9111	448451.39	2631110.476	1084.673	SPOT
9112	448456.456	2631104.559	1085.861	SPOT
9113	448461.377	2631095.415	1086.759	SPOT
9114	446014.574	2675370.964	924.169	RD B
9115	445977.788	2675364.841	924.119	RD
9116	445940.782	2675359.403	924.025	RD
9117	445907.005	2675354.425	923.991	RD
9118	445867.136	2675349.337	923.811	RD

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9119	445829.451	2675346.379	923.698	RD
9120	445813.911	2675351.071	923.679	RD
9121	445800.81	2675360.896	923.638	RD
9122	445792.634	2675375.144	923.748	RD
9123	445789.186	2675397.219	923.941	RD
9124	445786.214	2675420.225	924.23	RD
9125	445782.746	2675448.23	924.144	RD
9126	445777.014	2675479.351	923.973	RD
9127	445773.045	2675490.019	923.807	RD
9128	445760.038	2675506.372	922.877	RD
9129	445735.108	2675524.054	921.865	RD
9130	445712.646	2675535.557	921.513	RD
9131	445676.962	2675548.446	921.645	RD
9132	445636.546	2675554.947	922.158	RD
9133	445599.817	2675557.921	922.783	RD
9134	445562.476	2675559.149	923.84	RD
9135	445523.637	2675560.125	925.038	RD
9136	445483.711	2675559.894	926.526	RD
9137	445440.725	2675558.59	928.06	RD
9138	445393.214	2675556.988	929.662	RD
9139	445322.177	2675557.287	931.364	RD E
9140	445803.311	2675409.004	922.69	WING B
9141	445804.451	2675409.587	922.678	WING
9142	445797.783	2675422.873	924.014	WING E ABUT B
9143	445797.443	2675421.707	925.162	TC B
9144	445796.721	2675421.616	925.163	TC
9145	445796.568	2675421.475	924.273	BR B
9146	445776.994	2675419.061	924.23	BR
9147	445776.004	2675418.904	925.125	TC1 B
9148	445776.606	2675419.021	925.124	TC1
9149	445775.475	2675420.205	923.98	ABUT E WING B
9150	445765.922	2675391.001	922.669	WING
9151	445766.954	2675390.568	922.508	WING E
9152	445776.034	2675421.288	922.238	LB
9153	445769.164	2675475.971	921.923	LB
9154	445769.121	2675478.415	924.578	TC1
9155	445768.431	2675478.229	924.782	TC1 CLOSE
9156	445769.193	2675478.384	923.886	BR
9157	445760	2675487.273	922.68	WING B
9158	445759.186	2675486.638	922.656	WING
9159	445767.909	2675477.088	923.605	ABUT B WING E
9160	445789.224	2675480.822	924.016	BR CLOSE
9161	445789.467	2675481.039	924.955	TC
9162	445790.275	2675481.138	924.886	TC CLOSE
9163	445791.317	2675479.851	923.676	ABUT E WING B
9164	445793.321	2675489.965	922.82	WING
9165	445792.139	2675490.323	922.822	WING E
9166	458192.884	2596616.111	1366.736	CHK HECP 1
9167	445768.894	2675476.826	916.355	SPOT
9168	445769.154	2675474.918	914.85	SPOT
9169	445769.363	2675472.73	913.374	SPOT
9170	445769.816	2675469.951	911.5	SPOT
9171	445770.501	2675464.736	910.938	SPOT
9172	445771.364	2675458.615	912.212	SPOT
9173	445772.089	2675452.554	911.947	SPOT
9174	445772.916	2675446.078	911.687	SPOT
9175	445773.706	2675439.947	911.635	SPOT
9176	445774.241	2675435.966	911.873	SPOT

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9177	445774.508	2675433.773	913.298	SPOT
9178	445774.971	2675429.871	915.007	SPOT
9179	445775.192	2675428.171	915.318	SPOT
9180	445775.554	2675424.434	916.016	SPOT
9181	445775.954	2675420.593	915.329	SPOT
9182	445683.094	2675534.534	921.147	SPOT
9183	445686.144	2675522.837	920.412	SPOT
9184	445689.09	2675510.73	920.026	SPOT
9185	445692.621	2675497.592	920.407	SPOT
9186	445695.949	2675487.608	920.1	SPOT
9187	445697.195	2675485.287	918.793	SPOT
9188	445697.752	2675484.403	917.929	SPOT
9189	445697.848	2675483.281	912.821	SPOT
9190	445915.431	2675549.683	919.804	SPOT
9191	445916.164	2675531.609	919.96	SPOT
9192	445917.167	2675515.681	920.419	SPOT
9193	445917.812	2675504.175	919.275	SPOT
9194	445917.955	2675501.835	915.095	SPOT
9195	445917.742	2675500.866	913.435	SPOT
9196	445722.594	2675375.487	919.794	SPOT
9197	445717.443	2675397.591	920.882	SPOT
9198	445716.104	2675402.693	920.702	SPOT
9199	445714.711	2675406.696	918.317	SPOT
9200	445713.933	2675411.069	918.126	SPOT
9201	445712.438	2675418.076	916.124	SPOT
9202	445710.205	2675428.722	915.918	SPOT
9203	445707.751	2675440.796	915.303	SPOT
9204	445707.356	2675441.522	914.544	SPOT
9205	445706.443	2675443.446	913.695	SPOT
9206	445705.866	2675447.462	912.459	SPOT
9207	445704.847	2675454.6	912.572	SPOT
9208	445703.001	2675461.014	912.454	SPOT
9209	445703.371	2675464.341	912.174	SPOT
9210	445906.246	2675380.181	922.703	SPOT
9211	445906.813	2675404.135	921.637	SPOT
9212	445907.418	2675412.478	920.201	SPOT
9213	445907.653	2675416.002	917.672	SPOT
9214	445908.241	2675429.076	917.3	SPOT
9215	445908.89	2675436.981	916.888	SPOT
9216	445909.141	2675439.52	915.594	SPOT
9217	445910.201	2675447.887	915.635	SPOT
9218	445911.126	2675456.747	915.007	SPOT
9219	445911.344	2675460.224	914.206	SPOT
9220	445912.325	2675469.432	913.602	SPOT
9221	445912.673	2675471.383	912.668	SPOT
9222	445912.415	2675476.773	912.072	SPOT
9223	445913.032	2675481.204	911.879	SPOT
9224	445913.412	2675484.304	911.667	SPOT
9225	445914.173	2675487.255	911.541	SPOT
9226	445914.587	2675488.871	912.225	SPOT
9227	445914.866	2675495.146	912.05	SPOT
9228	446703.874	2680780.924	917.105	BR B
9229	446704.791	2680806.093	917.138	BR
9230	446799.711	2680802.465	917.178	BR
9231	446798.784	2680777.456	917.113	BR CLOSE E
9232	446774.926	2680777.116	915.641	PIER B 1.5W
9233	446775.78	2680804.586	915.748	PIER E 1.5W
9234	446728.888	2680806.529	915.099	PIER B 1.5W

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9235	446728.202	2680778.971	915.612	PIER E 1.5W
9236	446707.284	2680779.844	915.778	LB B
9237	446697.857	2680771.975	914.948	WING B
9238	446706.265	2680779.338	916.983	WING E ABUT B
9239	446708.02	2680807.411	915.611	WING B ABUT E
9240	446699.679	2680816.128	914.832	WING E
9241	446752.441	2680805.684	914.644	PIER B
9242	446751.452	2680778.133	915.496	PIER E
9243	446815.777	2680761.942	915.874	WING B
9244	446797.175	2680776.27	915.321	WING E ABUT B
9245	446797.893	2680803.728	915.472	WING B ABUT E
9246	446806.472	2680811.182	915.881	WING E
9247	446796.85	2680777.274	909.738	SPOT
9248	446794.305	2680777.486	909.388	SPOT
9249	446788.465	2680777.614	904.138	SPOT
9250	446784.156	2680777.901	903.651	SPOT
9251	446780.104	2680778.056	903.131	SPOT
9252	446772.883	2680778.217	902.428	SPOT
9253	446766.546	2680778.584	902.826	SPOT
9254	446761.01	2680778.751	902.533	SPOT
9255	446755.069	2680779.082	903.087	SPOT
9256	446749.429	2680779.225	902.037	SPOT
9257	446743.371	2680779.375	900.634	SPOT
9258	446737.226	2680779.494	901.513	SPOT
9259	446731.269	2680779.83	902.155	SPOT
9260	446725.87	2680780.028	904.217	SPOT
9261	446719.452	2680780.322	903.766	SPOT
9262	446715.836	2680780.367	907.277	SPOT
9263	446707.171	2680780.701	911.461	SPOT
9264	446839.201	2680958.45	911.452	SPOT
9265	446832.614	2680958.775	911.269	SPOT
9266	446826.638	2680959.883	909.661	SPOT
9267	446819.811	2680961.027	907.804	SPOT
9268	446815.378	2680961.776	907.583	SPOT
9269	446810.304	2680962.626	908.11	SPOT
9270	446805.133	2680963.266	908.448	SPOT
9271	446792.452	2680965.052	908.537	SPOT
9272	446788.776	2680965.559	907.586	SPOT
9273	446787.255	2680965.787	906.297	SPOT
9274	446779.955	2680966.345	905.251	SPOT
9275	446778.13	2680966.377	904.811	SPOT
9276	446774.112	2680967.025	904.651	SPOT
9277	446768.004	2680968.119	904.514	SPOT
9278	446763.032	2680969.128	903.997	SPOT
9279	446758.671	2680970.013	903.382	SPOT
9280	446755.126	2680971.074	902.959	SPOT
9281	446750.159	2680972.63	902.863	SPOT
9282	446747.612	2680972.834	902.481	SPOT
9283	446745.148	2680972.768	901.997	SPOT
9284	446740.179	2680974.958	901.694	SPOT
9285	446736.981	2680974.114	901.331	SPOT
9286	446835.347	2680486.799	908.4	SPOT
9287	446832.345	2680487.418	908.175	SPOT
9288	446828.897	2680487.959	906.839	SPOT
9289	446825.084	2680488.66	906.698	SPOT
9290	446821.052	2680489.555	906.438	SPOT
9291	446820.086	2680489.623	905.764	SPOT
9292	446816.974	2680490.583	905.822	SPOT

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9293	446814.273	2680491.322	906.285	SPOT
9294	446807.554	2680493.341	906.076	SPOT
9295	446804.055	2680494.537	905.622	SPOT
9296	446797.684	2680496.818	905.068	SPOT
9297	446792.388	2680499.429	904.266	SPOT
9298	446785.869	2680500.943	903.429	SPOT
9299	446780.812	2680501.893	902.481	SPOT
9300	446778.423	2680502.72	901.827	SPOT
9301	446777.05	2680503.131	901.615	SPOT
9302	446722.779	2680526.734	909.291	SPOT
9303	446732.62	2680522.135	909.168	SPOT
9304	446740.922	2680518.43	909.512	SPOT
9305	446757.723	2680511.836	909.929	SPOT
9306	446759.547	2680511.291	905.142	SPOT
9307	446760.929	2680511.002	903.957	SPOT
9308	446763.965	2680510.32	902.184	SPOT
9309	446764.986	2680506.371	901.578	SPOT
9310	446694.229	2680985.714	913.546	SPOT
9311	446704.916	2680983.173	913.604	SPOT
9312	446710.916	2680981.603	913.256	SPOT
9313	446719.156	2680980.143	909.67	SPOT
9314	446723.56	2680978.926	908.121	SPOT
9315	446726.634	2680977.862	902.36	SPOT
9316	443912.033	2670231.158	952.845	CHK Y 417 RESET
9317	446504.717	2680800.447	919.242	RD B
9318	446536.853	2680799.327	919.094	RD
9319	446576.26	2680798.382	918.191	RD
9320	446616.709	2680797.273	917.631	RD
9321	446656.404	2680795.593	917.377	RD
9322	446687.306	2680794.372	917.308	RD
9323	446704.501	2680793.488	917.175	RD
9324	446741.797	2680792.061	917.084	RD
9325	446799.255	2680790.162	917.172	RD
9326	446849.344	2680787.664	917.281	RD
9327	446889.337	2680786.159	917.717	RD
9328	446938.227	2680784.165	918.426	RD
9329	446979.679	2680782.628	919.057	RD
9330	447028.419	2680780.896	919.434	RD B
9331	446720.641	2680018.419	909.349	SPOT
9332	446733.764	2680021.293	907.828	SPOT
9333	446745.727	2680021.772	908.349	SPOT
9334	446756.903	2680022.24	908.84	SPOT
9335	446767.576	2680021.278	908.527	SPOT
9336	446770.995	2680021.241	906.074	SPOT
9337	446773.184	2680021.112	904.859	SPOT
9338	446776.304	2680021.101	903.642	SPOT
9339	446782.863	2680020.278	903.53	SPOT
9340	446790.393	2680019.125	903.619	SPOT
9341	446795.068	2680018.461	903.045	SPOT
9342	446798.578	2680017.888	902.737	SPOT
9343	446800.821	2680017.486	902.575	SPOT
9344	446291.71	2679747.189	923.608	SPOT
9345	446306.527	2679741.527	923.917	SPOT
9346	446322.527	2679735.708	922.162	SPOT
9347	446331.642	2679732.545	920.967	SPOT
9348	446335.118	2679731.083	919.729	SPOT
9349	446337.67	2679730.343	916.842	SPOT
9350	446342.976	2679728.086	911.557	SPOT

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9351	446347.114	2679725.552	910.226	SPOT
9352	446349.943	2679724.531	908.05	SPOT
9353	446351.759	2679723.509	907.244	SPOT
9354	446352.596	2679722.989	905.301	SPOT
9355	446355.114	2679722.967	903.092	SPOT
9356	446356.995	2679721.852	902.871	SPOT
9357	446358.164	2679720.32	902.799	SPOT
9358	446359.906	2679719.223	902.64	SPOT
9359	446360.714	2679718.72	902.52	SPOT
9360	446182.126	2679152.694	926.307	SPOT
9361	446193.708	2679160.676	921.952	SPOT
9362	446197.636	2679162.19	920.215	SPOT
9363	446201.418	2679163.595	917.4	SPOT
9364	446206.605	2679167.224	914.396	SPOT
9365	446214.157	2679172.409	911.018	SPOT
9366	446221.884	2679178.552	909.299	SPOT
9367	446228.098	2679182.639	909.892	SPOT
9368	446234.834	2679187.086	910.66	SPOT
9369	446247.395	2679194.223	909.904	SPOT
9370	446248.535	2679194.858	908.506	SPOT
9371	446249.184	2679195.881	907.027	SPOT
9372	446249.897	2679196.859	905.215	SPOT
9373	446252.045	2679197.426	904.598	SPOT
9374	446255.179	2679198.556	904.537	SPOT
9375	446261.147	2679200.775	904.777	SPOT
9376	446266.763	2679203.786	904.939	SPOT
9377	446270.102	2679205.201	904.528	SPOT
9378	446273.004	2679207.225	904.189	SPOT
9379	446275.988	2679209.279	903.93	SPOT
9380	446578.711	2678763.994	914.189	SPOT
9381	446581.993	2678777.713	913.104	SPOT
9382	446582.042	2678779.908	910.501	SPOT
9383	446582.208	2678784.123	909.782	SPOT
9384	446583.846	2678799.951	910.774	SPOT
9385	446583.345	2678815.363	910.911	SPOT
9386	446584.057	2678821.309	911.23	SPOT
9387	446584.378	2678826.355	909.368	SPOT
9388	446583.556	2678833.384	909.624	SPOT
9389	446583.96	2678838.435	910.007	SPOT
9390	446584.181	2678840.901	907.446	SPOT
9391	446583.19	2678842.839	906.846	SPOT
9392	446584.195	2678844.817	905.072	SPOT
9393	446585.465	2678847.663	904.57	SPOT
9394	446586.009	2678849.974	904.101	SPOT
9395	446844.76	2678810.309	912.968	SPOT
9396	446850.312	2678818.094	913.428	SPOT
9397	446854.401	2678824.998	913.058	SPOT
9398	446856.749	2678828.174	912.768	SPOT
9399	446857.456	2678830.345	910.418	SPOT
9400	446858.931	2678834.494	910.125	SPOT
9401	446863.177	2678838.751	909.66	SPOT
9402	446866.066	2678842.834	909.322	SPOT
9403	446867.864	2678845.668	908.261	SPOT
9404	446868.847	2678847.372	907.651	SPOT
9405	446870.799	2678849.948	907.164	SPOT
9406	446875.011	2678854.888	907.082	SPOT
9407	446880.073	2678860.074	906.314	SPOT
9408	446881.787	2678862.193	905.995	SPOT

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9409	446885.466	2678866.707	905.297	SPOT
9410	446887.665	2678869.505	904.76	SPOT
9411	447320.596	2678454.129	914.918	SPOT
9412	447326.988	2678460.738	915.631	SPOT
9413	447332.705	2678467.998	915.292	SPOT
9414	447340.78	2678475.173	915.332	SPOT
9415	447345.662	2678479.938	914.981	SPOT
9416	447347.073	2678482.847	912.791	SPOT
9417	447349.457	2678484.264	911.249	SPOT
9418	447350.961	2678485.255	910.189	SPOT
9419	447354.965	2678488.952	909.049	SPOT
9420	447357.102	2678491.251	908.058	SPOT
9421	447359.419	2678493.428	907.856	SPOT
9422	447364.346	2678498.007	907.976	SPOT
9423	447368.07	2678501.696	906.809	SPOT
9424	447370.068	2678503.731	906.354	SPOT
9425	447372.826	2678505.906	905.939	SPOT
9426	447374.736	2678507.66	906.074	SPOT
9427	447292.754	2678109.342	915.218	SPOT
9428	447309.884	2678108.35	913.884	SPOT
9429	447323.155	2678106.579	912.989	SPOT
9430	447330.287	2678106.461	911.841	SPOT
9431	447335.687	2678105.97	911.904	SPOT
9432	447342.598	2678105.268	911.246	SPOT
9433	447346.094	2678104.682	909.801	SPOT
9434	447348.997	2678104.864	908.831	SPOT
9435	447355.206	2678104.318	908.323	SPOT
9436	447359.72	2678103.607	907.437	SPOT
9437	447365.866	2678101.792	907.127	SPOT
9438	447372.532	2678099.698	907.091	SPOT
9439	447374.849	2678098.877	907.114	SPOT
9440	446897.431	2677899.847	915.81	SPOT
9441	446913.955	2677882.668	916.854	SPOT
9442	446921.752	2677875.297	915.93	SPOT
9443	446926.56	2677872.775	915.286	SPOT
9444	446931.614	2677869.378	915	SPOT
9445	446933.851	2677868.083	912.938	SPOT
9446	446935.766	2677866.058	910.805	SPOT
9447	446937.269	2677865.135	910.544	SPOT
9448	446938.13	2677864.238	908.877	SPOT
9449	446939.559	2677862.133	908.973	SPOT
9450	446944.04	2677859.971	908.903	SPOT
9451	446949.961	2677854.873	908.72	SPOT
9452	446952.605	2677852.155	908.348	SPOT
9453	446952.508	2677851.983	908.32	SPOT
9454	446956.438	2677847.276	907.775	SPOT
9455	446958.604	2677844.42	907.264	SPOT
9456	446549.781	2677820.864	925.668	SPOT
9457	446557.322	2677814.249	925.805	SPOT
9458	446563.052	2677811.165	922.126	SPOT
9459	446569.291	2677805.321	918.965	SPOT
9460	446571.579	2677803.082	916.515	SPOT
9461	446577.617	2677796.733	914.984	SPOT
9462	446578.12	2677796.077	914.054	SPOT
9463	446579.891	2677793.821	912.602	SPOT
9464	446580.368	2677793.102	911.191	SPOT
9465	446580.993	2677792.239	908.85	SPOT
9466	446582.396	2677790.806	907.337	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
9467	446512.003	2677425.128	918.142	SPOT
9468	446517.29	2677423.432	918.627	SPOT
9469	446523.622	2677421.517	917.402	SPOT
9470	446527.191	2677420.641	916.066	SPOT
9471	446535.508	2677419.022	914.913	SPOT
9472	446542.109	2677416.352	915.077	SPOT
9473	446546.513	2677414.552	913.762	SPOT
9474	446551.027	2677413.306	913.123	SPOT
9475	446554.995	2677412.146	913.317	SPOT
9476	446556.534	2677412.059	911.979	SPOT
9477	446557.357	2677412.073	910.377	SPOT
9478	446559.053	2677412.253	909.735	SPOT
9479	446563.955	2677411.276	909.52	SPOT
9480	446569.57	2677408.299	908.978	SPOT
9481	446572.179	2677407.223	908.377	SPOT
9482	446398.905	2677007.815	919.859	SPOT
9483	446413.12	2677011.348	919.661	SPOT
9484	446425.99	2677013.579	918.948	SPOT
9485	446433.234	2677014.606	916.763	SPOT
9486	446438.196	2677015.785	915.463	SPOT
9487	446439.686	2677016.316	911.051	SPOT
9488	446441.792	2677016.808	910.027	SPOT
9489	446443.321	2677017.158	909.437	SPOT
9490	446447	2677017.337	910.526	SPOT
9491	446453.355	2677017.856	909.867	SPOT
9492	446458.169	2677018.559	909.942	SPOT
9493	446461.826	2677018.934	909.824	SPOT
9494	446465.639	2677020.3	909.497	SPOT
9495	446467.754	2677020.815	909.179	SPOT
9496	446469.711	2677021.62	908.776	SPOT
9497	446520.165	2676444.308	917.059	SPOT
9498	446526.314	2676451.659	917.276	SPOT
9499	446528.55	2676456.047	915.575	SPOT
9500	446534.213	2676461.751	915.605	SPOT
9501	446541.31	2676471.746	915.311	SPOT
9502	446545.637	2676477.141	915.46	SPOT
9503	446547.717	2676479.974	913.033	SPOT
9504	446549.528	2676482.229	911.275	SPOT
9505	446552.919	2676487.393	911.559	SPOT
9506	446557.258	2676492.529	912.512	SPOT
9507	446562.094	2676497.697	911.659	SPOT
9508	446567.289	2676502.941	911.193	SPOT
9509	446570.894	2676506.776	910.295	SPOT
9510	446575.14	2676510.861	910.142	SPOT
9511	446578.91	2676515.105	910.533	SPOT
9512	446591.074	2676196.988	919.558	SPOT
9513	446602.775	2676186.98	919.179	SPOT
9514	446608.084	2676181.474	919.118	SPOT
9515	446608.461	2676180.388	915.49	SPOT
9516	446609.272	2676178.819	915.173	SPOT
9517	446610.566	2676177.18	913.852	SPOT
9518	446612.873	2676175.521	913.584	SPOT
9519	446613.267	2676175.044	913.14	SPOT
9520	446615.099	2676173.27	910.362	SPOT
9521	446616.118	2676170.717	909.209	SPOT
9522	446471.516	2675705.145	919.981	SPOT
9523	446481.704	2675693.253	919.707	SPOT
9524	446490.446	2675682.109	918.517	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
9525	446494.759	2675675.992	919.131	SPOT
9526	446497.726	2675670.432	918.923	SPOT
9527	446498.481	2675669.299	915.692	SPOT
9528	446499.138	2675668.454	913.792	SPOT
9529	446500.933	2675666.308	912.495	SPOT
9530	446502.215	2675664.656	911.629	SPOT
9531	446505.04	2675659.98	911.348	SPOT
9532	446507.948	2675654.571	911.32	SPOT
9533	446510.144	2675648.98	911.226	SPOT
9534	446510.712	2675645.915	910.601	SPOT
9535	445219.297	2675308.526	921.534	SPOT
9536	445233.368	2675297.688	921.755	SPOT
9537	445242.753	2675288.692	921.844	SPOT
9538	445244.452	2675287.606	920.956	SPOT
9539	445249.302	2675287.81	915.751	SPOT
9540	445250.214	2675286.556	915.007	SPOT
9541	445252.451	2675283.402	915.164	SPOT
9542	445253.51	2675281.02	914.168	SPOT
9543	445254.973	2675278.623	912.798	SPOT
9544	445255.979	2675277.15	912.04	SPOT
9545	445256.366	2675275.458	911.662	SPOT
9546	445057.329	2674835.058	926.377	SPOT
9547	445063.155	2674836.902	924.731	SPOT
9548	445067.872	2674837.904	924.465	SPOT
9549	445073.014	2674838.916	919.377	SPOT
9550	445074.225	2674839.123	918.714	SPOT
9551	445075.626	2674839.418	916.588	SPOT
9552	445078.143	2674840.442	915.452	SPOT
9553	445081.926	2674841.792	913.789	SPOT
9554	445085.858	2674842.889	913.931	SPOT
9555	445088.814	2674842.908	913.467	SPOT
9556	445253.798	2674427.167	942.958	SPOT
9557	445242.372	2674415.726	942.13	SPOT
9558	445259.812	2674429.376	940.528	SPOT
9559	445277.638	2674445.382	923.067	SPOT
9560	445277.819	2674446.104	920.352	SPOT
9561	445280.428	2674449.222	916.517	SPOT
9562	445281.213	2674450.609	915.413	SPOT
9563	445283.817	2674453.295	915.338	SPOT
9564	445287.693	2674455.551	914.603	SPOT
9565	445803.707	2674390.678	925.063	SPOT
9566	445792.317	2674396.375	923.598	SPOT
9567	445816.563	2674411.928	924.288	SPOT
9568	445807.537	2674415.621	922.402	SPOT
9569	445795.432	2674419.94	922.21	SPOT
9570	445785.77	2674423.851	921.141	SPOT
9571	445775.88	2674427.332	919.21	SPOT
9572	445763.67	2674431.782	918.704	SPOT
9573	445760.284	2674433.165	918.234	SPOT
9574	445758.414	2674434.069	917.236	SPOT
9575	445755.764	2674435.051	916.008	SPOT
9576	445751.692	2674436.799	915.527	SPOT
9577	445746.111	2674439.641	915.077	SPOT
9578	445741.354	2674441.744	915.01	SPOT
9579	445737.3	2674442.952	914.63	SPOT
9580	445734.016	2674444.27	914.449	SPOT
9581	446077.788	2674724.485	923.076	SPOT
9582	446072.733	2674733.314	923.337	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
9583	446067.703	2674741.747	921.737	SPOT
9584	446063.726	2674747.552	921.908	SPOT
9585	446059.765	2674753.723	922.317	SPOT
9586	446048.849	2674767.965	922.557	SPOT
9587	446041.757	2674777.591	922.881	SPOT
9588	446037.005	2674783.908	922.532	SPOT
9589	446031.723	2674790.794	921.738	SPOT
9590	446029.722	2674794.638	920.323	SPOT
9591	446028.452	2674796.45	918.783	SPOT
9592	446026.77	2674798.157	917.752	SPOT
9593	446024.972	2674800.816	916.825	SPOT
9594	446022.85	2674803.678	916.284	SPOT
9595	446020.551	2674807.731	915.518	SPOT
9596	446019.924	2674810.069	914.819	SPOT
9597	446019.429	2674812.131	914.404	SPOT
9598	442985.413	2665762.415	953.786	SPOT
9599	442998.542	2665765.147	954.004	SPOT
9600	443014.954	2665769.394	953.833	SPOT
9601	443022.799	2665771.296	950.75	SPOT
9602	443028.556	2665772.66	947.685	SPOT
9603	443031.673	2665773.183	943.696	SPOT
9604	443033.251	2665774.314	942.84	SPOT
9605	443035.519	2665774.273	942.94	SPOT
9606	443042.18	2665775.93	943.098	SPOT
9607	443047.537	2665777.119	942.872	SPOT
9608	443052.306	2665778.261	942.709	SPOT
9609	443058.483	2665779.133	942.248	SPOT
9610	443067.51	2665781.627	941.842	SPOT
9611	443070.221	2665782.158	941.519	SPOT
9612	443072.544	2665782.615	941.389	SPOT
9613	442906.587	2666262.772	949.44	SPOT
9614	442921.705	2666268.582	948.726	SPOT
9615	442928.168	2666271.661	948.223	SPOT
9616	442933.012	2666274.317	948.333	SPOT
9617	442937.259	2666276.345	946.784	SPOT
9618	442944.915	2666281.869	945.759	SPOT
9619	442947.508	2666283.602	946.021	SPOT
9620	442950.922	2666286.678	945.519	SPOT
9621	442952.338	2666287.762	944.45	SPOT
9622	442953.578	2666289.414	943.507	SPOT
9623	442956.391	2666291.851	942.874	SPOT
9624	442961.885	2666296.238	942.705	SPOT
9625	442968.601	2666301.088	942.293	SPOT
9626	442975.286	2666306.028	941.703	SPOT
9627	442981.79	2666311.327	941.589	SPOT
9628	442987.222	2666316.044	941.348	SPOT
9629	442989.581	2666317.541	941.505	SPOT
9630	442577.746	2666543.713	946.945	SPOT
9631	442579.707	2666546.594	946.157	SPOT
9632	442584.505	2666555.988	946.913	SPOT
9633	442588.064	2666565.679	946.931	SPOT
9634	442590.077	2666572.753	947.023	SPOT
9635	442591.892	2666578.524	946.737	SPOT
9636	442592.613	2666580.169	943.437	SPOT
9637	442593.462	2666584.046	941.445	SPOT
9638	442595.03	2666586.238	940.975	SPOT
9639	442596.032	2666588.43	941.456	SPOT
9640	442597.385	2666592.11	941.159	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
9641	442598.036	2666594.267	940.522	SPOT
9642	442598.776	2666597.08	939.719	SPOT
9643	442599.202	2666598.211	939.531	SPOT
9644	442342.235	2667031.396	951.002	SPOT
9645	442348.035	2667036.466	950.755	SPOT
9646	442351.606	2667042.787	948.036	SPOT
9647	442356.529	2667049.955	945.471	SPOT
9648	442361.99	2667056.599	945.124	SPOT
9649	442365.718	2667061.208	944.856	SPOT
9650	442368.551	2667064.401	943.801	SPOT
9651	442369.808	2667065.683	942.44	SPOT
9652	442370.114	2667066.663	938.604	SPOT
9653	442373.471	2667069.537	938.373	SPOT
9654	442374.957	2667070.13	938.347	SPOT
9655	442134.955	2667516.081	945.084	SPOT
9656	442140.677	2667532.516	944.757	SPOT
9657	442144.618	2667539.43	943.481	SPOT
9658	442146.468	2667543.047	942.462	SPOT
9659	442149.857	2667547.617	942.499	SPOT
9660	442151.878	2667550.369	941.626	SPOT
9661	442152.48	2667552.26	940.469	SPOT
9662	442155.029	2667556.836	939.546	SPOT
9663	442158.74	2667566.099	939.26	SPOT
9664	442162.082	2667574.439	938.646	SPOT
9665	442166.351	2667583.606	938.276	SPOT
9666	442167.289	2667586.504	938.101	SPOT
9667	443911.962	2670231.144	952.839	CHK Y417
9668	446280.369	2674655.677	924.499	SPOT
9669	446287.152	2674672.295	923.406	SPOT
9670	446290.049	2674678.83	924.145	SPOT
9671	446295.586	2674690.732	924.1	SPOT
9672	446298.883	2674698.389	924.024	SPOT
9673	446301.68	2674704.95	923.464	SPOT
9674	446302.61	2674706.71	921.218	SPOT
9675	446304.017	2674708.499	919.113	SPOT
9676	446304.568	2674709.706	918.616	SPOT
9677	446304.577	2674710.245	917.684	SPOT
9678	446305.725	2674713.152	916.292	SPOT
9679	446306.928	2674715.544	915.781	SPOT
9680	446309.56	2674718.511	916.154	SPOT
9681	446311.937	2674720.356	915.732	SPOT
9682	446313.341	2674722.334	915.539	SPOT
9683	446550.153	2674293.995	924.222	SPOT
9684	446559.615	2674298.676	925.11	SPOT
9685	446565.969	2674302.892	925.499	SPOT
9686	446572.734	2674305.621	925.34	SPOT
9687	446575.787	2674308.345	923.776	SPOT
9688	446577.077	2674309.142	922.506	SPOT
9689	446578.387	2674309.926	920.854	SPOT
9690	446579.946	2674310.624	920.496	SPOT
9691	446581.251	2674311.647	919.173	SPOT
9692	446582.263	2674312.344	918.477	SPOT
9693	446584.132	2674313.681	917.721	SPOT
9694	446586.529	2674314.797	916.539	SPOT
9695	446588.206	2674315.773	915.496	SPOT
9696	446591.52	2674317.102	915.667	SPOT
9697	446594.076	2674317.805	915.951	SPOT
9698	446596.012	2674318.036	915.971	SPOT
9699	446598.281	2674318.881	916.083	SPOT
9700	446601.467	2674320.857	915.938	SPOT
9701	446447.128	2673918.697	926.795	SPOT
9702	446460.43	2673915.469	927.081	SPOT
9703	446470.959	2673915.05	926.322	SPOT
9704	446473.485	2673914.498	923.754	SPOT
9705	446476.822	2673914.414	922.911	SPOT
9706	446484.855	2673913.699	922.149	SPOT
9707	446488.898	2673913.137	921.451	SPOT
9708	446492.041	2673912.993	921.824	SPOT
9709	446504.07	2673911.627	921.828	SPOT
9710	446510.153	2673910.666	921.099	SPOT
9711	446513.843	2673910.377	919.613	SPOT
9712	446518.145	2673909.74	918.831	SPOT
9713	446527.021	2673909.123	918.194	SPOT
9714	446531.726	2673909.817	917.382	SPOT
9715	446538.727	2673908.675	917.31	SPOT
9716	446545.586	2673907.657	917.121	SPOT
9717	446550.206	2673906.726	916.9	SPOT
9718	446553.765	2673905.44	916.312	SPOT
9719	442870.195	2671815.989	928.561	SPOT
9720	442879.901	2671807.76	929.301	SPOT
9721	442891.006	2671797.04	928.835	SPOT
9722	442899.098	2671789.181	928.636	SPOT
9723	442900.703	2671787.851	927.526	SPOT
9724	442901.858	2671786.9	926.32	SPOT
9725	442904.662	2671783.873	925.878	SPOT
9726	442908.688	2671777.437	925.778	SPOT
9727	442912.491	2671771.141	925.671	SPOT
9728	442915.22	2671766.873	925.65	SPOT
9729	442784.52	2671362.39	934.658	SPOT
9730	442798.145	2671367.622	934.555	SPOT
9731	442804.666	2671370.671	934.407	SPOT
9732	442811.478	2671373.807	931.479	SPOT
9733	442818.58	2671377.342	930.92	SPOT
9734	442826.43	2671380.081	931.525	SPOT
9735	442834.182	2671383.177	931.356	SPOT
9736	442836.072	2671383.839	928.946	SPOT
9737	442837.728	2671384.587	926.607	SPOT
9738	442843.122	2671387.948	926.636	SPOT
9739	442849.061	2671390.539	926.748	SPOT
9740	442853.723	2671392.588	926.982	SPOT
9741	442857.856	2671393.747	927.571	SPOT
9742	442862.784	2671395.544	928.028	SPOT
9743	442869.787	2671397.751	928.513	SPOT
9744	442880.416	2671402.484	927.767	SPOT
9745	442887.002	2671405.768	927.808	SPOT
9746	443066.559	2671062.448	937.334	SPOT
9747	443075.218	2671068.582	937.154	SPOT
9748	443087.553	2671076.656	935.167	SPOT
9749	443099.682	2671084.412	933.63	SPOT
9750	443108.975	2671091.167	932.706	SPOT
9751	443116.039	2671095.895	933.116	SPOT
9752	443123.991	2671100.818	933.269	SPOT
9753	443133.396	2671106.412	932.973	SPOT
9754	443136.034	2671106.97	931.731	SPOT
9755	443138.861	2671109.346	930.98	SPOT
9756	443140.194	2671110.285	929.734	SPOT
9757	443143.203	2671113.254	928.941	SPOT
9758	443152.231	2671118.163	928.263	SPOT
9759	443160.847	2671123.495	928.324	SPOT
9760	443171.69	2671129.605	927.784	SPOT
9761	443178.527	2671133.492	927.481	SPOT
9762	443185.017	2671137.373	927.037	SPOT
9763	443186.114	2671138.507	928.505	SPOT
9764	443187.482	2671139.156	929.381	SPOT
9765	443190.048	2671140.93	931.264	SPOT
9766	443192.35	2671142.618	934.51	SPOT
9767	443356.14	2670652.364	932.201	SPOT
9768	443360.382	2670659.525	932.99	SPOT
9769	443364.222	2670666.974	932.517	SPOT
9770	443368.041	2670673.728	931.918	SPOT
9771	443369.502	2670676.457	931.8	SPOT
9772	443370.637	2670678.213	930.407	SPOT
9773	443371.427	2670679.534	929.545	SPOT
9774	443372.584	2670682.28	928.73	SPOT
9775	443376.029	2670687.395	928.606	SPOT
9776	443380.488	2670691.489	928.895	SPOT
9777	443386.208	2670698.919	928.719	SPOT
9778	443392.065	2670705.038	928.403	SPOT
9779	443397.866	2670709.752	927.95	SPOT
9780	443400.168	2670713.062	927.952	SPOT
9781	443341.481	2670623.262	939.259	SPOT
9782	443351.862	2670646.07	936.601	SPOT
9783	444102.118	2669643.449	937.965	SPOT
9784	444116.513	2669657.044	936.915	SPOT
9785	444118.027	2669659.334	935.234	SPOT
9786	444126.751	2669668.121	934.148	SPOT
9787	444134.007	2669675.583	934.24	SPOT
9788	444143.912	2669685.21	933.424	SPOT
9789	444151.417	2669690.841	932.779	SPOT
9790	444153.156	2669692.401	930.722	SPOT
9791	444156.909	2669696.026	929.946	SPOT
9792	444163.951	2669700.853	930.132	SPOT
9793	444173.586	2669708.608	931.371	SPOT
9794	444179.582	2669713.892	930.827	SPOT
9795	444181.392	2669715.194	929.707	SPOT
9796	444186.519	2669719.097	929.77	SPOT
9797	444194.103	2669723.585	928.93	SPOT
9798	444196.585	2669725.445	928.588	SPOT
9799	444202.351	2669219.224	938.397	SPOT
9800	444217.174	2669227.838	937.911	SPOT
9801	444225.222	2669232.538	935.958	SPOT
9802	444230.531	2669235.021	935.51	SPOT
9803	444234.123	2669236.93	934.314	SPOT
9804	444238.361	2669238.694	933.795	SPOT
9805	444238.934	2669239.491	932.096	SPOT
9806	444240.123	2669240.36	930.957	SPOT
9807	444244.557	2669239.849	930.301	SPOT
9808	444250.095	2669242.198	929.766	SPOT
9809	444255.245	2669243.452	929.92	SPOT
9810	444259.108	2669244.398	929.923	SPOT
9811	444463.616	2668696.128	940.361	SPOT
9812	444480.637	2668696.389	940.181	SPOT
9813	444493.181	2668696.132	939.12	SPOT
9814	444500.893	2668696.048	937.823	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
9815	444502.979	2668695.686	936.226	SPOT
9816	444505.496	2668695.527	933.9	SPOT
9817	444507.21	2668695.87	932.267	SPOT
9818	444512.529	2668695.593	932.081	SPOT
9819	444519.438	2668695.571	931.552	SPOT
9820	444525.548	2668695.751	931.781	SPOT
9821	444532.633	2668695.873	931.814	SPOT
9822	444543.86	2668694.541	932.459	SPOT
9823	444551.727	2668694.976	932.492	SPOT
9824	444552.951	2668695.185	934.937	SPOT
9825	444306.763	2668239.403	939.993	SPOT
9826	444311.352	2668233.682	938.79	SPOT
9827	444321.993	2668219.756	938.972	SPOT
9828	444333.027	2668204.226	939.162	SPOT
9829	444338.749	2668196.468	939.07	SPOT
9830	444342.419	2668191.834	938.463	SPOT
9831	444345	2668188.668	937.275	SPOT
9832	444346.237	2668186.79	936.444	SPOT
9833	444346.799	2668186.208	933.836	SPOT
9834	444349.061	2668183.156	933.341	SPOT
9835	444351.307	2668175.686	933.083	SPOT
9836	444352.831	2668171.137	932.417	SPOT
9837	444354.054	2668168.637	932.63	SPOT
9838	443894.204	2668167.783	940.99	SPOT
9839	443888.572	2668159.189	939.853	SPOT
9840	443883.371	2668150.523	939.699	SPOT
9841	443881.077	2668146.711	939.02	SPOT
9842	443878.186	2668141.832	940.041	SPOT
9843	443872.083	2668132.554	940.465	SPOT
9844	443866.516	2668123.352	940.929	SPOT
9845	443863.739	2668118.817	940.849	SPOT
9846	443859.933	2668112.917	939.971	SPOT
9847	443855.355	2668105.726	938.984	SPOT
9848	443852.925	2668102.672	938.841	SPOT
9849	443852.28	2668100.934	938.08	SPOT
9850	443851.801	2668099.853	935.529	SPOT
9851	443849.649	2668095.662	935.271	SPOT
9852	443845.027	2668088.651	934.614	SPOT
9853	443841.247	2668082.682	933.633	SPOT
9854	443838.67	2668079.516	932.954	SPOT
9855	443836.33	2668076.3	933.004	SPOT
9856	443834.569	2668073.564	932.698	SPOT
9857	443832.704	2668072.252	932.488	SPOT
9858	443581.495	2668548.498	943.394	SPOT
9859	443568.839	2668540.798	941.841	SPOT
9860	443560.293	2668535.953	940.102	SPOT
9861	443557.334	2668534.795	939.271	SPOT
9862	443555.012	2668533.46	938.967	SPOT
9863	443553.431	2668532.489	935.826	SPOT
9864	443550.301	2668531.284	934.789	SPOT
9865	443544.706	2668527.9	934.192	SPOT
9866	443543.024	2668526.961	933.566	SPOT
9867	443541.037	2668527.06	933.323	SPOT
9868	443537.938	2668527.328	933.663	SPOT
9869	443911.955	2670231.133	952.847	CHK Y 417 RESET
9870	441800.791	2667780.365	949.477	SPOT
9871	441805.062	2667785.31	949.907	SPOT
9872	441808.834	2667790.352	948.616	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
9873	441813.305	2667794.621	944.881	SPOT
9874	441815.584	2667797.233	942.644	SPOT
9875	441819.726	2667800.736	942.295	SPOT
9876	441823.194	2667804.562	942.174	SPOT
9877	441825.021	2667806.977	940.629	SPOT
9878	441826.535	2667808.383	940.479	SPOT
9879	441827.953	2667810.545	939.754	SPOT
9880	441834.079	2667816.445	939.349	SPOT
9881	441839.88	2667823.304	938.864	SPOT
9882	441842.66	2667826.295	938.678	SPOT
9883	441704.836	2668269.805	943.079	SPOT
9884	441714.508	2668269.951	942.874	SPOT
9885	441722.373	2668270.712	943.485	SPOT
9886	441738.572	2668271.308	943.514	SPOT
9887	441743.193	2668272.135	943.082	SPOT
9888	441749.28	2668272.444	941.571	SPOT
9889	441755.846	2668272.956	940.958	SPOT
9890	441762.243	2668272.971	940.595	SPOT
9891	441766.201	2668273.289	939.042	SPOT
9892	441769.724	2668273.92	938.007	SPOT
9893	441775.975	2668274.155	937.154	SPOT
9894	441780.45	2668273.766	936.663	SPOT
9895	441783.597	2668273.505	936.515	SPOT
9896	441789.084	2668272.96	936.417	SPOT
9897	442021.576	2668570.686	945.198	SPOT
9898	442033.267	2668562.381	943.696	SPOT
9899	442043.415	2668555.539	942	SPOT
9900	442048.3	2668552.151	941.227	SPOT
9901	442052.374	2668548.293	941.241	SPOT
9902	442055.446	2668545.287	940.78	SPOT
9903	442057.089	2668544.184	938.026	SPOT
9904	442061.201	2668541.691	935.758	SPOT
9905	442063.959	2668538.222	936.09	SPOT
9906	442066.75	2668536.046	935.581	SPOT
9907	442067.644	2668534.622	935.593	SPOT
9908	442069.156	2668532.688	935.08	SPOT
9909	442070.307	2668530.289	934.94	SPOT
9910	442571.516	2668838.98	944.071	SPOT
9911	442572.854	2668831.557	942.395	SPOT
9912	442573.97	2668828.714	941.127	SPOT
9913	442575.255	2668825.532	939.819	SPOT
9914	442575.597	2668824.01	935.917	SPOT
9915	442576.031	2668820.111	934.625	SPOT
9916	442577.123	2668816.717	934.735	SPOT
9917	442578.543	2668813.311	935.123	SPOT
9918	442579.833	2668806.829	935.367	SPOT
9919	442581.025	2668803.491	935.71	SPOT
9920	442582.45	2668796.358	936.224	SPOT
9921	442583.918	2668789.069	936.594	SPOT
9922	442586.132	2668779.267	936.47	SPOT
9923	442587.543	2668773.263	936.486	SPOT
9924	443107.454	2668883.34	944.63	SPOT
9925	443096.601	2668870.198	942.679	SPOT
9926	443088.871	2668861.81	941.371	SPOT
9927	443085.69	2668858.997	940.178	SPOT
9928	443083.565	2668856.723	938.539	SPOT
9929	443082.465	2668855.192	937.501	SPOT
9930	443082.034	2668854.202	934.473	SPOT

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9931	443079.391	2668850.796	934.968	SPOT
9932	443074.608	2668846.725	934.935	SPOT
9933	443070.391	2668842.202	935.158	SPOT
9934	443066.795	2668838.813	935.018	SPOT
9935	437319.697	2655644.464	989.372	SPOT
9936	437325.926	2655650.58	988.219	SPOT
9937	437331.135	2655655.347	987.656	SPOT
9938	437332.371	2655657.227	985.401	SPOT
9939	437332.879	2655658.356	983.323	SPOT
9940	437334.149	2655659.59	982.749	SPOT
9941	437338.214	2655664.666	982.17	SPOT
9942	437342.961	2655670.112	981.587	SPOT
9943	437347.745	2655675.684	981.628	SPOT
9944	437351.095	2655679.381	981.086	SPOT
9945	437719.805	2655517.128	989.293	SPOT
9946	437726.986	2655534.92	988.413	SPOT
9947	437732.997	2655548.427	988.729	SPOT
9948	437736.46	2655555.547	987.511	SPOT
9949	437740.588	2655564.776	987.078	SPOT
9950	437741.071	2655566.407	985.044	SPOT
9951	437741.827	2655569.118	984.332	SPOT
9952	437743.492	2655576.491	983.54	SPOT
9953	437746.237	2655583.636	982.759	SPOT
9954	437748.584	2655589.285	982.129	SPOT
9955	437750.055	2655593.892	981.345	SPOT
9956	437750.771	2655595.237	980.932	SPOT
9957	437904.878	2655189.553	991.627	SPOT
9958	437915.135	2655189.674	990.876	SPOT
9959	437919.958	2655190.407	990.445	SPOT
9960	437923.701	2655190.22	989.49	SPOT
9961	437928.386	2655190.654	988.976	SPOT
9962	437932.076	2655190.965	988.148	SPOT
9963	437933.811	2655190.565	984.66	SPOT
9964	437936.253	2655190.056	983.628	SPOT
9965	437943.18	2655189.629	983.642	SPOT
9966	437957.997	2655187.909	983.772	SPOT
9967	437965.52	2655187.545	983.22	SPOT
9968	437973.62	2655187.186	983.013	SPOT
9969	437978.954	2655185.936	982.595	SPOT
9970	437983.991	2655185.421	982.303	SPOT
9971	437987.209	2655185.344	982.236	SPOT
9972	438011.84	2654747.782	989.105	SPOT
9973	438018.88	2654751.85	988.016	SPOT
9974	438025.122	2654754.894	988.005	SPOT
9975	438027.814	2654756.15	986.024	SPOT
9976	438029.823	2654759.722	986.22	SPOT
9977	438035.43	2654761.096	985.713	SPOT
9978	438038.223	2654762.554	984.524	SPOT
9979	438043.14	2654765.638	982.923	SPOT
9980	438048.554	2654767.838	981.943	SPOT
9981	438052.417	2654769.733	981.618	SPOT
9982	438054.191	2654770.637	981.486	SPOT
9983	438112.794	2654311.079	992.165	SPOT
9984	438118.581	2654312.521	991.302	SPOT
9985	438122.238	2654314.11	989.887	SPOT
9986	438130.083	2654315.532	989.358	SPOT
9987	438134.013	2654315.808	989.9	SPOT
9988	438136.62	2654316.307	988.436	SPOT

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9989	438137.874	2654316.951	986.783	SPOT
9990	438141.318	2654317.775	985.811	SPOT
9991	438147.999	2654320.419	985.514	SPOT
9992	438154.514	2654323.079	985.391	SPOT
9993	438160.361	2654325.056	984.987	SPOT
9994	438165.537	2654326.553	984.694	SPOT
9995	438168.803	2654326.659	985.146	SPOT
9996	438137.419	2654026.298	996.133	SPOT
9997	438148.867	2654028.385	996.184	SPOT
9998	438152.022	2654028.607	993.035	SPOT
15000	446868.633	2680014.245	921.998	SPOT
15001	446850.547	2680015.038	921.404	SPOT
15002	446839.828	2680016.514	915.304	SPOT
15003	446828.575	2680017.847	911.099	SPOT
15004	446819.605	2680019.09	909.689	SPOT
15005	446816.972	2680019.156	905.462	SPOT
15006	446814.339	2680019.163	903.387	SPOT
15007	446811.885	2680018.774	902.046	SPOT
15008	446448.07	2679675.563	911.055	SPOT
15009	446396.873	2679702.799	911.344	SPOT
15010	446393.418	2679704.524	908.685	SPOT
15011	446390.765	2679705.861	905.801	SPOT
15012	446389.018	2679707.25	904.198	SPOT
15013	446384.5	2679708.106	904.131	SPOT
15014	446379.122	2679709.54	904.448	SPOT
15015	446374.309	2679711.526	904.252	SPOT
15016	446366.714	2679714.661	903.665	SPOT
15017	446351.302	2679251.331	913.323	SPOT
15018	446323.727	2679236.443	913.882	SPOT
15019	446291.877	2679219.486	911.96	SPOT
15020	446286.559	2679216.5	908.258	SPOT
15021	446285.692	2679215.732	904.718	SPOT
15022	446282.918	2679213.627	903.93	SPOT
15023	446281.066	2679212.013	903.958	SPOT
15024	446612.625	2678999.992	918.207	SPOT
15025	446610.452	2678981.929	918.072	SPOT
15026	446607.619	2678962.342	913.139	SPOT
15027	446599.829	2678922.833	913.524	SPOT
15028	446595.693	2678908.246	910.6	SPOT
15029	446593.91	2678898.116	908.439	SPOT
15030	446593.649	2678893.725	907.328	SPOT
15031	446592.508	2678887.591	907.4	SPOT
15032	446590.374	2678878.651	907.034	SPOT
15033	446589.092	2678872.639	906.272	SPOT
15034	446588.917	2678866.797	905.452	SPOT
15035	446588.447	2678862.295	904.899	SPOT
15036	446912.089	2678912.815	921.4	SPOT
15037	446907.353	2678904.877	921.862	SPOT
15038	446902.458	2678897.636	922.15	SPOT
15039	446901.062	2678893.199	916.93	SPOT
15040	446898.354	2678887.958	911.995	SPOT
15041	446895.901	2678883.958	909.585	SPOT
15042	446895.997	2678883.298	907.602	SPOT
15043	446895.411	2678881.512	905.33	SPOT
15044	446893.905	2678880.5	904.151	SPOT
15045	447422.53	2678567.32	922.787	SPOT
15046	447406.995	2678548.252	924.191	SPOT
15047	447403.128	2678544.397	918.274	SPOT

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15048	447397.699	2678537.705	911.408	SPOT
15049	447384.997	2678525.074	909.725	SPOT
15050	447385.005	2678524.968	909.635	SPOT
15051	447383.699	2678523.058	908.142	SPOT
15052	447383.12	2678521.416	906.353	SPOT
15053	447381.515	2678518.475	905.508	SPOT
15054	447437.388	2678105.018	914.716	SPOT
15055	447401.358	2678103.666	914.844	SPOT
15056	447394.615	2678099.498	908.793	SPOT
15057	447394.495	2678099.437	908.754	SPOT
15058	447389.307	2678097.99	906.829	SPOT
15059	447386.638	2678099.409	906.622	SPOT
15060	447024.485	2677805.257	914.111	SPOT
15061	446998.64	2677824.341	914.034	SPOT
15062	446977.983	2677839.264	913.82	SPOT
15063	446975.583	2677840.554	909.861	SPOT
15064	446972.175	2677841.536	909.231	SPOT
15065	446970.102	2677842.876	907.217	SPOT
15066	446968.635	2677843.632	907.387	SPOT
15067	446633.259	2677754.058	917.226	SPOT
15068	446622.261	2677763.566	916.815	SPOT
15069	446618.101	2677767.17	913.003	SPOT
15070	446615.053	2677768.928	910.615	SPOT
15071	446613.874	2677769.763	909.666	SPOT
15072	446610.409	2677771.461	909.996	SPOT
15073	446607.075	2677773.051	909.971	SPOT
15074	446604.254	2677775.398	909.588	SPOT
15075	446601.279	2677777.381	909.121	SPOT
15076	446597.752	2677780.344	908.772	SPOT
15077	446594.91	2677782.321	907.974	SPOT
15078	446635.299	2677393.908	916.947	SPOT
15079	446602.665	2677401.372	917.658	SPOT
15080	446595.459	2677402.002	913.577	SPOT
15081	446592.38	2677402.376	911.042	SPOT
15082	446588.973	2677403.048	909.688	SPOT
15083	446584.947	2677402.738	908.626	SPOT
15084	446540.613	2677032.521	917.455	SPOT
15085	446512.161	2677027.217	917.956	SPOT
15086	446494.984	2677025.091	916.217	SPOT
15087	446487.078	2677024.307	913.278	SPOT
15088	446484.999	2677024.337	911.951	SPOT
15089	446483.381	2677024.555	909.796	SPOT
15090	446479.06	2677023.365	909.458	SPOT
15091	446474.788	2677022.99	909.278	SPOT
15092	446472.955	2677022.711	909.017	SPOT
15093	446622.159	2676575.225	918.203	SPOT
15094	446603.599	2676552.546	918.1	SPOT
15095	446591.321	2676535.294	917.625	SPOT
15096	446588.9	2676532.243	915.822	SPOT
15097	446587.02	2676529.472	914.157	SPOT
15098	446586.704	2676528.991	911.96	SPOT
15099	446585.705	2676525.332	910.012	SPOT
15100	446584.11	2676522.099	910.209	SPOT
15101	446584.156	2676520.076	910.274	SPOT
15102	446581.997	2676519.227	910.416	SPOT
15103	446700.11	2676114.049	916.671	SPOT
15104	446676.646	2676127.883	917.578	SPOT
15105	446657.087	2676141.357	917.353	SPOT

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15106	446650.896	2676144.606	914.928	SPOT
15107	446648.515	2676146.111	912.25	SPOT
15108	446645.899	2676147.081	911.906	SPOT
15109	446642.785	2676149.923	912.124	SPOT
15110	446640.945	2676151.204	911.537	SPOT
15111	446634.94	2676153.496	911.471	SPOT
15112	446630.456	2676155.645	911.256	SPOT
15113	446624.662	2676160.852	911.325	SPOT
15114	446620.747	2676164.154	910.731	SPOT
15115	446553.744	2675587.831	919.769	SPOT
15116	446539.039	2675605.692	920.109	SPOT
15117	446526.97	2675622.919	920.016	SPOT
15118	446523.641	2675627.183	917.107	SPOT
15119	446522.293	2675628.757	914.857	SPOT
15120	446520.98	2675630.509	911.521	SPOT
15121	446519.548	2675632.736	911.51	SPOT
15122	446516.952	2675635.664	911.171	SPOT
15123	446514.872	2675638.583	910.943	SPOT
15124	446514.03	2675641.616	910.672	SPOT
15125	445306.565	2675219.565	919.079	SPOT
15126	445291.922	2675232.319	920.292	SPOT
15127	445285.145	2675238.635	917.989	SPOT
15128	445277.852	2675248.142	917.572	SPOT
15129	445275.494	2675251.274	913.673	SPOT
15130	445272.783	2675254.249	913.976	SPOT
15131	445269.337	2675256.941	913.723	SPOT
15132	445267.125	2675259.491	912.967	SPOT
15133	445265.196	2675261.937	912.32	SPOT
15134	445264.102	2675263.502	911.793	SPOT
15135	445165.553	2674856.458	921.123	SPOT
15136	445142.183	2674853.916	921.713	SPOT
15137	445130.545	2674851.582	917.29	SPOT
15138	445128.139	2674851.302	914.392	SPOT
15139	445124.913	2674850.908	914.112	SPOT
15140	445121.972	2674849.155	913.808	SPOT
15141	445117.339	2674847.495	913.58	SPOT
15142	445111.033	2674845.677	914.072	SPOT
15143	445106.317	2674844.224	914.409	SPOT
15144	445099.979	2674843.502	914.449	SPOT
15145	445096.078	2674842.245	914.145	SPOT
15146	445334.843	2674516.471	922.408	SPOT
15147	445318.582	2674496.203	921.741	SPOT
15148	445314.703	2674490.626	916.783	SPOT
15149	445312.421	2674488.203	915.622	SPOT
15150	445310.29	2674485.819	914.078	SPOT
15151	445308.519	2674483.476	913.621	SPOT
15152	445306.055	2674481.099	913.38	SPOT
15153	445303.787	2674477.908	913.474	SPOT
15154	445302.19	2674475.669	913.861	SPOT
15155	445299.41	2674470.124	913.788	SPOT
15156	445298.049	2674466.489	913.915	SPOT
15157	445295.677	2674464.039	913.737	SPOT
15158	445293.009	2674460.219	914.257	SPOT
15159	445289.653	2674456.07	914.967	SPOT
15160	445673.073	2674465.834	921.285	SPOT
15161	445693.132	2674458.801	921.408	SPOT
15162	445714.55	2674451.027	921.806	SPOT
15163	445717.212	2674451.397	918.891	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
15164	445720.664	2674450.154	916.191	SPOT
15165	445722.98	2674448.659	914.5	SPOT
15166	445726.753	2674447.461	914.462	SPOT
15167	445728.028	2674447.391	914.021	SPOT
15168	445979.087	2674857.435	930.39	SPOT
15169	445997.527	2674840.299	929.018	SPOT
15170	446001.098	2674838.881	923.277	SPOT
15171	446002.683	2674834.116	919.601	SPOT
15172	446004.279	2674830.801	918.389	SPOT
15173	446004.978	2674829.997	915.805	SPOT
15174	446007.383	2674827.591	915.098	SPOT
15175	446008.949	2674825.293	914.878	SPOT
15176	443153.843	2665802.866	950.061	SPOT
15177	443125.852	2665794.905	949.469	SPOT
15178	443098.253	2665788.63	949.068	SPOT
15179	443084.983	2665786.167	947.155	SPOT
15180	443081.756	2665785.454	943.642	SPOT
15181	443079.871	2665784.966	941.199	SPOT
15182	443078.534	2665784.591	941.111	SPOT
15183	443015.361	2666336.909	947.921	SPOT
15184	443003.27	2666327.931	945.906	SPOT
15185	443000.3	2666325.647	946.77	SPOT
15186	442997.382	2666322.651	945.899	SPOT
15187	442995.907	2666321.381	943.317	SPOT
15188	442993.498	2666320.727	940.803	SPOT
15189	442992.025	2666320.255	941.18	SPOT
15190	442992.229	2666319.263	941.171	SPOT
15191	442624.482	2666668.897	948.513	SPOT
15192	442619.356	2666651.593	950.057	SPOT
15193	442614.007	2666640.442	948.296	SPOT
15194	442612.398	2666631.288	945.472	SPOT
15195	442609.72	2666622.279	944.569	SPOT
15196	442608.827	2666618.369	942.784	SPOT
15197	442607.891	2666615.514	941.569	SPOT
15198	442606.733	2666612.687	940.409	SPOT
15199	442605.554	2666610.961	939.46	SPOT
15200	442428.3	2667149.092	946.349	SPOT
15201	442414.415	2667130.114	946.121	SPOT
15202	442404.932	2667116.354	945.11	SPOT
15203	442400.738	2667110.392	942.601	SPOT
15204	442396.92	2667105.031	941.399	SPOT
15205	442392.594	2667098.708	941.313	SPOT
15206	442390.404	2667095.241	940.697	SPOT
15207	442388.704	2667092.677	939.908	SPOT
15208	442387.201	2667088.164	939.475	SPOT
15209	442384.921	2667083.229	939.213	SPOT
15210	442381.456	2667079.122	938.532	SPOT
15211	442195.212	2667625.833	947.774	SPOT
15212	442187.64	2667611.429	949.052	SPOT
15213	442183.149	2667601.973	946.921	SPOT
15214	442178.669	2667594.246	943.932	SPOT
15215	442177.11	2667592.455	939.438	SPOT
15216	442170.18	2667593.184	938.274	SPOT
15217	442169.205	2667591.875	937.715	SPOT
15218	443911.985	2670231.128	952.845	BM CHK
15219	446357.334	2674825.519	930.68	SPOT
15220	446348.722	2674805.051	929.754	SPOT
15221	446343.115	2674791.63	923.83	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
15222	446336.787	2674776.557	923.139	SPOT
15223	446335.075	2674771.684	920.7	SPOT
15224	446331.366	2674763.151	919.768	SPOT
15225	446328.312	2674756.523	918.097	SPOT
15226	446326.366	2674750.494	917.502	SPOT
15227	446323.901	2674747.081	917.119	SPOT
15228	446321.855	2674742.749	917.579	SPOT
15229	446319.576	2674738.366	917.03	SPOT
15230	446317.113	2674732.569	916.345	SPOT
15231	446315.534	2674727.767	915.715	SPOT
15232	446314.497	2674725.726	915.517	SPOT
15233	446696.294	2674378.427	929.807	SPOT
15234	446680.555	2674369.463	926.615	SPOT
15235	446655.318	2674356.72	924.735	SPOT
15236	446640.335	2674345.652	922.831	SPOT
15237	446623.952	2674335.422	921.57	SPOT
15238	446619.995	2674333.414	917.259	SPOT
15239	446616.919	2674331.616	917.038	SPOT
15240	446613.576	2674329.307	916.548	SPOT
15241	446611.73	2674326.424	916.216	SPOT
15242	446609.131	2674323.144	916.09	SPOT
15243	446606.269	2674321.375	916.44	SPOT
15244	446595.169	2673902.233	925.488	SPOT
15245	446567.729	2673904.389	924.103	SPOT
15246	446563.651	2673903.848	920.839	SPOT
15247	446561.395	2673904.147	917.827	SPOT
15248	446558.473	2673903.917	916.273	SPOT
15249	446686.389	2673610.133	930.09	SPOT
15250	446666.977	2673608.546	927.216	SPOT
15251	446642.416	2673604.403	926.366	SPOT
15252	446635.979	2673602.764	924.157	SPOT
15253	446633.243	2673600.984	921.268	SPOT
15254	446622.211	2673596.709	920.924	SPOT
15255	446616.777	2673596.251	919.98	SPOT
15256	446613.022	2673595.472	918.049	SPOT
15257	446608.855	2673595.134	917.377	SPOT
15258	446606.177	2673593.945	917.347	SPOT
15259	446603.615	2673591.728	917.024	SPOT
15260	446726.531	2673217.68	926.339	SPOT
15261	446708.41	2673204.095	925.622	SPOT
15262	446696.211	2673194.461	925.148	SPOT
15263	446690.142	2673188.335	923.72	SPOT
15264	446686.652	2673186.202	921.963	SPOT
15265	446685.813	2673185.332	919.305	SPOT
15266	446683.932	2673183.295	918.58	SPOT
15267	446681.956	2673181.026	918.255	SPOT
15268	446678.858	2673178.641	918.121	SPOT
15269	446677.431	2673175.836	918.111	SPOT
15270	446677.187	2673176.245	918.113	SPOT
15271	446672.43	2673173.479	918.367	SPOT
15272	446669.471	2673171.259	917.853	SPOT
15273	446667.312	2673169.78	918.1	SPOT
15274	446662.654	2673167.81	918.851	SPOT
15275	446658.426	2673164.894	919.047	SPOT
15276	446656.153	2673163.487	919.662	SPOT
15277	446652.02	2673161.044	919.398	SPOT
15278	446650.466	2673159.99	918.226	SPOT
15279	446649.006	2673158.766	918.408	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
15280	446645.89	2673157.179	920.794	SPOT
15281	446643.344	2673155.921	922.688	SPOT
15282	446642.129	2673154.487	925.843	SPOT
15283	446635.115	2673150.423	926.256	SPOT
15284	446627.064	2673144.952	927.658	SPOT
15285	446510.609	2673565.437	927.335	SPOT
15286	446520.395	2673568.312	924.827	SPOT
15287	446532.133	2673572.142	924.434	SPOT
15288	446534.731	2673572.8	925.236	SPOT
15289	446549.106	2673577.735	925.695	SPOT
15290	446556.913	2673580.868	925.261	SPOT
15291	446562.794	2673582.93	923.465	SPOT
15292	446569.233	2673585.015	923.039	SPOT
15293	446573.788	2673586.329	922.282	SPOT
15294	446577.34	2673587.817	920.57	SPOT
15295	446581.505	2673589.243	918.88	SPOT
15296	446583.083	2673590.027	918.195	SPOT
15297	446586.602	2673591.226	917.071	SPOT
15298	446588.693	2673592.795	916.953	SPOT
15299	446590.361	2673593.661	916.513	SPOT
15300	446769.877	2672857.143	927.207	SPOT
15301	446776.611	2672856.807	926.296	SPOT
15302	446781.647	2672856.848	924.742	SPOT
15303	446795.544	2672856.094	925.033	SPOT
15304	446796.907	2672855.986	924.206	SPOT
15305	446797.125	2672855.94	922.4	SPOT
15306	446801.06	2672855.615	921.603	SPOT
15307	446801.996	2672855.359	919.063	SPOT
15308	446805.121	2672855.304	917.587	SPOT
15309	446806.682	2672855.157	917.222	SPOT
15310	446812.867	2672847.001	917.658	SPOT
15311	446816.652	2672847.314	918.474	SPOT
15312	446820.884	2672846.929	919.048	SPOT
15313	446824.037	2672845.313	919.019	SPOT
15314	446829.847	2672845.144	919.474	SPOT
15315	446835.98	2672844.889	920.204	SPOT
15316	446842.835	2672844.234	921.181	SPOT
15317	446849.073	2672844.198	922.169	SPOT
15318	446853.931	2672844.298	923.112	SPOT
15319	446884.214	2672845.71	924.565	SPOT
15320	446861.612	2672428.403	926.269	SPOT
15321	446850.701	2672428.943	927.112	SPOT
15322	446835.022	2672428.895	925.746	SPOT
15323	446825.766	2672428.388	922.885	SPOT
15324	446824.792	2672428.749	920.644	SPOT
15325	446822.275	2672428.468	919.635	SPOT
15326	446820.12	2672428.824	919.285	SPOT
15327	446818.399	2672426.364	919.282	SPOT
15328	446816.024	2672426.847	919.019	SPOT
15329	446812.247	2672425.892	918.979	SPOT
15330	446807.443	2672426.19	919.396	SPOT
15331	446802.596	2672427.08	919.836	SPOT
15332	446797.912	2672427.149	920.708	SPOT
15333	446790.984	2672427.877	920.963	SPOT
15334	446785.834	2672428.116	920.569	SPOT
15335	446782.437	2672428.694	920.202	SPOT
15336	446780.246	2672428.946	921.271	SPOT
15337	446779.512	2672428.913	922.494	SPOT

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15338	446777.753	2672429.22	922.83	SPOT
15339	446777.036	2672429.227	924.555	SPOT
15340	446772.385	2672430.428	927.199	SPOT
15341	446748.404	2672433.555	927.646	SPOT
15342	446723.007	2672437.387	928.835	SPOT
15343	446704.28	2672018.055	925.989	SPOT
15344	446712.824	2672019.392	925.169	SPOT
15345	446720.716	2672020.541	924.322	SPOT
15346	446724.962	2672021.582	921.789	SPOT
15347	446726.447	2672022.063	921.444	SPOT
15348	446728.832	2672022.318	920.648	SPOT
15349	446734.006	2672023.454	920.409	SPOT
15350	446739.983	2672023.979	920.04	SPOT
15351	446745.083	2672023.717	919.357	SPOT
15352	446658.337	2671975.073	928.265	SPOT
15353	446669.445	2671963.353	928.784	SPOT
15354	446675.327	2671959.31	928.741	SPOT
15355	446676.393	2671958.004	926.389	SPOT
15356	446677.854	2671956.207	924.076	SPOT
15357	446678.838	2671955.146	923.262	SPOT
15358	446679.761	2671954.361	921.958	SPOT
15359	446681.269	2671952.7	921.109	SPOT
15360	446681.99	2671952.224	920.062	SPOT
15361	446683.565	2671950.144	918.963	SPOT
15362	446684.057	2671949.072	918.748	SPOT
15363	446684.68	2671948.134	918.66	SPOT
15364	446684.05	2671943.362	918.213	SPOT
15365	446761.463	2672024.936	919.559	SPOT
15366	446763.366	2672025.119	919.863	SPOT
15367	446765.45	2672025.312	922.678	SPOT
15368	446769.444	2672025.896	923.856	SPOT
15369	446772.708	2672025.857	926.8	SPOT
15370	446798.94	2672024.752	927.86	SPOT
15371	446420.804	2671898.383	925.568	SPOT
15372	446439.603	2671908.547	925.885	SPOT
15373	446454.417	2671916.403	926.155	SPOT
15374	446458.141	2671918.482	923.881	SPOT
15375	446465.315	2671921.502	923.956	SPOT
15376	446469.476	2671923.541	922.442	SPOT
15377	446466.623	2671925.075	922.511	SPOT
15378	446471.683	2671925.664	921.634	SPOT
15379	446473.995	2671927.324	921.754	SPOT
15380	446476.92	2671928.729	921.537	SPOT
15381	446480.874	2671930.877	921.268	SPOT
15382	446484.303	2671933.124	920.731	SPOT
15383	446487.575	2671934.849	920.379	SPOT
15384	446491.178	2671935.828	919.451	SPOT
15385	446493.039	2671936.798	918.791	SPOT
15386	446083.815	2672001.582	928.546	SPOT
15387	446081.783	2672020.036	928.26	SPOT
15388	446080.464	2672041.989	927.1	SPOT
15389	446080.152	2672046.652	925.751	SPOT
15390	446080.179	2672050.096	923.164	SPOT
15391	446079.369	2672053.166	921.708	SPOT
15392	446077.905	2672057.523	921.823	SPOT
15393	446076.559	2672061.92	921.374	SPOT
15394	446075.81	2672066.188	920.974	SPOT
15395	446074.942	2672071.072	920.648	SPOT

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15396	446072.14	2672073.92	920.433	SPOT
15397	446072.349	2672076.008	920.216	SPOT
15398	446073.369	2672082.364	920.756	SPOT
15399	446072.053	2672088.734	921.239	SPOT
15400	446071.222	2672092.421	922.301	SPOT
15401	446071.269	2672097.227	924.179	SPOT
15402	446070.934	2672097.875	924.22	SPOT
15403	446071.825	2672102.063	926.458	SPOT
15404	446071.745	2672105.129	929.508	SPOT
15405	446074.057	2672120.577	930.299	SPOT
15406	446537.622	2671949.656	928.118	SPOT
15407	446523.935	2671944.837	928.271	SPOT
15408	446516.057	2671941.544	928.414	SPOT
15409	446514.967	2671941.27	925.083	SPOT
15410	446513.369	2671940.473	923.616	SPOT
15411	446511.56	2671940.21	922.753	SPOT
15412	446510.251	2671939.907	921.492	SPOT
15413	446508.65	2671939.005	919.902	SPOT
15414	446506.197	2671939.573	919.007	SPOT
15415	445703.661	2672152.111	928.245	SPOT
15416	445700.804	2672146.731	927.294	SPOT
15417	445693.9	2672134.031	927.446	SPOT
15418	445693.368	2672132.98	926.669	SPOT
15419	445692.294	2672131.602	925.2	SPOT
15420	445690.876	2672128.716	924.332	SPOT
15421	445690.647	2672128.372	923.587	SPOT
15422	445690.039	2672126.924	922.935	SPOT
15423	445689.295	2672124.751	921.302	SPOT
15424	445687.332	2672121.526	921.176	SPOT
15425	445684.884	2672116.521	921.305	SPOT
15426	445683.616	2672114.549	921.071	SPOT
15427	445681.563	2672112.282	920.984	SPOT
15428	445679.084	2672108.747	920.704	SPOT
15429	445676.476	2672105.401	920.579	SPOT
15430	445675.009	2672102.795	920.591	SPOT
15431	445672.357	2672100.609	920.709	SPOT
15432	445671.431	2672096.918	921.014	SPOT
15433	445670.582	2672093.709	922.306	SPOT
15434	445668.073	2672086.993	924.739	SPOT
15435	445666.311	2672082.259	929.142	SPOT
15436	445664.06	2672076.129	936.157	SPOT
15437	445281.381	2672425.054	925.93	SPOT
15438	445283.897	2672427.123	923.975	SPOT
15439	445286.415	2672434.98	923.755	SPOT
15440	445289.803	2672443.446	924.598	SPOT
15441	445291.517	2672447.273	921.938	SPOT
15442	445292.525	2672450.116	922.097	SPOT
15443	445295.893	2672456.092	922.469	SPOT
15444	445300.443	2672462.218	922.608	SPOT
15445	445304.796	2672469.217	922.964	SPOT
15446	445310.775	2672474.258	923.093	SPOT
15447	445316.236	2672479.95	922.63	SPOT
15448	445321.885	2672484.451	922.075	SPOT
15449	445325.782	2672488.805	921.801	SPOT
15450	445326.585	2672491.513	925.347	SPOT
15451	445330.263	2672495.387	927.747	SPOT
15452	445334.521	2672501.683	929.117	SPOT
15453	444851.359	2672757.109	929.387	SPOT

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15454	444842.036	2672745.869	928.757	SPOT
15455	444837.222	2672739.542	927.749	SPOT
15456	444835.577	2672737.818	926.324	SPOT
15457	444834.66	2672736.308	925.864	SPOT
15458	444833.799	2672735.534	925.05	SPOT
15459	444832.885	2672734.459	924.047	SPOT
15460	444831.066	2672732.688	923.869	SPOT
15461	444827.902	2672729.393	923.681	SPOT
15462	444823.552	2672725.626	923.48	SPOT
15463	444817.722	2672719.892	922.654	SPOT
15464	444814.168	2672716.276	923.063	SPOT
15465	444812.149	2672713.339	922.521	SPOT
15466	444808.616	2672709.188	922.71	SPOT
15467	444806.654	2672705.792	922.339	SPOT
15468	444803.06	2672700.204	922.759	SPOT
15469	444801.252	2672696.322	924.5	SPOT
15470	444800.244	2672693.244	925.729	SPOT
15471	444798.284	2672689.96	931.351	SPOT
15472	444792.367	2672678.03	933.981	SPOT
15473	444402.88	2672726.779	934.185	SPOT
15474	444400.977	2672734.694	932.696	SPOT
15475	444398.651	2672741.221	926.989	SPOT
15476	444398.599	2672755.69	927.04	SPOT
15477	444398.38	2672760.164	925.048	SPOT
15478	444396.847	2672763.135	924.481	SPOT
15479	444394.905	2672765.98	924.07	SPOT
15480	444393.177	2672770.414	923.865	SPOT
15481	444393.248	2672772.946	923.834	SPOT
15482	444391.276	2672781.15	924.027	SPOT
15483	444390.705	2672788.158	924.2	SPOT
15484	444389.933	2672796.375	924.484	SPOT
15485	444388.847	2672803.623	923.879	SPOT
15486	444387.414	2672810.925	923.725	SPOT
15487	444387.333	2672813.751	923.566	SPOT
15488	444387.002	2672816.06	924.394	SPOT
15489	444386.572	2672817.141	925.712	SPOT
15490	444384.315	2672818.99	930.349	SPOT
15491	444382.213	2672825.418	932.335	SPOT
15492	444380.023	2672839.455	932.39	SPOT
15493	444380.502	2672834.326	931.798	SPOT
15494	444380.905	2672832.572	932.065	SPOT
15495	444125.818	2672603.416	930.715	SPOT
15496	444130.291	2672600.938	929.136	SPOT
15497	444138.153	2672597.139	928.796	SPOT
15498	444140.177	2672595.891	929.083	SPOT
15499	444147.407	2672592.493	927.832	SPOT
15500	444152.671	2672590.32	926.85	SPOT
15501	444154.349	2672589.645	926.102	SPOT
15502	444157.264	2672588.17	925.13	SPOT
15503	444163.645	2672584.793	924.83	SPOT
15504	444168.965	2672580.959	924.286	SPOT
15505	444168.947	2672580.952	924.254	SPOT
15506	444173.108	2672578.112	923.653	SPOT
15507	444176.192	2672576.163	923.627	SPOT
15508	444178.255	2672575.099	923.62	SPOT
15509	444182.941	2672574.842	924.166	SPOT
15510	444185.051	2672573.822	924.444	SPOT
15511	444189.385	2672571.23	924.314	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
15512	444194.864	2672567.239	923.995	SPOT
15513	444198.634	2672564.784	924.08	SPOT
15514	444201.59	2672562.6	926.802	SPOT
15515	444206.49	2672560.041	928.972	SPOT
15516	444210.796	2672556.234	934.559	SPOT
15517	443760.305	2672226.985	932.09	SPOT
15518	443748.89	2672251.712	932.648	SPOT
15519	443736.105	2672275.469	929.487	SPOT
15520	443734.859	2672277.634	927.239	SPOT
15521	443732.856	2672280.927	928.024	SPOT
15522	443732.329	2672282.383	924.391	SPOT
15523	443730.404	2672287.708	924.102	SPOT
15524	443727.111	2672295.372	923.662	SPOT
15525	443723.116	2672299.122	923.751	SPOT
15526	443719.427	2672303.139	923.778	SPOT
15527	443717.213	2672306.943	924.208	SPOT
15528	443715.576	2672310.426	924.475	SPOT
15529	443714.59	2672313.453	925.665	SPOT
15530	443714.053	2672315.455	926.919	SPOT
15531	443713.534	2672316.844	929.967	SPOT
15532	443711.325	2672322.461	932.372	SPOT
15533	443708.897	2672330.832	934.646	SPOT
15534	443703.086	2672351.879	935.26	SPOT
15535	443256.276	2672125.791	936.973	SPOT
15536	443258.881	2672119.084	935.219	SPOT
15537	443263.303	2672109.686	933.178	SPOT
15538	443264.147	2672108.848	929.848	SPOT
15539	443266.103	2672103.605	927.989	SPOT
15540	443266.487	2672102.574	925.689	SPOT
15541	443268.64	2672096.997	925.521	SPOT
15542	443272.325	2672087.881	925.178	SPOT
15543	443273.908	2672081.465	925.267	SPOT
15544	443275.153	2672078.356	925.382	SPOT
15545	443276.141	2672073.144	925.079	SPOT
15546	443277.731	2672067.643	925.364	SPOT
15547	443280.679	2672060.881	925.475	SPOT
15548	443283.444	2672055.465	925.983	SPOT
15549	443285.351	2672051.889	928.822	SPOT
15550	443286.385	2672049.262	931.485	SPOT
15551	443286.483	2672044.652	934.156	SPOT
15552	443292.867	2672016.549	935.349	SPOT
15553	?	?	?	0
15554	?	?	?	0
15555	?	?	?	0
15556	?	?	?	0
15557	?	?	?	0
15558	?	?	?	0
15559	?	?	?	0
15560	?	?	?	0
15561	?	?	?	0
15562	?	?	?	0
15563	443227.706	2671168.545	938.158	SPOT
15564	443204.04	2671151.543	934.904	SPOT
15565	443430.489	2670763.283	937.126	SPOT
15566	443420.35	2670747.36	935.813	SPOT
15567	443413.223	2670736.893	936.527	SPOT
15568	443408.469	2670729.895	934.566	SPOT
15569	443407.324	2670727.088	930.224	SPOT

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15570	443405.388	2670725.455	928.043	SPOT
15571	443403.466	2670721.65	927.492	SPOT
15572	443402.931	2670718.935	927.407	SPOT
15573	443401.159	2670714.9	927.587	SPOT
15574	444227.106	2669758.331	939.533	SPOT
15575	444210.037	2669739.628	939.066	SPOT
15576	444206.244	2669735.37	934.031	SPOT
15577	444203.08	2669733.314	931.698	SPOT
15578	444200.779	2669731.14	930.259	SPOT
15579	444198.169	2669728.783	928.178	SPOT
15580	444304.684	2669280.644	938.21	SPOT
15581	444290.67	2669269.739	936.142	SPOT
15582	444279.905	2669260.044	935.632	SPOT
15583	444275.963	2669256.567	932.938	SPOT
15584	444273.313	2669254.811	931.382	SPOT
15585	444270.198	2669251.969	930.949	SPOT
15586	444267.786	2669250.236	930.471	SPOT
15587	444265.035	2669248.586	930.646	SPOT
15588	444262.911	2669246.097	930.23	SPOT
15589	444600.677	2668705.138	963.286	SPOT
15590	444582.431	2668698.25	948.305	SPOT
15591	444570.7	2668697.087	940.583	SPOT
15592	444559.696	2668696.048	938.181	SPOT
15593	444555.739	2668695.542	936.93	SPOT
15594	444384.212	2668138.967	941.381	SPOT
15595	444376.397	2668147.832	939.939	SPOT
15596	444367.175	2668158.255	938.339	SPOT
15597	444364.54	2668160.944	935.689	SPOT
15598	444363.222	2668161.876	933.176	SPOT
15599	444360.26	2668162.187	932.838	SPOT
15600	444357.801	2668163.559	932.592	SPOT
15601	444355.807	2668164.589	932.524	SPOT
15602	443801.93	2668021.748	942.818	SPOT
15603	443823.967	2668058.632	943.147	SPOT
15604	443826.349	2668060.542	939.116	SPOT
15605	443828.403	2668062.824	937.362	SPOT
15606	443829.573	2668065.324	935.176	SPOT
15607	443830.048	2668067.115	932.83	SPOT
15608	443830.426	2668068.442	931.813	SPOT
15609	443461.225	2668485.615	943.938	SPOT
15610	443481.102	2668496.109	941.951	SPOT
15611	443497.833	2668504.569	941.079	SPOT
15612	443502.656	2668507.307	939.572	SPOT
15613	443506.367	2668509.742	936.252	SPOT
15614	443509.765	2668512.002	935.721	SPOT
15615	443513.927	2668514.646	935.651	SPOT
15616	443517.14	2668518.305	935.454	SPOT
15617	443521.177	2668520.05	934.875	SPOT
15618	443525.298	2668522.494	934.577	SPOT
15619	441893.309	2667888.828	946.49	SPOT
15620	441887.124	2667881.266	945.627	SPOT
15621	441880.082	2667873.255	946.043	SPOT
15622	441861.884	2667853.069	944.138	SPOT
15623	441858.904	2667848.791	942.153	SPOT
15624	441858.549	2667847.916	939.99	SPOT
15625	441856.987	2667845.697	938.365	SPOT
15626	441854.578	2667842.567	938.405	SPOT
15627	441850.918	2667837.175	938.413	SPOT

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15628	441847.726	2667832.143	938.455	SPOT
15629	441845.078	2667829.33	938.235	SPOT
15630	441845.251	2668279.75	948.29	SPOT
15631	441828.695	2668279.236	947.395	SPOT
15632	441812.98	2668277.752	946.092	SPOT
15633	441811.524	2668277.298	942.892	SPOT
15634	441805.633	2668276.149	940.339	SPOT
15635	441803.899	2668275.933	938.665	SPOT
15636	441802.679	2668274.745	937.393	SPOT
15637	441799.615	2668274.018	936.902	SPOT
15638	441796.457	2668272.869	936.461	SPOT
15639	441792.812	2668272.648	936.308	SPOT
15640	441791.158	2668272.847	936.377	SPOT
15641	442126.988	2668485.251	948.443	SPOT
15642	442118.472	2668492.493	947.42	SPOT
15643	442104.51	2668503.732	943.877	SPOT
15644	442088.645	2668518.181	941.436	SPOT
15645	442084.246	2668521.474	938.699	SPOT
15646	442083.581	2668522.156	936.314	SPOT
15647	442080.687	2668523.194	935.809	SPOT
15648	442078.759	2668524.979	935.376	SPOT
15649	442076.002	2668525.175	935.254	SPOT
15650	442599.508	2668718.53	948.093	SPOT
15651	442594.051	2668743.42	944.671	SPOT
15652	442589.113	2668761.84	942.35	SPOT
15653	442589.473	2668767.929	938.058	SPOT
15654	443012.497	2668779.238	943.537	SPOT
15655	443031.014	2668798.084	941.251	SPOT
15656	443050.544	2668819.742	939.47	SPOT
15657	443052.567	2668822.429	937.796	SPOT
15658	443053.248	2668823.102	935.613	SPOT
15659	443055.109	2668825.096	935.271	SPOT
15660	443058.198	2668830.268	934.929	SPOT
15661	443062.169	2668834.28	934.791	SPOT
15662	443064.794	2668837.313	934.955	SPOT
15663	437350.798	2655675.738	981.288	SPOT
15664	437353.604	2655678.544	981.414	SPOT
15665	437356.887	2655681.3	981.453	SPOT
15666	437360.162	2655687.015	981.593	SPOT
15667	437362.8	2655688.663	982.335	SPOT
15668	437365.562	2655694.148	982.001	SPOT
15669	437368.665	2655695.844	981.872	SPOT
15670	437369.685	2655698.332	982.74	SPOT
15671	437371.618	2655700.144	984.083	SPOT
15672	437374.355	2655701.827	986.71	SPOT
15673	437382.448	2655711.53	987.761	SPOT
15674	437385.896	2655715.035	990.654	SPOT
15675	437399.124	2655727.988	991.458	SPOT
15676	437778.688	2655662.025	991.656	SPOT
15677	437769.294	2655638.374	992.135	SPOT
15678	437762.484	2655623.199	992.146	SPOT
15679	437760.415	2655618.786	987.636	SPOT
15680	437758.891	2655616.045	983.88	SPOT
15681	437757.656	2655612.565	982.105	SPOT
15682	437756.741	2655610.265	980.81	SPOT
15683	438030.882	2655181.249	994.981	SPOT
15684	438011.959	2655181.769	994.919	SPOT
15685	438006.154	2655183.221	990.52	SPOT

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15686	438002.257	2655183.017	987.564	SPOT
15687	438001.108	2655183.376	983.425	SPOT
15688	437996.587	2655182.984	982.667	SPOT
15689	437993.607	2655183.545	982.081	SPOT
15690	437991.297	2655184.277	982.349	SPOT
15691	438094.354	2654789.99	988.784	SPOT
15692	438083.433	2654784.143	987.136	SPOT
15693	438080.331	2654782.97	983.268	SPOT
15694	438078.644	2654781.955	982.833	SPOT
15695	438075.362	2654780.354	982.178	SPOT
15696	438073.383	2654779.61	981.992	SPOT
15697	438072.789	2654779.114	981.914	SPOT
15698	438197.578	2654335.893	991.663	SPOT
15699	438191.751	2654334.643	990.012	SPOT
15700	438189.575	2654333.15	985.933	SPOT
15701	438187.882	2654333.557	985.96	SPOT
15702	438184.746	2654331.983	985.618	SPOT
15703	438181.6	2654331.05	985.706	SPOT
15704	438177.661	2654329.247	985.59	SPOT
15705	438175.457	2654328.193	985.435	SPOT
15706	438256.472	2654054.492	991.833	SPOT
15707	438239.518	2654050.453	990.839	SPOT
15708	438232.351	2654047.27	988.894	SPOT
15709	438220.728	2654043.645	988.753	SPOT
15710	438209.389	2654040.282	988.037	SPOT
15711	438203.9	2654038.061	987.08	SPOT
15712	438196.845	2654034.445	986.142	SPOT
15713	438193.615	2654033.706	986.018	SPOT
15714	438189.119	2654032.258	985.575	SPOT
15715	438412.474	2653775.587	998.068	SPOT
15716	438410.572	2653768.301	998.136	SPOT
15717	438410.87	2653766.253	995.827	SPOT
15718	438410.95	2653762.216	994.501	SPOT
15719	438410.943	2653760.805	990.764	SPOT
15720	438413.91	2653757.488	990.251	SPOT
15721	438413.826	2653752.018	990.194	SPOT
15722	438414.002	2653745.296	990.557	SPOT
15723	438414.149	2653737.41	990.818	SPOT
15724	438414.12	2653728.661	990.83	SPOT
15725	438413.521	2653720.541	990.938	SPOT
15726	438412.144	2653710.72	991.096	SPOT
15727	438412.202	2653700.935	991.297	SPOT
15728	438411.493	2653690.815	990.866	SPOT
15729	438411.458	2653683.051	990.409	SPOT
15730	438411.139	2653679.067	991.365	SPOT
15731	438410.881	2653676.337	993.678	SPOT
15732	438409.965	2653662.382	993.291	SPOT
15733	438409.626	2653658.989	994.156	SPOT
15734	438405.165	2653628.296	995.695	SPOT
15735	438301.933	2658242.952	984.624	SPOT
15736	438294.955	2658226.701	980.59	SPOT
15737	438290.144	2658219.745	979.324	SPOT
15738	438288.988	2658216.363	974.077	SPOT
15739	438286.748	2658212.722	973.38	SPOT
15740	438286.451	2658211.412	970.153	SPOT
15741	438284.093	2658205.898	970.066	SPOT
15742	438280.565	2658199.137	970.533	SPOT
15743	438277.058	2658191.423	970.808	SPOT

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15744	438272.155	2658181.459	971.19	SPOT
15745	438266.841	2658170.511	970.973	SPOT
15746	438264.819	2658167.175	972.066	SPOT
15747	438263.685	2658164.791	974.542	SPOT
15748	438262.064	2658160.337	976.51	SPOT
15749	438257.754	2658151.454	976.857	SPOT
15750	438254.669	2658144.302	980.506	SPOT
15751	438251.14	2658136.141	981.726	SPOT
15752	438247.701	2658130.086	983.026	SPOT
15753	438597.887	2657814.886	984.649	SPOT
15754	438604.294	2657824.456	983.6	SPOT
15755	438605.783	2657827.466	980.277	SPOT
15756	438607.283	2657829.635	977.762	SPOT
15757	438609.2	2657832.745	976.604	SPOT
15758	438611.53	2657836.655	976.532	SPOT
15759	438612.762	2657839.094	977.387	SPOT
15760	438614.63	2657841.915	976.79	SPOT
15761	438615.486	2657842.862	975.234	SPOT
15762	438616.03	2657843.639	971.776	SPOT
15763	438616.065	2657844.434	971.459	SPOT
15764	438617.495	2657847.039	971.42	SPOT
15765	438619.683	2657850.47	971.481	SPOT
15766	438624.436	2657854.635	971.527	SPOT
15767	438630.16	2657860.167	971	SPOT
15768	438634.279	2657864.918	970.919	SPOT
15769	438639.789	2657871.625	971.645	SPOT
15770	438644.983	2657877.54	971.607	SPOT
15771	438648.641	2657881.505	971.796	SPOT
15772	438650.032	2657883.669	971.777	SPOT
15773	438651.393	2657885.015	974.314	SPOT
15774	438654.291	2657889.947	978.011	SPOT
15775	438658.736	2657895.244	981.04	SPOT
15776	438671.831	2657910.728	984.229	SPOT
15777	439060.701	2657613.909	977.667	SPOT
15778	439047.434	2657598.344	976.772	SPOT
15779	439033.003	2657583.703	978.208	SPOT
15780	439031.136	2657581.21	976.906	SPOT
15781	439030.549	2657580.719	973.977	SPOT
15782	439028.432	2657578.124	972.633	SPOT
15783	439027.031	2657575.361	972.628	SPOT
15784	439021.783	2657571.099	972.353	SPOT
15785	439018.872	2657566.817	972.764	SPOT
15786	439016.933	2657564.007	973.39	SPOT
15787	439012.583	2657558.236	972.791	SPOT
15788	439009.056	2657554.761	972.42	SPOT
15789	439004.67	2657550.805	972.564	SPOT
15790	438999.56	2657547.707	972.523	SPOT
15791	438996.96	2657546.16	973.587	SPOT
15792	438995.989	2657546.155	977.1	SPOT
15793	438994.346	2657545.448	978.185	SPOT
15794	438986.76	2657539.831	979.064	SPOT
15795	438982.552	2657536.345	980.412	SPOT
15796	438978.176	2657532.519	983.933	SPOT
15797	438970.118	2657525.147	984.534	SPOT
15798	438966.405	2657521.35	985.899	SPOT
15799	439421.26	2657394.213	985.375	SPOT
15800	439425.045	2657409.414	984.243	SPOT
15801	439427.239	2657417.268	983.982	SPOT

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15802	439428.432	2657421.191	981.475	SPOT
15803	439429.667	2657424.58	980.654	SPOT
15804	439430.431	2657427.326	980.062	SPOT
15805	439430.62	2657428.576	978.32	SPOT
15806	439431.092	2657430.152	977.993	SPOT
15807	439431.479	2657431.118	975.834	SPOT
15808	439432.042	2657432.922	974.826	SPOT
15809	439433.099	2657435.62	974.036	SPOT
15810	439434.229	2657438.596	973.66	SPOT
15811	439435.88	2657443.945	973.265	SPOT
15812	439438.452	2657449.962	972.907	SPOT
15813	439440.516	2657453.794	972.975	SPOT
15814	439442.959	2657458.321	972.277	SPOT
15815	439445.088	2657460.479	972.346	SPOT
15816	439446.595	2657462.946	972.57	SPOT
15817	439446.984	2657465.885	973.699	SPOT
15818	439447.953	2657469.551	973.753	SPOT
15819	439448.707	2657474.077	974.028	SPOT
15820	439449.183	2657477.764	974.243	SPOT
15821	439451.059	2657482.359	975.798	SPOT
15822	439452.212	2657488.5	977.197	SPOT
15823	439455.562	2657498.68	977.48	SPOT
15824	439712.894	2657065.881	980.953	SPOT
15825	439691.984	2657068.074	979.555	SPOT
15826	439675.052	2657070.444	978.204	SPOT
15827	439666.973	2657072.074	975.382	SPOT
15828	439662.201	2657072.459	974.206	SPOT
15829	439658.897	2657073.265	973.462	SPOT
15830	439652.746	2657073.247	973.62	SPOT
15831	439646.526	2657072.811	973.929	SPOT
15832	439641.775	2657073.196	973.75	SPOT
15833	439636.902	2657074.041	973.402	SPOT
15834	439632.152	2657074.555	973.182	SPOT
15835	439626.631	2657074.728	973.517	SPOT
15836	439621.893	2657074.883	973.873	SPOT
15837	439616.925	2657075.626	973.765	SPOT
15838	439615.812	2657075.591	976.026	SPOT
15839	439614.751	2657076.033	977.108	SPOT
15840	439609.966	2657077.884	978.447	SPOT
15841	439607.08	2657079.24	980.5	SPOT
15842	439603.908	2657079.677	983.113	SPOT
15843	439602.578	2657079.94	985.515	SPOT
15844	439595.639	2657079.825	985.903	SPOT
15845	439589.001	2657080.409	986.995	SPOT
15846	439571.105	2657081.652	987.641	SPOT
15847	439581.24	2656695.751	983.07	SPOT
15848	439589.58	2656689.655	983.071	SPOT
15849	439592.967	2656686.751	982.714	SPOT
15850	439596.394	2656684.282	980.773	SPOT
15851	439597.272	2656684.26	978.423	SPOT
15852	439600.08	2656682.384	976.579	SPOT
15853	439602.8	2656680.765	975.637	SPOT
15854	439603.598	2656680.326	974.415	SPOT
15855	439605.457	2656680.698	973.024	SPOT
15856	439607.086	2656679.122	973.101	SPOT
15857	439608.553	2656676.733	973.067	SPOT
15858	439611.796	2656673.85	973.406	SPOT
15859	439615.828	2656670.217	973.777	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
15860	439617.612	2656669.574	973.978	SPOT
15861	439618.253	2656667.735	974.018	SPOT
15862	439621.598	2656664.256	974.139	SPOT
15863	439625.935	2656659.465	973.978	SPOT
15864	439630.001	2656655.177	974.605	SPOT
15865	439634.737	2656651.217	974.714	SPOT
15866	439636.562	2656649.036	975.257	SPOT
15867	439638.89	2656647.883	976.898	SPOT
15868	439643.382	2656646.442	979.679	SPOT
15869	439665.091	2656636.3	981.621	SPOT
15870	439463.919	2656211.479	980.409	SPOT
15871	439449.884	2656220.596	979.97	SPOT
15872	439431.93	2656231.595	979.919	SPOT
15873	439424.359	2656236.12	977.321	SPOT
15874	439420.641	2656237.617	975.855	SPOT
15875	439415.322	2656241.042	975.411	SPOT
15876	439407.377	2656243.917	974.766	SPOT
15877	439401.509	2656247.751	974.047	SPOT
15878	439396.626	2656251.1	974.15	SPOT
15879	439390.538	2656254.845	974.41	SPOT
15880	439387.064	2656257.125	974.619	SPOT
15881	439383.692	2656259.603	975.457	SPOT
15882	439382.486	2656260.998	976.411	SPOT
15883	439381.88	2656261.677	977.806	SPOT
15884	439378.968	2656264.481	978.99	SPOT
15885	439374.733	2656267.719	980.41	SPOT
15886	439372.415	2656269.091	983.197	SPOT
15887	439369.794	2656271.345	983.927	SPOT
15888	439369.4	2656271.747	986.306	SPOT
15889	439352.73	2656282.519	986.356	SPOT
15890	439335.452	2656296.213	986.052	SPOT
15891	439321.396	2656306.399	986.91	SPOT
15892	439138.682	2655958.22	987.612	SPOT
15893	439145.811	2655943.273	987.271	SPOT
15894	439151.281	2655931.837	986.07	SPOT
15895	439153.08	2655928.524	984.024	SPOT
15896	439154.619	2655925.246	979.648	SPOT
15897	439155.176	2655924.444	977.56	SPOT
15898	439157.194	2655921.143	976.248	SPOT
15899	439158.969	2655917.547	976.657	SPOT
15900	439160.747	2655912.719	976.585	SPOT
15901	439162.292	2655908.356	976.643	SPOT
15902	439164.118	2655903.879	976.806	SPOT
15903	439165.8	2655898.563	976.845	SPOT
15904	439166.803	2655894.498	976.511	SPOT
15905	439167.561	2655891.955	976.876	SPOT
15906	439168.454	2655889.751	976.536	SPOT
15907	439169.129	2655883.585	976.117	SPOT
15908	439170.485	2655881.547	975.822	SPOT
15909	439170.079	2655878.154	976.172	SPOT
15910	439170.624	2655876.043	976.874	SPOT
15911	439171.454	2655873.511	978.161	SPOT
15912	439171.873	2655868.993	979.857	SPOT
15913	439173.106	2655865.807	981.358	SPOT
15914	439174.383	2655861.126	983.725	SPOT
15915	438697.308	2655978.738	987.134	SPOT
15916	438702.487	2655997.235	984.516	SPOT
15917	438702.123	2656017.256	983.08	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
15918	438702.392	2656021.383	982.023	SPOT
15919	438703.28	2656023.183	979.946	SPOT
15920	438703.634	2656025.27	977.605	SPOT
15921	438703.881	2656027.76	977.339	SPOT
15922	438702.977	2656032.419	977.372	SPOT
15923	438704.212	2656034.435	977.393	SPOT
15924	438704.918	2656040.171	977.542	SPOT
15925	438707.131	2656046.553	977.028	SPOT
15926	438708.851	2656053.225	976.365	SPOT
15927	438710.718	2656058.036	976.231	SPOT
15928	438713.302	2656063.525	976.199	SPOT
15929	438714.516	2656066.928	976.046	SPOT
15930	438716.23	2656069.332	975.514	SPOT
15931	438717.147	2656071.903	975.603	SPOT
15932	438717.88	2656073.475	976.139	SPOT
15933	438718.704	2656074.631	976.576	SPOT
15934	438720.506	2656075.515	979.849	SPOT
15935	438723.278	2656081.523	982.572	SPOT
15936	438722.973	2656085.603	988.932	SPOT
15937	438727.154	2656101.311	988.927	SPOT
15938	438728.087	2656104.527	989.783	SPOT
15939	438733.268	2656124.131	990.803	SPOT
15940	438304.475	2656277.65	989.656	SPOT
15941	438302.597	2656259.837	989.189	SPOT
15942	438301.916	2656254.813	987.451	SPOT
15943	438300.012	2656242.553	985.899	SPOT
15944	438299.381	2656235.181	984.918	SPOT
15945	438298.589	2656231.159	983.52	SPOT
15946	438298.466	2656229.157	982.108	SPOT
15947	438298.441	2656227.588	980.434	SPOT
15948	438298.75	2656226.407	977.152	SPOT
15949	438297.188	2656224.282	976.847	SPOT
15950	438295.681	2656222.422	976.64	SPOT
15951	438206.572	2656298.505	987.369	SPOT
15952	438206.783	2656287.247	987.783	SPOT
15953	438205.757	2656276.374	988.888	SPOT
15954	438205.37	2656265.892	989.059	SPOT
15955	438205.173	2656258.035	988.205	SPOT
15956	438205.292	2656256.746	986.075	SPOT
15957	438205.482	2656254.058	984.024	SPOT
15958	438205.319	2656251.738	982.909	SPOT
15959	438205.207	2656250.498	981.362	SPOT
15960	438204.984	2656249.489	981.125	SPOT
15961	438205.136	2656248.572	978.407	SPOT
15962	438205.863	2656246.222	976.858	SPOT
15963	438205.369	2656243.994	977.018	SPOT
15964	438205.07	2656242.706	977.038	SPOT
15965	438205.287	2656240.054	977.633	SPOT
15966	438203.691	2656235.066	977.861	SPOT
15967	438203.692	2656229.803	978.163	SPOT
15968	438202.84	2656220.961	978.352	SPOT
15969	438202.697	2656214.057	978.058	SPOT
15970	438201.138	2656207.029	977.767	SPOT
15971	438200.943	2656202.049	977.582	SPOT
15972	438201.226	2656198.001	977.521	SPOT
15973	438201.312	2656194.489	978.048	SPOT
15974	438200.501	2656193.493	980.874	SPOT
15975	438200.415	2656188.318	983.462	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
15976	438203.768	2656171.865	984.455	SPOT
15977	438207.081	2656157.657	985.29	SPOT
15978	438207.21	2656151.331	988.125	SPOT
15979	437572.751	2656123.704	988.524	SPOT
15980	437578.718	2656144.968	987.54	SPOT
15981	437583.919	2656164.351	986.451	SPOT
15982	437585.596	2656169.943	984.861	SPOT
15983	437586.224	2656172.637	981.931	SPOT
15984	437586.767	2656176.348	981.977	SPOT
15985	437587.206	2656181.403	981.786	SPOT
15986	437588.581	2656184.78	981.599	SPOT
15987	437589.589	2656192.356	981.195	SPOT
15988	437590.899	2656196.94	980.429	SPOT
15989	437592.046	2656201.381	979.861	SPOT
15990	437592.829	2656205.258	980.007	SPOT
15991	437594.147	2656209.547	980.311	SPOT
15992	437595.902	2656213.555	980.473	SPOT
15993	437597.545	2656217.317	980.277	SPOT
15994	437598.829	2656221.272	980.554	SPOT
15995	437600.76	2656224.12	980.786	SPOT
15996	437602.399	2656226.257	981.391	SPOT
15997	437602.654	2656227.15	984.791	SPOT
15998	437604.339	2656231.082	986.323	SPOT
15999	437606.912	2656241.528	987.883	SPOT
16000	437608.551	2656247.494	989.2	SPOT
16001	437610.038	2656254.841	992.028	SPOT
16002	437613.382	2656274.969	992.406	SPOT
16003	438870.188	2653613.007	996.573	SPOT
16004	438840.657	2653599.335	998.281	SPOT
16005	438835.025	2653597.595	997.154	SPOT
16006	438829.889	2653595.325	994.737	SPOT
16007	438828.472	2653594.599	990.154	SPOT
16008	438823.217	2653592.717	989.495	SPOT
16009	438817.87	2653589.816	989.87	SPOT
16010	438809.565	2653584.814	990.71	SPOT
16011	438802.847	2653581.224	991.214	SPOT
16012	438794.022	2653575.806	991.589	SPOT
16013	438781.976	2653569.934	992.014	SPOT
16014	438772.794	2653565.699	992.291	SPOT
16015	438764.529	2653561.558	992.309	SPOT
16016	438763.354	2653561.319	993.382	SPOT
16017	438761.208	2653560.772	993.366	SPOT
16018	438759.992	2653560.105	994.677	SPOT
16019	438745.066	2653553.964	994.403	SPOT
16020	438732.384	2653548.954	995.076	SPOT
16021	438702.515	2653538.428	994.623	SPOT
16022	438694.226	2652874.266	1000.79	SPOT
16023	438704.262	2652873.792	1000.15	SPOT
16024	438709.74	2652874.139	998.681	SPOT
16025	438720.163	2652874.006	998.386	SPOT
16026	438725.425	2652874.008	996.488	SPOT
16027	438729.973	2652874.484	995.294	SPOT
16028	438730.933	2652874.388	992.374	SPOT
16029	438733.153	2652874.456	991.131	SPOT
16030	438734.401	2652874.633	990.733	SPOT
16031	438736.03	2652874.916	990.661	SPOT
16032	438740.993	2652874.93	990.766	SPOT
16033	438746.24	2652874.198	990.85	SPOT

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16034	438752.642	2652872.754	991.242	SPOT
16035	438759.664	2652871.986	991.222	SPOT
16036	438765.127	2652870.09	991.29	SPOT
16037	438773.862	2652868.539	991.631	SPOT
16038	438782.408	2652867.434	991.906	SPOT
16039	438789.566	2652865.895	992.002	SPOT
16040	438794.863	2652865.727	992.495	SPOT
16041	438803.179	2652864.036	992.734	SPOT
16042	438807.28	2652863.548	994.704	SPOT
16043	438816.934	2652862.303	996.016	SPOT
16044	438842.506	2652858.337	996.573	SPOT
16045	438859.102	2652859.754	999.303	SPOT
16046	438922.628	2652425.484	999.137	SPOT
16047	438908.955	2652414.005	998.1	SPOT
16048	438899.735	2652406.829	996.227	SPOT
16049	438895.668	2652404.157	994.456	SPOT
16050	438891.118	2652400.491	994.534	SPOT
16051	438888.536	2652397.273	992.174	SPOT
16052	438884.841	2652394.156	991.823	SPOT
16053	438880.686	2652390.702	991.914	SPOT
16054	438875.696	2652386.668	991.817	SPOT
16055	438871.954	2652383.958	991.379	SPOT
16056	438868.187	2652381.466	991.071	SPOT
16057	438864.314	2652378.404	990.528	SPOT
16058	438861.199	2652376.243	990.253	SPOT
16059	438859.022	2652374.313	989.412	SPOT
16060	438854.223	2652373.442	989.89	SPOT
16061	438852.099	2652371.508	990.641	SPOT
16062	438850.82	2652371.177	993.001	SPOT
16063	438850.192	2652371.006	994.128	SPOT
16064	438848.484	2652368.948	995.208	SPOT
16065	438843.397	2652365.473	998.486	SPOT
16066	438835.721	2652361.181	1002.433	SPOT
16067	439336.754	2652192.421	999.169	SPOT
16068	439335.281	2652210.105	997.421	SPOT
16069	439334.63	2652222.032	996.567	SPOT
16070	439333.954	2652227.279	996.605	SPOT
16071	439333.844	2652230.297	995.409	SPOT
16072	439333.572	2652231.632	993.083	SPOT
16073	439333.124	2652234.378	992.241	SPOT
16074	439332.813	2652237.262	991.593	SPOT
16075	439333.085	2652240.288	992.218	SPOT
16076	439332.916	2652243.302	992.074	SPOT
16077	439333.729	2652247.38	991.675	SPOT
16078	439333.228	2652248.914	991.853	SPOT
16079	439336.566	2652254.476	992.471	SPOT
16080	439338.063	2652262.593	992.249	SPOT
16081	439339.68	2652269.193	992.422	SPOT
16082	439338.69	2652273.127	992.212	SPOT
16083	439337.911	2652277.993	991.995	SPOT
16084	439338.637	2652281.615	991.963	SPOT
16085	439338.387	2652283.431	992.953	SPOT
16086	439335.952	2652287.356	996.595	SPOT
16087	439336.814	2652302.248	997.898	SPOT
16088	439336.887	2652332.024	998.11	SPOT
16089	439823.382	2652306.211	999.048	SPOT
16090	439838.932	2652277.406	998.874	SPOT
16091	439855.212	2652241.161	998.783	SPOT

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16092	439857.615	2652236.242	996.861	SPOT
16093	439857.892	2652234.948	993.683	SPOT
16094	439858.98	2652232.516	993.082	SPOT
16095	439862.843	2652230.015	993.187	SPOT
16096	439865.742	2652226.187	993.36	SPOT
16097	439868.737	2652222.985	992.997	SPOT
16098	439871.343	2652218.845	992.736	SPOT
16099	439876.121	2652213.215	991.769	SPOT
16100	439879.637	2652210.255	991.86	SPOT
16101	439881.329	2652206.472	992.193	SPOT
16102	439886.169	2652198.719	992.3	SPOT
16103	439885.798	2652199.981	992.686	SPOT
16104	439887.234	2652197.446	997.142	SPOT
16105	439888.05	2652196.183	997.226	SPOT
16106	439889.152	2652194.162	999.9	SPOT
16107	439891.073	2652191.06	1003.295	SPOT
16108	439892.04	2652189.453	1007.159	SPOT
16109	439900.952	2652179.285	1009.211	SPOT
16110	440177.126	2652586.092	1001.451	SPOT
16111	440168.777	2652592.128	998.975	SPOT
16112	440157.208	2652601.586	998.544	SPOT
16113	440153.377	2652604.676	998.972	SPOT
16114	440141.053	2652616.217	998.956	SPOT
16115	440130.511	2652624.381	998.657	SPOT
16116	440125.823	2652629.114	997.796	SPOT
16117	440124.523	2652630.38	995.916	SPOT
16118	440121.032	2652633.679	995.467	SPOT
16119	440119.202	2652635.074	994.488	SPOT
16120	440112.516	2652640.28	993.52	SPOT
16121	440109.152	2652644.14	993.235	SPOT
16122	440105.67	2652646.998	993.006	SPOT
16123	440101.279	2652651.567	992.266	SPOT
16124	440099.76	2652653.095	992.478	SPOT
16125	440098.065	2652655.508	992.505	SPOT
16126	440096.821	2652657.726	992.901	SPOT
16127	440095.187	2652659.267	992.908	SPOT
16128	440092.675	2652661.761	993.699	SPOT
16129	440091.765	2652662.99	996.958	SPOT
16130	440082.803	2652670.244	1002.68	SPOT
16131	440058.378	2652699.465	1003.107	SPOT
16132	440056.435	2653116.001	1002.385	SPOT
16133	440068.978	2653116.913	1002.112	SPOT
16134	440081.317	2653119.457	999.967	SPOT
16135	440083.117	2653120.336	996.466	SPOT
16136	440086.732	2653122.545	995.389	SPOT
16137	440088.662	2653122.872	995.003	SPOT
16138	440090.115	2653124.208	994.905	SPOT
16139	440095.465	2653124.99	994.818	SPOT
16140	440097.577	2653126.389	994.385	SPOT
16141	440098.991	2653126.572	994.204	SPOT
16142	440101.563	2653127.403	994.27	SPOT
16143	440103.341	2653128.005	994.262	SPOT
16144	440106.63	2653127.508	994.831	SPOT
16145	440110.452	2653127.797	995.285	SPOT
16146	440116.099	2653129.206	995.845	SPOT
16147	440124.161	2653133.017	996.473	SPOT
16148	440126.337	2653133.804	996.815	SPOT
16149	440127.346	2653134.458	999.016	SPOT

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16150	440129.809	2653135.183	1000.073	SPOT
16151	440144.989	2653139.477	1000.886	SPOT
16152	440162.174	2653143.02	1002.114	SPOT
16153	440181.023	2653143.188	1003.263	SPOT
16154	440206.489	2653137.651	1003.409	SPOT
16155	440233.985	2653135.238	1004.228	SPOT
16156	440267.891	2653129.418	1003.814	SPOT
16157	440526.383	2653301.877	1005.724	SPOT
16158	440523.176	2653307.383	1005.797	SPOT
16159	440520.693	2653311.36	1001.966	SPOT
16160	440517.731	2653316.37	1000.458	SPOT
16161	440514.481	2653323.572	1001.171	SPOT
16162	440506.892	2653337.279	1000.967	SPOT
16163	440504.269	2653341.725	1000.642	SPOT
16164	440502.726	2653344.382	999.452	SPOT
16165	440500.476	2653348.183	998.992	SPOT
16166	440499.933	2653348.884	997.25	SPOT
16167	440497.899	2653351.398	996.301	SPOT
16168	440495.497	2653355.441	996.266	SPOT
16169	440491.958	2653361.373	996.193	SPOT
16170	440489.37	2653366.104	995.999	SPOT
16171	440486.852	2653371.641	995.511	SPOT
16172	440484.952	2653375.341	995.147	SPOT
16173	440483.561	2653378.456	993.956	SPOT
16174	440483.418	2653381.515	994.794	SPOT
16175	440481.627	2653383.711	994.821	SPOT
16176	440478.171	2653388.067	995.297	SPOT
16177	440477.283	2653392.259	1000.896	SPOT
16178	440475.062	2653398.013	1002.986	SPOT
16179	440463.482	2653414.404	1005.048	SPOT
16180	440448.979	2653434.325	1004.332	SPOT
16181	440914.282	2653644.538	1003.163	SPOT
16182	440931.07	2653630.043	1003.094	SPOT
16183	440945.942	2653614.514	1001.166	SPOT
16184	440952.145	2653608.553	999.789	SPOT
16185	440955.52	2653604.161	997.765	SPOT
16186	440960.198	2653599.716	997.444	SPOT
16187	440962.707	2653597.026	997.673	SPOT
16188	440971.545	2653593	997.779	SPOT
16189	440980.442	2653586.216	997.658	SPOT
16190	440982.313	2653581.949	996.522	SPOT
16191	440983.182	2653579.058	995.588	SPOT
16192	440987.633	2653577.423	994.875	SPOT
16193	441028.501	2653545.483	1005.759	SPOT
16194	441021.96	2653555.609	1005.934	SPOT
16195	441017.567	2653558.719	1003.347	SPOT
16196	441004.724	2653566.292	1003.491	SPOT
16197	441002.977	2653566.855	999.665	SPOT
16198	441002.069	2653567.976	1000.144	SPOT
16199	441001.432	2653568.819	997.079	SPOT
16200	441000.156	2653570.025	995.452	SPOT
16201	440999.407	2653570.935	994.6	SPOT
16202	440998.593	2653571.424	994.285	SPOT
16203	441181.268	2654105.752	1002.543	SPOT
16204	441196.14	2654102.717	1001.473	SPOT
16205	441202.404	2654102.721	999.328	SPOT
16206	441207.643	2654103.172	997.727	SPOT
16207	441209.957	2654103.258	997.598	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
16208	441213.121	2654102.532	997.417	SPOT
16209	441218.378	2654101.363	996.581	SPOT
16210	441220.718	2654100.203	995.771	SPOT
16211	441224.697	2654099.19	996.182	SPOT
16212	441230.644	2654097.345	996.148	SPOT
16213	441230.973	2654097.541	996.106	SPOT
16214	441233.672	2654097.214	997.107	SPOT
16215	441235.853	2654096.378	998.475	SPOT
16216	441239.018	2654095.252	999.296	SPOT
16217	441245.872	2654093.004	998.713	SPOT
16218	441246.023	2654092.877	999.972	SPOT
16219	441260.646	2654092.042	1000.039	SPOT
16220	441260.636	2654092.018	999.979	SPOT
16221	441261.42	2654092.311	1002.665	SPOT
16222	441277.737	2654092.227	1003.61	SPOT
16223	441625.618	2654141.461	1003.725	SPOT
16224	441621.076	2654131.004	1001.575	SPOT
16225	441620.086	2654129.776	998.702	SPOT
16226	441618.858	2654126.74	998.328	SPOT
16227	441618.126	2654125.791	997.814	SPOT
16228	441614.682	2654118.352	997.861	SPOT
16229	441612.47	2654112.566	997.768	SPOT
16230	441608.355	2654102.137	998.495	SPOT
16231	441602.094	2654089.391	997.999	SPOT
16232	441598.239	2654081.072	998.378	SPOT
16233	441597.05	2654079.27	999.753	SPOT
16234	441595.332	2654076.253	1002.431	SPOT
16235	441594.359	2654073.884	1004.319	SPOT
16236	441591.608	2654068.913	1005.657	SPOT
16237	441590.642	2654066.634	1006.807	SPOT
16238	441586.12	2654056.868	1007.343	SPOT
16239	441579.971	2654041.135	1007.3	SPOT
16240	441930	2653800.058	1007.224	SPOT
16241	441934.4	2653807.502	1007.526	SPOT
16242	441937.769	2653813.469	1007.243	SPOT
16243	441938.745	2653814.878	1004.432	SPOT
16244	441939.943	2653817.02	1002.361	SPOT
16245	441943.83	2653824.262	1001.179	SPOT
16246	441944.917	2653826.516	999.725	SPOT
16247	441949.641	2653834.853	999.631	SPOT
16248	441956.633	2653846.066	999.724	SPOT
16249	441957.321	2653846.979	999.281	SPOT
16250	441957.822	2653848.33	998.506	SPOT
16251	441960.329	2653852.445	998.321	SPOT
16252	441963.95	2653858.481	998.51	SPOT
16253	441966.243	2653862.732	998.834	SPOT
16254	441970.74	2653869.175	997.999	SPOT
16255	441972.872	2653874.098	996.946	SPOT
16256	441974.902	2653878.032	996.774	SPOT
16257	441977.629	2653880.637	997.355	SPOT
16258	441979.751	2653883.915	998.019	SPOT
16259	441981.505	2653885.905	999.426	SPOT
16260	441982.314	2653888.078	1000.853	SPOT
16261	441988.602	2653898.351	1002.255	SPOT
16262	441994.568	2653910.352	1003.547	SPOT
16263	442216.597	2653573.619	1006.696	SPOT
16264	442228.839	2653578.893	1004.099	SPOT
16265	442233.999	2653580.957	1001.295	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
16266	442235.12	2653582.188	999.885	SPOT
16267	442238.185	2653582.918	998.629	SPOT
16268	442241.577	2653585.044	998.497	SPOT
16269	442244.119	2653588.065	998.363	SPOT
16270	442248.084	2653589.37	998.577	SPOT
16271	442251.635	2653590.603	998.559	SPOT
16272	442255.866	2653591.172	998.578	SPOT
16273	442259.785	2653592.008	998.804	SPOT
16274	442264.443	2653593.24	998.929	SPOT
16275	442264.652	2653593.217	998.929	SPOT
16276	442269.813	2653594.462	998.857	SPOT
16277	442273.615	2653595.533	998.408	SPOT
16278	442276.059	2653595.745	999.734	SPOT
16279	442277.457	2653595.485	1001.056	SPOT
16280	442280.682	2653596.084	1003.737	SPOT
16281	442293.956	2653600.947	1006.678	SPOT
16282	442300.465	2653603.826	1007.703	SPOT
16283	442137.338	2653181.897	1005.792	SPOT
16284	442132.406	2653195.539	1006.322	SPOT
16285	442129.634	2653199.763	1001.662	SPOT
16286	442128.747	2653203.545	1001.258	SPOT
16287	442127.257	2653206.139	999.229	SPOT
16288	442125.685	2653208.736	998.379	SPOT
16289	442124.101	2653211.718	998.318	SPOT
16290	442122.108	2653215.101	998.527	SPOT
16291	442119.681	2653218.669	998.836	SPOT
16292	442119.14	2653222.85	998.502	SPOT
16293	442116.79	2653226.385	998.727	SPOT
16294	442114.883	2653230.331	998.945	SPOT
16295	442113.116	2653236.422	999.551	SPOT
16296	442111.775	2653240.624	999.657	SPOT
16297	442110.802	2653243.703	999.823	SPOT
16298	441778.247	2653139.06	1007.17	SPOT
16299	441758.847	2653120.29	1008.281	SPOT
16300	441752.157	2653132.093	1006.669	SPOT
16301	441745.207	2653150.815	1007.122	SPOT
16302	441743.783	2653154.054	1005.386	SPOT
16303	441742.397	2653157.026	1001.979	SPOT
16304	441487.933	2652870.18	1011.882	SPOT
16305	441473.754	2652890.829	1009.445	SPOT
16306	441469.403	2652898.262	1007.124	SPOT
16307	441468.138	2652901.09	1002.953	SPOT
16308	441466.742	2652903.182	1001.359	SPOT
16309	441464.488	2652905.495	999.566	SPOT
16310	441460.488	2652908.825	997.988	SPOT
16311	441459.261	2652911.33	997.564	SPOT
16312	441459.274	2652911.835	997.449	SPOT
16313	441440.575	2652568.199	1008.087	SPOT
16314	441415.658	2652552.886	1006.154	SPOT
16315	441413.617	2652550.695	1002.273	SPOT
16316	441410.323	2652549.52	999.162	SPOT
16317	441409.433	2652548.337	999.868	SPOT
16318	441408.15	2652547.606	997.715	SPOT
16319	441259.632	2652116.922	1009.033	SPOT
16320	441220.276	2652115.648	1006.496	SPOT
16321	441216.947	2652115.299	1005.427	SPOT
16322	441196.085	2652115.312	1004.441	SPOT
16323	441178.839	2652115.847	1002.787	SPOT

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16324	441177.448	2652115.768	1002.092	SPOT
16325	441174.885	2652116.112	1000.836	SPOT
16326	441171.767	2652116.03	1000.359	SPOT
16327	441167.668	2652115.412	999.931	SPOT
16328	441163.957	2652114.898	999.148	SPOT
16329	441160.96	2652115.111	999.064	SPOT
16330	441152.086	2651763.51	1009.535	SPOT
16331	441119.34	2651762.924	1008.816	SPOT
16332	441099.116	2651761.036	1007.853	SPOT
16333	441086.303	2651758.712	1007.596	SPOT
16334	441083.058	2651758.363	1005.43	SPOT
16335	441082.839	2651758.4	1005.424	SPOT
16336	441081.893	2651758.416	1001.487	SPOT
16337	441077.935	2651757.798	1000.615	SPOT
16338	441075.149	2651756.1	1000.678	SPOT
16339	441071.684	2651755.018	1000.501	SPOT
16340	441068.092	2651754.448	1000.438	SPOT
16341	441330.648	2651427.586	1011.284	SPOT
16342	441311.291	2651426.954	1010.45	SPOT
16343	441302.553	2651426.13	1009.886	SPOT
16344	441295.028	2651425.582	1007.497	SPOT
16345	441291.356	2651426.148	1004.397	SPOT
16346	441286.254	2651425.61	1003.492	SPOT
16347	441280.415	2651423.56	1002.678	SPOT
16348	441274.41	2651422.721	1002.602	SPOT
16349	441268.194	2651421.335	1002.226	SPOT
16350	441263.18	2651420.523	1001.186	SPOT
16351	441257.437	2651419.439	1000.981	SPOT
16352	441253.244	2651420.038	1000.357	SPOT
16353	441250.04	2651418.706	1000.179	SPOT
16354	441246.792	2651418.687	1000.178	SPOT
16355	441340.949	2650983.348	1008.474	SPOT
16356	441319.187	2650982.415	1010.341	SPOT
16357	441312.214	2650983.21	1006.444	SPOT
16358	441308.701	2650983.771	1005.532	SPOT
16359	441307.648	2650983.595	1002.913	SPOT
16360	441304.55	2650982.643	1002.216	SPOT
16361	441300.597	2650981.538	1002.348	SPOT
16362	441295.819	2650981.553	1002.344	SPOT
16363	441290.906	2650980.471	1002.364	SPOT
16364	441529.899	2650599.501	1010.579	SPOT
16365	441519.749	2650593.161	1015.745	SPOT
16366	441517.747	2650585.414	1009.83	SPOT
16367	441513.328	2650581.071	1006.037	SPOT
16368	441512.796	2650580.784	1004.112	SPOT
16369	441507.477	2650574.091	1003.456	SPOT
16370	441505.441	2650570.196	1003.129	SPOT
16371	441502.753	2650565.681	1003.229	SPOT
16372	441499.854	2650561.421	1002.859	SPOT
16373	441497.293	2650556.854	1002.841	SPOT
16374	441494.003	2650552.233	1003.239	SPOT
16375	441494.001	2650552.225	1003.17	SPOT
16376	441879.997	2650394.516	1014.493	SPOT
16377	441878.367	2650353.514	1008.775	SPOT
16378	441878.192	2650351.813	1004.955	SPOT
16379	441878.257	2650347.961	1003.964	SPOT
16380	441878.596	2650344.856	1003.869	SPOT
16381	441878.576	2650340.632	1003.623	SPOT

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16382	441878.58	2650335.531	1003.773	SPOT
16383	442347.144	2650384.071	1012.11	SPOT
16384	442350.961	2650363.082	1011.011	SPOT
16385	442351.218	2650359.732	1008.164	SPOT
16386	442351.908	2650354.504	1006.885	SPOT
16387	442351.94	2650352.661	1004.958	SPOT
16388	442379.072	2650618.743	1012.353	SPOT
16389	442411.028	2650634.558	1008.849	SPOT
16390	442413.266	2650635.566	1006.939	SPOT
16391	442563.183	2651185.38	1016.891	SPOT
16392	442566.334	2651181.751	1013.265	SPOT
16393	442569.603	2651178.489	1011.687	SPOT
16394	442572.994	2651175.074	1007.097	SPOT
16395	442576.171	2651173.008	1006.48	SPOT
16396	442577.977	2651170.762	1006.7	SPOT
16397	442580.56	2651166.953	1006.597	SPOT
16398	442584.646	2651163.349	1006.997	SPOT
16399	442587.577	2651160.256	1007.181	SPOT
16400	442591.291	2651156.013	1007.257	SPOT
16401	442595.326	2651151.853	1006.728	SPOT
16402	442598.878	2651148.321	1006.74	SPOT
16403	442602.807	2651142.6	1006.38	SPOT
16404	442605.762	2651138.204	1006.297	SPOT
16405	442797.398	2650985.089	1013.036	SPOT
16406	442788.266	2650971.98	1010.193	SPOT
16407	442786.683	2650968.509	1008.303	SPOT
16408	442784.36	2650963.858	1008.35	SPOT
16409	442781.7	2650959.845	1007.973	SPOT
16410	442779.956	2650955.929	1007.481	SPOT
16411	442777.824	2650951.983	1007.296	SPOT
16412	442775.237	2650947.233	1006.484	SPOT
16413	442774.027	2650944.171	1006.244	SPOT
16414	444374.854	2649698.359	1014.624	SPOT
16415	444375.89	2649693.455	1014.5	SPOT
16416	444377.232	2649688.581	1014.847	SPOT
16417	444378.114	2649682.121	1015.119	SPOT
16418	444379.629	2649676.029	1016.04	SPOT
16419	444386.765	2649651.233	1019.463	SPOT
16420	444396.276	2649622.119	1019.906	SPOT
16421	444227.642	2649480.597	1021.917	SPOT
16422	444192.206	2649463.12	1019.508	SPOT
16423	444186.432	2649460.959	1014.699	SPOT
16424	444182.655	2649459.449	1014.775	SPOT
16425	444176.428	2649456.892	1015.384	SPOT
16426	444171.947	2649454.434	1015.322	SPOT
16427	444521.726	2649176.073	1024.688	SPOT
16428	444500.607	2649172.497	1023.066	SPOT
16429	444493.85	2649169.972	1018.411	SPOT
16430	444493.013	2649170.038	1016.804	SPOT
16431	444488.313	2649168.895	1015.774	SPOT
16432	444481.698	2649166.857	1015.935	SPOT
16433	444475.531	2649164.448	1015.909	SPOT
16434	444471.471	2649163.853	1015.714	SPOT
16435	444818.653	2649985.835	1017.252	SPOT
16436	444803.9	2650003.169	1017.311	SPOT
16437	444827.698	2650010.407	1018.878	SPOT
16438	444815.259	2650016.825	1017.329	SPOT
16439	444812.585	2650018.068	1013.598	SPOT

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16440	444809.96	2650019.035	1013.352	SPOT
16441	444807.744	2650020.855	1013.653	SPOT
16442	444805.354	2650022.763	1014.667	SPOT
16443	444802.899	2650024.913	1013.448	SPOT
16444	444798.932	2650027.013	1013.431	SPOT
16445	444792.331	2650031.342	1013.315	SPOT
16446	444784.57	2650035.084	1013.95	SPOT
16447	444778.394	2650039.191	1013.281	SPOT
16448	444772.857	2650042.502	1013.541	SPOT
16449	444573.753	2650476.971	1020.812	SPOT
16450	444596.36	2650485.023	1019.393	SPOT
16451	444602.167	2650487.476	1015.784	SPOT
16452	444605.264	2650489.001	1012.504	SPOT
16453	444610.751	2650490.726	1013.115	SPOT
16454	444616.887	2650492.144	1012.897	SPOT
16455	444622.196	2650493.829	1013.117	SPOT
16456	444629.155	2650495.524	1012.773	SPOT
16457	444635.566	2650496.456	1012.123	SPOT
16458	444640.853	2650497.729	1012.322	SPOT
16459	444646.904	2650498.723	1012.945	SPOT
16460	444652.288	2650499.982	1013.258	SPOT
16461	444655.297	2650501.377	1013.747	SPOT
16462	444656.829	2650501.59	1014.384	SPOT
16463	444660.629	2650502.218	1017.84	SPOT
16464	444672.065	2650505.501	1019.613	SPOT
16465	444424.673	2650737.844	1017.116	SPOT
16466	444425.102	2650710.312	1016.737	SPOT
16467	444424.846	2650706.723	1014.521	SPOT
16468	444524.349	2651109.008	1016.04	SPOT
16469	444487.116	2651121.782	1017.279	SPOT
16470	444482.873	2651123.809	1013.822	SPOT
16471	444481.366	2651124.379	1012.704	SPOT
16472	444478.033	2651126.876	1010.124	SPOT
16473	444474.237	2651128.712	1010.466	SPOT
16474	444469.646	2651130.147	1010.717	SPOT
16475	444214.154	2651380.556	1021.418	SPOT
16476	444209.868	2651348.169	1019.714	SPOT
16477	444209.223	2651344.112	1016.418	SPOT
16478	444206.563	2651333.155	1013.075	SPOT
16479	444207.37	2651330.711	1011.009	SPOT
16480	444206.279	2651325.885	1010.662	SPOT
16481	444205.613	2651320.651	1010.696	SPOT
16482	444204.062	2651314.97	1010.377	SPOT
16483	444202.696	2651309.141	1010.111	SPOT
16484	444201.134	2651305.132	1009.047	SPOT
16485	444200.583	2651302.351	1010.056	SPOT
16486	444201.523	2651299.179	1012.571	SPOT
16487	444199.979	2651296.472	1014.835	SPOT
16488	444192.592	2651275.416	1016.642	SPOT
16489	444080.904	2651453.257	1019.598	SPOT
16490	444064.15	2651436.697	1017.501	SPOT
16491	444058.053	2651432.618	1013.302	SPOT
16492	444057.221	2651431.413	1012.438	SPOT
16493	444055.195	2651429.792	1009.922	SPOT
16494	444052.791	2651426.578	1010.384	SPOT
16495	444050.02	2651422.709	1010.524	SPOT
16496	444048.115	2651418.45	1010.716	SPOT
16497	444045.379	2651413.2	1011.121	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
16498	444042.882	2651408.102	1011.651	SPOT
16499	444039.759	2651403.087	1011.691	SPOT
16500	444035.973	2651398.539	1011.607	SPOT
16501	444033.273	2651393.705	1011.574	SPOT
16502	444030.49	2651389.795	1011.479	SPOT
16503	444029.22	2651386.756	1012.348	SPOT
16504	444027.97	2651385.553	1013.397	SPOT
16505	444020.281	2651376.02	1020.21	SPOT
16506	444012.129	2651362.529	1022.347	SPOT
16507	443881.045	2651863.34	1015.588	SPOT
16508	443863.539	2651869.013	1016.03	SPOT
16509	443854.786	2651875.65	1013.436	SPOT
16510	443852.566	2651876.563	1011.589	SPOT
16511	443848.814	2651878.729	1011.111	SPOT
16512	443844.169	2651880.839	1010.9	SPOT
16513	443838.941	2651883.303	1010.703	SPOT
16514	443834.174	2651885.447	1010.039	SPOT
16515	443829.003	2651886.93	1010.128	SPOT
16516	443824.208	2651889.343	1010.052	SPOT
16517	443819.231	2651891.206	1010.285	SPOT
16518	443455.796	2652018.78	1018.317	SPOT
16519	443471.383	2652000.79	1016.042	SPOT
16520	443477.527	2651995.23	1012.832	SPOT
16521	443478.719	2651992.7	1009.699	SPOT
16522	443480.37	2651990.03	1007.856	SPOT
16523	443482.496	2651988.548	1007.535	SPOT
16524	443196.39	2651620.713	1013.495	SPOT
16525	443220.133	2651617.889	1013.41	SPOT
16526	443222.076	2651617.571	1012.283	SPOT
16527	443222.438	2651617.033	1010.113	SPOT
16528	443225.578	2651617.433	1008.996	SPOT
16529	443230.052	2651616.176	1008.059	SPOT
16530	443234.505	2651615.007	1008.042	SPOT
16531	443343.503	2651338.977	1012.257	BR B
16532	443341.083	2651338.512	1012.339	BR
16533	443347.228	2651301.742	1012.497	BR
16534	443349.541	2651302.617	1012.474	BR CLOSE
16535	443344.538	2651334.745	1010.927	LB B
16536	443349.903	2651302.898	1011.213	LB E
16537	443325.881	2651240.98	1014.336	SPOT
16538	443316.771	2651266.017	1013.38	SPOT
16539	443315.578	2651269.646	1011.329	SPOT
16540	443314.94	2651271.488	1010.147	SPOT
16541	443313.76	2651275.71	1007.729	SPOT
16542	443311.997	2651279.969	1007.749	SPOT
16543	443309.602	2651285.108	1008.43	SPOT
16544	443307.424	2651291.213	1008.48	SPOT
16545	443306.247	2651296.994	1009.012	SPOT
16546	443304.66	2651304.223	1009.712	SPOT
16547	443303.167	2651311.318	1009.612	SPOT
16548	443301.671	2651317.632	1009.196	SPOT
16549	443300.546	2651322.975	1009.543	SPOT
16550	443300.253	2651326.139	1010.544	SPOT
16551	443299.88	2651328.354	1011.878	SPOT
16552	443295.315	2651349.028	1014.331	SPOT
16553	443075.442	2651043.104	1016.414	SPOT
16554	443084.406	2651020.662	1017.166	SPOT
16555	443089.426	2651010.407	1013.41	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
16556	443090.847	2651007.898	1009.046	SPOT
16557	443094.644	2651002.204	1008.374	SPOT
16558	443097.255	2650996.956	1007.995	SPOT
16559	443099.304	2650993.791	1008.313	SPOT
16560	447951.935	2648884.135	1033.58	SPOT
16561	447930.485	2648886.583	1033.066	SPOT
16562	447925.589	2648887.293	1031.952	SPOT
16563	447918.17	2648888.108	1027.517	SPOT
16564	447915.564	2648889.288	1023.317	SPOT
16565	447911.816	2648891.405	1023.446	SPOT
16566	447905.517	2648892.61	1023.429	SPOT
16567	447898.763	2648893.602	1023.115	SPOT
16568	447892.941	2648894.519	1023.135	SPOT
16569	447886.554	2648895.733	1022.678	SPOT
16570	447881.771	2648896.549	1022.438	SPOT
16571	447878.537	2648896.782	1024.469	SPOT
16572	447730.861	2648544.467	1030.981	SPOT
16573	447729.124	2648559.989	1031.346	SPOT
16574	447727.952	2648572.267	1031.055	SPOT
16575	447727.376	2648578.198	1028.423	SPOT
16576	447726.87	2648581.034	1024.535	SPOT
16577	447726.002	2648585.015	1023.09	SPOT
16578	447726.232	2648591.342	1023.238	SPOT
16579	447726.037	2648596.939	1023.356	SPOT
16580	447581.953	2648210.165	1029.959	SPOT
16581	447556.384	2648193.799	1029.24	SPOT
16582	447555.266	2648192.065	1025.188	SPOT
16583	447550.994	2648188.866	1022.285	SPOT
16584	447547.587	2648186.336	1022.757	SPOT
16585	447543.7	2648184.176	1022.608	SPOT
16586	447540.255	2648181.494	1023.203	SPOT
16587	447534.973	2648179.521	1023.637	SPOT
16588	447765.331	2647933.167	1028.754	SPOT
16589	447771.566	2647916.1	1030.535	SPOT
16590	447767.123	2647914.74	1029.139	SPOT
16591	447746.052	2647906.476	1028.163	SPOT
16592	447739.408	2647904.339	1026.414	SPOT
16593	447737.054	2647903.663	1025.267	SPOT
16594	447732.485	2647902.599	1024.439	SPOT
16595	447726.662	2647900.551	1024.412	SPOT
16596	447722.262	2647899.373	1024.07	SPOT
16597	447608.946	2647570.927	1032.773	SPOT
16598	447606.967	2647576.811	1030.148	SPOT
16599	447605.11	2647584.868	1031.751	SPOT
16600	447600.974	2647603.025	1032.402	SPOT
16601	447598.967	2647604.895	1030.081	SPOT
16602	447597.065	2647613.258	1026.88	SPOT
16603	447595.776	2647618.277	1026.452	SPOT
16604	447593.839	2647624.871	1025.813	SPOT
16605	447592.346	2647630.368	1025.198	SPOT
16606	447591.262	2647635.194	1024.792	SPOT
16607	447179.354	2647435.779	1032.548	SPOT
16608	447160.83	2647445.884	1031.892	SPOT
16609	447152.363	2647451.222	1028.273	SPOT
16610	447144.707	2647456.092	1027.096	SPOT
16611	447141.37	2647457.738	1026.515	SPOT
16612	447136.752	2647459.955	1025.935	SPOT
16613	447136.723	2647459.808	1025.946	SPOT

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16614	447132.195	2647462.512	1025.149	SPOT
16615	447128.353	2647464.896	1024.289	SPOT
16616	447126.225	2647467.383	1023.758	SPOT
16617	447123.333	2647470.755	1022.695	SPOT
16618	447427.888	2649049.862	1029.131	SPOT
16619	447448.309	2649029.894	1026.777	SPOT
16620	447456.225	2649024.065	1026.156	SPOT
16621	447457.308	2649022.985	1022.615	SPOT
16622	447460.713	2649021.736	1022.663	SPOT
16623	447464.635	2649020.009	1023.019	SPOT
16624	447467.802	2649017.819	1022.882	SPOT
16625	447471.935	2649014.98	1022.98	SPOT
16626	447477.316	2649012.073	1022.806	SPOT
16627	447481.746	2649010.018	1022.845	SPOT
16628	447485.922	2649008.239	1023.107	SPOT
16629	447491.68	2649006.188	1022.903	SPOT
16630	447494.109	2649005.96	1024.095	SPOT
16631	447496.869	2649005.899	1026.172	SPOT
16632	447503.618	2649003.378	1027.878	SPOT
16633	447521.53	2648994.992	1027.249	SPOT
16634	447040.489	2648901.237	1031.629	SPOT
16635	447046.135	2648899.617	1028.281	SPOT
16636	447054.539	2648896.297	1027.128	SPOT
16637	447060.612	2648894.176	1025.477	SPOT
16638	447066.877	2648891.934	1026.977	SPOT
16639	447079.987	2648888.598	1027.534	SPOT
16640	447096.799	2648885.886	1027.23	SPOT
16641	447097.727	2648886.522	1025.342	SPOT
16642	447100.432	2648885.936	1025.15	SPOT
16643	447103.995	2648884.899	1023.941	SPOT
16644	446865.444	2648430.823	1030.068	SPOT
16645	446870.604	2648407.193	1026.623	SPOT
16646	446872.845	2648386.767	1026.541	SPOT
16647	446875.585	2648369.231	1025.777	SPOT
16648	446875.236	2648364.384	1024.327	SPOT
16649	446876.397	2648363.849	1021.116	SPOT
16650	446877.25	2648359.607	1019.912	SPOT
16651	446877.621	2648354.489	1020.078	SPOT
16652	446878.372	2648350.872	1020.092	SPOT
16653	446879.002	2648347.072	1020.185	SPOT
16654	446497.146	2648412.496	1027.381	SPOT
16655	446484.943	2648398.139	1024.574	SPOT
16656	446482.41	2648395.929	1025.159	SPOT
16657	446475.247	2648389.898	1025.525	SPOT
16658	446472.023	2648386.549	1024.078	SPOT
16659	446470.524	2648384.715	1022.119	SPOT
16660	446468.588	2648381.956	1021.116	SPOT
16661	446464.448	2648377.834	1020.811	SPOT
16662	446460.592	2648374.922	1020.927	SPOT
16663	446455.8	2648370.589	1020.25	SPOT
16664	446452.625	2648367.366	1019.527	SPOT
16665	446173.435	2648739.012	1027.837	SPOT
16666	446175.642	2648736.96	1026.84	SPOT
16667	446180.1	2648731.909	1027.153	SPOT
16668	446189.735	2648719.73	1025.242	SPOT
16669	446192.228	2648716.354	1020.698	SPOT
16670	446194.61	2648712.993	1020.829	SPOT
16671	446197.826	2648710.088	1020.541	SPOT

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16672	446200.656	2648706.37	1020.179	SPOT
16673	446203.73	2648702.911	1019.79	SPOT
16674	445823.234	2648390.169	1026.747	SPOT
16675	445829.393	2648383.388	1023.625	SPOT
16676	445847.034	2648358.786	1023.97	SPOT
16677	445848.048	2648356.492	1020.656	SPOT
16678	445850.942	2648353.396	1019.642	SPOT
16679	445853.61	2648349.023	1019.595	SPOT
16680	445856.067	2648344.914	1019.371	SPOT
16681	445859.264	2648340.399	1018.906	SPOT
16682	445861.368	2648337.068	1018.34	SPOT
16683	445728.641	2647961.909	1029.403	SPOT
16684	445740.739	2647966.232	1028.519	SPOT
16685	445745.559	2647967.531	1024.389	SPOT
16686	445748.365	2647967.848	1023.267	SPOT
16687	445751.631	2647967.273	1022.82	SPOT
16688	445752.928	2647967.532	1019.257	SPOT
16689	445757.489	2647968.097	1018.93	SPOT
16690	445762.939	2647968.897	1018.883	SPOT
16691	445767.767	2647969.705	1018.826	SPOT
16692	445771.754	2647970.507	1018.871	SPOT
16693	445335.357	2647864.98	1025.019	SPOT
16694	445325.592	2647832.235	1022.452	SPOT
16695	445325.247	2647830.155	1018.978	SPOT
16696	445324.733	2647828.233	1018.051	SPOT
16697	445324.579	2647827.327	1016.87	SPOT
16698	445323.705	2647824.61	1016.5	SPOT
16699	445322.833	2647821.85	1016.437	SPOT
16700	445321.786	2647818.797	1016.6	SPOT
16701	445321.466	2647816.946	1017	SPOT
16702	445320.172	2647812.055	1016.707	SPOT
16703	444897.391	2648006.464	1027.569	SPOT
16704	444895.408	2647998.476	1025.818	SPOT
16705	444892.542	2647985.296	1025.132	SPOT
16706	444891.204	2647979.291	1021.759	SPOT
16707	444891.294	2647977.861	1018.743	SPOT
16708	444890.64	2647973.65	1018.108	SPOT
16709	444889.444	2647969.026	1018.823	SPOT
16710	444830.876	2648245.97	1024.206	SPOT
16711	444827.255	2648254.563	1022.475	SPOT
16712	444824.061	2648258.025	1023.168	SPOT
16713	444821.2	2648262.506	1022.477	SPOT
16714	444819.937	2648263.739	1020.227	SPOT
16715	444818.716	2648266.647	1019.099	SPOT
16716	444818.281	2648267.597	1016.68	SPOT
16717	444671.231	2648826.115	1026.024	SPOT
16718	444658.869	2648809.418	1024.859	SPOT
16719	444652.103	2648801.337	1021.347	SPOT
16720	444650.451	2648798.899	1016.64	SPOT
16721	444648.104	2648796.328	1015.493	SPOT
16722	444645.16	2648792.712	1016.083	SPOT
16723	444642.3	2648789.232	1016.338	SPOT
16724	444639.273	2648785.663	1016.285	SPOT
16725	447228.554	2647065.478	1036.745	SPOT
16726	447226.016	2647068.536	1032.756	SPOT
16727	447212.836	2647076.19	1031.909	SPOT
16728	447192.385	2647086.874	1029.898	SPOT
16729	447187.072	2647088.796	1027.182	SPOT

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16730	447185.413	2647089.193	1026.588	SPOT
16731	447180.936	2647091.957	1026.404	SPOT
16732	447175.995	2647094.38	1026.361	SPOT
16733	447169.687	2647096.673	1026.284	SPOT
16734	447164.173	2647098.722	1025.972	SPOT
16735	447164.141	2647098.689	1025.994	SPOT
16736	446980.624	2646676.353	1033.717	SPOT
16737	446969.681	2646691.608	1033.384	SPOT
16738	446964.204	2646700.374	1031.97	SPOT
16739	446962.457	2646703.034	1029.855	SPOT
16740	446960.308	2646705.792	1028.935	SPOT
16741	446959.578	2646706.523	1027.578	SPOT
16742	446956.601	2646710.279	1025.498	SPOT
16743	446954.031	2646713.599	1025.516	SPOT
16744	446952.365	2646715.24	1026.503	SPOT
16745	446951.863	2646716.522	1027.106	SPOT
16746	446950.331	2646719.481	1026.107	SPOT
16747	446881.29	2646296.047	1040.149	SPOT
16748	446861.341	2646295.678	1038.957	SPOT
16749	446843.983	2646298.393	1037.752	SPOT
16750	446834.256	2646301.726	1031.035	SPOT
16751	446833.162	2646302.44	1029.72	SPOT
16752	446831.3	2646302.72	1028.885	SPOT
16753	446829.578	2646302.721	1028.031	SPOT
16754	446825.031	2646303.413	1027.422	SPOT
16755	446818.917	2646303.529	1027.713	SPOT
16756	446812.184	2646303.521	1027.74	SPOT
16757	446806.315	2646303.797	1027.372	SPOT
16758	446639.888	2645944.342	1035.488	SPOT
16759	446615.666	2645945.659	1034.16	SPOT
16760	446614.413	2645945.474	1032.917	SPOT
16761	446601.843	2645945.036	1029.936	SPOT
16762	446592.321	2645947.48	1028.699	SPOT
16763	446585.278	2645948.191	1028.434	SPOT
16764	446577.4	2645950.264	1028.869	SPOT
16765	446570.804	2645952.454	1029.36	SPOT
16766	446564.592	2645954.369	1028.454	SPOT
16767	446555.909	2645955.404	1027.654	SPOT
16768	446550.215	2645956.601	1028.351	SPOT
16769	446546.767	2645958.055	1028.427	SPOT
16770	446541.572	2645960.152	1028.651	SPOT
16771	446537.991	2645961.925	1028.955	SPOT
16772	446524.553	2645501.439	1038.852	SPOT
16773	446500.554	2645512.571	1038.696	SPOT
16774	446496.827	2645513.532	1033.824	SPOT
16775	446494.367	2645514.303	1032.382	SPOT
16776	446492.435	2645515.279	1028.86	SPOT
16777	446488.393	2645517.716	1028.194	SPOT
16778	446482.179	2645519.132	1027.854	SPOT
16779	446476.274	2645521.322	1028.796	SPOT
16780	446472.395	2645523.634	1029.71	SPOT
16781	446465.102	2645528.485	1030.179	SPOT
16782	446457.209	2645533.987	1029.848	SPOT
16783	446448.642	2645538.889	1029.827	SPOT
16784	446442.206	2645543.286	1030.193	SPOT
16785	446434.125	2645550.457	1029.678	SPOT
16786	446429.351	2645554.307	1029.672	SPOT
16787	446424.484	2645558.272	1028.947	SPOT
16788	446419.975	2645560.724	1028.739	SPOT
16789	446573.163	2645094.084	1040.702	SPOT
16790	446569.037	2645090.849	1038.534	SPOT
16791	446542.324	2645075.599	1036.572	SPOT
16792	446541.584	2645074.409	1034.402	SPOT
16793	446540.092	2645072.998	1033.865	SPOT
16794	446536.736	2645070.736	1030.671	SPOT
16795	446534.419	2645069.46	1030.998	SPOT
16796	446530.205	2645066.351	1031.336	SPOT
16797	446525.658	2645064.267	1031.821	SPOT
16798	446521.946	2645062.629	1031.832	SPOT
16799	446799.275	2645016.314	1042.778	SPOT
16800	446805.789	2644999.312	1042.308	SPOT
16801	446808.425	2644993.752	1039.475	SPOT
16802	446809.366	2644990.782	1035.659	SPOT
16803	446810.53	2644990.055	1032.392	SPOT
16804	446812.016	2644985.742	1031.62	SPOT
16805	446813.011	2644981.5	1031.809	SPOT
16806	446813.336	2644977.559	1031.982	SPOT
16807	447276.976	2645162.641	1039.322	SPOT
16808	447264.58	2645147.531	1038.359	SPOT
16809	447251.712	2645133.446	1038.693	SPOT
16810	447249.631	2645131.719	1036.653	SPOT
16811	447248.408	2645129.99	1035.584	SPOT
16812	447247.928	2645129.176	1034.126	SPOT
16813	447245.4	2645126.825	1031.38	SPOT
16814	447243.702	2645124.98	1031.24	SPOT
16815	447242.639	2645123.39	1030.669	SPOT
16816	447518.379	2644734.687	1040.364	SPOT
16817	447511.759	2644718.231	1037.256	SPOT
16818	447505.778	2644703.949	1036.945	SPOT
16819	447505.435	2644702.642	1034.883	SPOT
16820	447504.629	2644699.774	1034.302	SPOT
16821	447502.218	2644694.84	1034.148	SPOT
16822	447500.231	2644690.201	1034.132	SPOT
16823	447497.838	2644685.224	1033.789	SPOT
16824	447495.65	2644680.168	1033.556	SPOT
16825	447493.245	2644675.897	1033.224	SPOT
16826	447491.041	2644671.749	1032.748	SPOT
16827	447977.373	2644592.149	1045.435	SPOT
16828	447975.405	2644578.183	1044.94	SPOT
16829	447972.649	2644568.051	1041.67	SPOT
16830	447972.376	2644565.539	1039.737	SPOT
16831	447972.502	2644562.91	1038.35	SPOT
16832	447971.62	2644560.454	1034.309	SPOT
16833	447970.287	2644555.976	1032.891	SPOT
16834	447969.972	2644551.886	1033.408	SPOT
16835	447969.131	2644547.632	1033.764	SPOT
16836	447968.422	2644543.371	1033.653	SPOT
16837	448443.501	2644379.413	1042.199	SPOT
16838	448438.98	2644367.034	1041.511	SPOT
16839	448436.238	2644359.397	1038.187	SPOT
16840	448434.871	2644358.144	1035.122	SPOT
16841	448434.02	2644352.282	1033.614	SPOT
16842	448432.64	2644347.938	1033.408	SPOT
16843	448430.358	2644343.817	1032.861	SPOT
16844	448427.592	2644339.035	1033.468	SPOT
16845	448424.31	2644333.688	1033.423	SPOT
16846	448421.479	2644329.401	1032.806	SPOT
16847	448418.294	2644326.345	1032.763	SPOT
16848	448415.917	2644322.964	1033.338	SPOT
16849	448414.619	2644320.147	1033.862	SPOT
16850	448411.989	2644315.54	1035.887	SPOT
16851	448411.455	2644314.894	1036.414	SPOT
16852	448409.803	2644312.915	1037.554	SPOT
16853	448409.568	2644312.577	1039.475	SPOT
16854	448837.701	2644143.743	1044.199	SPOT
16855	448832.947	2644139.989	1040.846	SPOT
16856	448827.849	2644137.122	1039.281	SPOT
16857	448826.471	2644136.273	1037.226	SPOT
16858	448823.71	2644134.803	1035.403	SPOT
16859	448819.59	2644132.005	1035.773	SPOT
16860	448815.855	2644128.727	1035.797	SPOT
16861	448811.659	2644125.437	1035.804	SPOT
16862	448807.017	2644121.54	1035.761	SPOT
16863	448802.472	2644117.749	1035.667	SPOT
16864	448797.778	2644113.561	1035.812	SPOT
16865	448793.075	2644110.386	1035.703	SPOT
16866	448787.824	2644106.183	1035.544	SPOT
16867	448784.442	2644103.251	1035.726	SPOT
16868	448782.159	2644101.759	1036.105	SPOT
16869	448781.149	2644100.614	1037.044	SPOT
16870	448780.764	2644100.209	1039.643	SPOT
16871	448890.45	2643885.908	1036.42	SPOT
16872	448892.474	2643886.574	1033.278	SPOT
16873	448897.597	2643888.424	1035.289	SPOT
16874	448903.977	2643890.693	1035.928	SPOT
16875	448909.743	2643892.612	1036.273	SPOT
16876	448916.324	2643895.033	1036.299	SPOT
16877	448923.597	2643897.798	1036.919	SPOT
16878	448931.707	2643900.517	1037.365	SPOT
16879	448938.079	2643902.731	1037.567	SPOT
16880	448941.042	2643903.855	1038.348	SPOT
16881	448944.239	2643904.839	1039.167	SPOT
16882	448947.639	2643906.185	1039.262	SPOT
16883	448950.913	2643907.486	1040.338	SPOT
16884	448952.057	2643907.803	1040.36	SPOT
16885	448952.671	2643906.525	1053.763	LB B
16886	448889.497	2643885.701	1055.442	LB E
16887	449031.424	2643759.499	1046.762	SPOT
16888	449014.995	2643754.299	1042.733	SPOT
16889	449007.994	2643752.121	1039.865	SPOT
16890	449006.324	2643756.059	1040.975	SPOT
16891	449003.742	2643753.99	1037.072	SPOT
16892	448998.04	2643751.351	1036.486	SPOT
16893	448992.226	2643749.442	1036.634	SPOT
16894	448984.444	2643746.453	1036.444	SPOT
16895	448760.965	2643268.799	1040.554	SPOT
16896	448771.544	2643255.586	1041.802	SPOT
16897	448786.887	2643238.606	1041.072	SPOT
16898	448290.089	2643099.245	1043.114	SPOT
16899	448289.502	2643115.538	1042.861	SPOT
16900	448288.506	2643131.282	1041.8	SPOT
16901	448288.182	2643136.134	1039.605	SPOT
16902	447804.294	2642996.1	1042.312	SPOT
16903	447817.167	2643023.907	1041.137	SPOT

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16904	447816.23	2643026.489	1038.745	SPOT
16905	447818.459	2643030.14	1037.169	SPOT
16906	447821.523	2643034.67	1036.417	SPOT
16907	447825.513	2643041.468	1036.536	SPOT
16908	447829.099	2643046.93	1036.674	SPOT
16909	447427.421	2642850.055	1040.297	SPOT
16910	447427.853	2642847.828	1041.44	SPOT
16911	447426.082	2642844.82	1042.129	SPOT
16912	447425.523	2642841.093	1044.484	SPOT
16913	447423.966	2642837.997	1045.115	SPOT
16914	447110.241	2642986.52	1049.897	SPOT
16915	447124.443	2642990.298	1046.708	SPOT
16916	447131.714	2642992.317	1044.533	SPOT
16917	447134.788	2642992.858	1043.529	SPOT
16918	447136.617	2642993.709	1041.177	SPOT
16919	447138.137	2642994.399	1041.356	SPOT
16920	447139.227	2642994.16	1038.754	SPOT
16921	447143.402	2642995.972	1037.31	SPOT
16922	447147.893	2642998.013	1036.521	SPOT
16923	447150.803	2642999.129	1038.003	SPOT
16924	447153.77	2642999.777	1038.531	SPOT
16925	447157.275	2643001.242	1037.31	SPOT
16926	446747.526	2643120.592	1052.602	SPOT
16927	446762.575	2643130.243	1052.31	SPOT
16928	446773.89	2643139.633	1042.616	SPOT
16929	446774.799	2643140.158	1039.963	SPOT
16930	446778.048	2643141.364	1038.874	SPOT
16931	446780.241	2643143.188	1038.507	SPOT
16932	446531.302	2643472.931	1044.328	SPOT
16933	446543.4	2643493.933	1043.728	SPOT
16934	446545.104	2643496.775	1045.147	SPOT
16935	446547.952	2643500.559	1044.648	SPOT
16936	446549.834	2643503.894	1039.974	SPOT
16937	446552.378	2643507.605	1039.65	SPOT
16938	446554.865	2643513.252	1039.667	SPOT
16939	446557.593	2643518.481	1039.512	SPOT
16940	446560.792	2643524.198	1039.451	SPOT
16941	446563.507	2643529.488	1038.278	SPOT
16942	446565.72	2643533.469	1037.518	SPOT
16943	446245.209	2643158.31	1046.456	SPOT
16944	446230.906	2643178.08	1044.936	SPOT
16945	446230.701	2643178.064	1044.885	SPOT
16946	446228.626	2643182.083	1042.127	SPOT
16947	446228.627	2643182.082	1042.075	SPOT
16948	446227.181	2643185.708	1040.687	SPOT
16949	446224.097	2643190.393	1040.196	SPOT
16950	446221.548	2643195.08	1039.777	SPOT
16951	446221.233	2643195.663	1039.724	SPOT
16952	446219.21	2643199.812	1039.306	SPOT
16953	445982.513	2642769.814	1047.532	SPOT
16954	445963.411	2642761.447	1046.458	SPOT
16955	445960.593	2642759.678	1044.733	SPOT
16956	445958.867	2642759.264	1044.006	SPOT
16957	445958.059	2642758.425	1042.244	SPOT
16958	445952.669	2642756.041	1041.308	SPOT
16959	445947.096	2642753.872	1041.031	SPOT
16960	445941.369	2642752.064	1040.599	SPOT
16961	445936.151	2642749.594	1040.208	SPOT

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16962	445930.391	2642747.541	1040.159	SPOT
16963	445925.759	2642744.97	1040.509	SPOT
16964	446152.252	2642338.945	1047.77	SPOT
16965	446148.329	2642339.211	1046.04	SPOT
16966	446142.547	2642338.427	1045.109	SPOT
16967	446140.774	2642338.635	1040.591	SPOT
16968	446136.99	2642338.743	1040.564	SPOT
16969	446132.293	2642338.02	1041.103	SPOT
16970	446128.214	2642337.157	1041.286	SPOT
16971	446124.086	2642336.023	1040.837	SPOT
16972	446119.654	2642335.659	1040.498	SPOT
16973	445832.083	2642177.508	1048.751	SPOT
16974	445849.968	2642194.475	1047.591	SPOT
16975	445850.978	2642197.445	1046.128	SPOT
16976	445854.691	2642201.44	1045.758	SPOT
16977	445855.648	2642202.128	1044.051	SPOT
16978	445856.293	2642202.749	1043.689	SPOT
16979	445856.763	2642203.006	1042.526	SPOT
16980	445859.882	2642206.812	1041.413	SPOT
16981	445864.692	2642211.305	1041.233	SPOT
16982	445868.918	2642214.741	1041.067	SPOT
16983	445477.015	2642079.269	1047.475	SPOT
16984	445455.881	2642077.001	1047.134	SPOT
16985	445450.419	2642077.584	1045.379	SPOT
16986	445448.459	2642077.922	1042.035	SPOT
16987	445442.603	2642077.468	1042.348	SPOT
16988	445437.076	2642078.351	1042.151	SPOT
16989	445590.024	2641640.96	1050.399	SPOT
16990	445566.545	2641636.369	1048.08	SPOT
16991	445564.467	2641636.093	1046.564	SPOT
16992	445562.345	2641635.501	1045.778	SPOT
16993	445561.358	2641635.108	1042.695	SPOT
16994	445557.15	2641633.726	1041.342	SPOT
16995	445552.99	2641632.928	1041.551	SPOT
16996	445548.557	2641632.372	1041.584	SPOT
16997	445544.27	2641632.065	1041.848	SPOT
16998	445911.823	2641370.092	1047.669	SPOT
16999	445907.235	2641352.462	1048.291	SPOT
17000	445903.148	2641334.957	1048.215	SPOT
17001	445902.669	2641331.22	1047.037	SPOT
17002	445901.684	2641327.236	1046.704	SPOT
17003	445901.797	2641325.761	1044.366	SPOT
17004	445900.345	2641319.631	1044.253	SPOT
17005	445899.077	2641315.19	1043.878	SPOT
17006	445898.693	2641311.447	1043.581	SPOT
17007	446290.88	2641268.916	1051.579	SPOT
17008	446276.832	2641264.728	1052.697	SPOT
17009	446269.049	2641262.221	1047.527	SPOT
17010	446268.055	2641262.111	1044.408	SPOT
17011	446262.386	2641261.247	1043.977	SPOT
17012	446256.441	2641259.84	1044.424	SPOT
17013	446251.813	2641258.56	1044.743	SPOT
17014	446247.758	2641257.319	1044.584	SPOT
17015	446130.623	2640801.973	1053.915	SPOT
17016	446119.613	2640818.122	1055.025	SPOT
17017	446115.189	2640825.512	1049.843	SPOT
17018	446112.855	2640829.308	1048.711	SPOT
17019	446111.229	2640830.756	1044.261	SPOT

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17020	446108.986	2640834.687	1044.632	SPOT
17021	446106.932	2640837.29	1044.652	SPOT
17022	445750.151	2640765.869	1048.897	SPOT
17023	445758.486	2640794.294	1048.812	SPOT
17024	445759.851	2640799.406	1046.96	SPOT
17025	445763.046	2640810.402	1046.665	SPOT
17026	445765.168	2640815.997	1045.979	SPOT
17027	445767.247	2640821.271	1045.147	SPOT
17028	445768.529	2640826.258	1044.558	SPOT
17029	445770.237	2640830.779	1044.174	SPOT
17030	445771.4	2640835.319	1044.262	SPOT
17031	445772.167	2640839.513	1045.429	SPOT
17032	445773.633	2640842.934	1046.627	SPOT
17033	445777.981	2640847.636	1048.797	SPOT
17034	445644.661	2640464.994	1052.025	SPOT
17035	445620.259	2640468.677	1049.506	SPOT
17036	445616.538	2640469.037	1050.525	SPOT
17037	445609.72	2640470.405	1050.03	SPOT
17038	445606.942	2640469.148	1045.731	SPOT
17039	445600.927	2640470.338	1045.462	SPOT
17040	445596.27	2640470.569	1045.454	SPOT
17041	445591.929	2640471.483	1045.492	SPOT
17042	435160.312	2654875.53	1104.58	CHK 8
17043	449969.839	2638671.686	1064.094	SPOT
17044	449952.625	2638682.659	1062.739	SPOT
17045	449950.441	2638683.523	1060.32	SPOT
17046	449948.238	2638684.878	1059.973	SPOT
17047	449946.882	2638685.86	1056.78	SPOT
17048	449945.059	2638688.202	1056.06	SPOT
17049	449941.225	2638690.896	1056.196	SPOT
17050	449507.763	2638831.328	1067.837	SPOT
17051	449506.277	2638821.748	1064.412	SPOT
17052	449505.449	2638814.062	1062.969	SPOT
17053	449504.668	2638811.508	1060.113	SPOT
17054	449503.945	2638779.474	1059.02	SPOT
17055	449504.266	2638777.391	1055.428	SPOT
17056	449505.25	2638772.326	1055.199	SPOT
17057	449074.645	2638762.096	1065.578	SPOT
17058	449094.829	2638754.557	1065.547	SPOT
17059	449098.407	2638754.293	1061.289	SPOT
17060	449102.808	2638752.354	1057.839	SPOT
17061	449103.841	2638752.552	1056.623	SPOT
17062	449107.179	2638751.297	1055.021	SPOT
17063	448853.878	2638574.808	1062.043	SPOT
17064	448847.867	2638567.863	1063.083	SPOT
17065	448840.739	2638558.596	1062.834	SPOT
17066	448839.145	2638555.547	1061.07	SPOT
17067	448836.611	2638550.444	1060.708	SPOT
17068	448835.342	2638548.111	1058.749	SPOT
17069	448834.382	2638546.418	1057.623	SPOT
17070	448833.717	2638545.577	1054.695	SPOT
17071	448831.57	2638541.023	1054.627	SPOT
17072	448829.149	2638537.412	1054.404	SPOT
17073	448826.268	2638532.636	1053.786	SPOT
17074	448824.191	2638530.358	1052.978	SPOT
17075	448822.676	2638527.9	1053.177	SPOT
17076	448821.129	2638525.686	1053.447	SPOT
17077	448819.799	2638522.875	1055.085	SPOT

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17078	448824.607	2638945.36	1062.498	SPOT
17079	448788.569	2638933.491	1059.72	SPOT
17080	448785.251	2638931.496	1054.725	SPOT
17081	448778.204	2638930.133	1054.547	SPOT
17082	448775.432	2638929.813	1053.921	SPOT
17083	448772.828	2638928.648	1053.832	SPOT
17084	448767.936	2638927.233	1053.772	SPOT
17085	448763.676	2638926.846	1053.994	SPOT
17086	449120.845	2639184.503	1063.436	SPOT
17087	449103.062	2639193.613	1062.686	SPOT
17088	449102.1	2639194.253	1058.003	SPOT
17089	449098.73	2639196.852	1056.765	SPOT
17090	449097.117	2639197.634	1053.799	SPOT
17091	449093.707	2639199.728	1053.43	SPOT
17092	449092.442	2639200.902	1052.445	SPOT
17093	449320.465	2639528.478	1065.573	SPOT
17094	449306.46	2639530.498	1065.238	SPOT
17095	449302.616	2639525.412	1060.413	SPOT
17096	449299.206	2639528.087	1057.568	SPOT
17097	449296.206	2639529.172	1056.033	SPOT
17098	449295.077	2639529.155	1053.334	SPOT
17099	448823.428	2639747.568	1064.901	SPOT
17100	448821.676	2639723.079	1064.763	SPOT
17101	448820.399	2639715.179	1062.207	SPOT
17102	448821.152	2639712.272	1060.247	SPOT
17103	448354.977	2639751.642	1061.458	SPOT
17104	448355.518	2639742.182	1060.641	SPOT
17105	448359.193	2639730.909	1058.231	SPOT
17106	448359.587	2639728.292	1054.572	SPOT
17107	448359.88	2639727.382	1052.994	SPOT
17108	448360.929	2639724.877	1051.51	SPOT
17109	448360.237	2639721.575	1051.062	SPOT
17110	448361.043	2639716.152	1051.43	SPOT
17111	448362.709	2639710.014	1051.581	SPOT
17112	448363.79	2639704.567	1052.588	SPOT
17113	448364.81	2639699.277	1052.79	SPOT
17114	447909.662	2639566.651	1058.344	SPOT
17115	447902.985	2639548.2	1057.904	SPOT
17116	447901.002	2639541.203	1055.061	SPOT
17117	447897.512	2639533.155	1055.221	SPOT
17118	447894.88	2639530.415	1053.59	SPOT
17119	447890.737	2639520.253	1053.7	SPOT
17120	447887.872	2639512.632	1052.667	SPOT
17121	447886.086	2639507.949	1052.017	SPOT
17122	447561.305	2639798.578	1057.56	SPOT
17123	447540.251	2639804.489	1057.16	SPOT
17124	447522.188	2639808.311	1056.132	SPOT
17125	447508.834	2639811.577	1055.029	SPOT
17126	447496.842	2639814.606	1054.446	SPOT
17127	447493.571	2639815.317	1052.58	SPOT
17128	447489.18	2639815.919	1051.599	SPOT
17129	447485.154	2639816.979	1051.285	SPOT
17130	447480.484	2639818.56	1051.267	SPOT
17131	447476.963	2639819.679	1051.301	SPOT
17132	447318.53	2639992.298	1064.21	SPOT
17133	447334.418	2639973.368	1063.845	SPOT
17134	447339.119	2639967.271	1058.195	SPOT
17135	447343.525	2639961.303	1056.05	SPOT

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17136	447344.798	2639960.615	1053.913	SPOT
17137	447345.653	2639958.984	1053.373	SPOT
17138	447346.252	2639958.331	1050.615	SPOT
17139	447143.101	2639553.561	1056.132	SPOT
17140	447152.931	2639537.354	1056.158	SPOT
17141	447163.318	2639520.003	1055.805	SPOT
17142	447164.79	2639517.836	1054.025	SPOT
17143	447169.168	2639511.746	1052.573	SPOT
17144	447172.522	2639506.878	1051.597	SPOT
17145	447176.497	2639501.31	1050.798	SPOT
17146	447179.105	2639498.162	1050.432	SPOT
17147	447005.476	2639714.611	1059.404	SPOT
17148	446982.834	2639704.195	1057.68	SPOT
17149	446980.593	2639703.84	1055.64	SPOT
17150	446978.065	2639703.219	1055.222	SPOT
17151	446974.225	2639701.276	1050.266	SPOT
17152	446969.429	2639699.064	1050.358	SPOT
17153	446963.744	2639695.197	1050.307	SPOT
17154	446955.481	2639691.178	1050.247	SPOT
17155	446950.86	2639689.151	1049.556	SPOT
17156	446429.268	2639890.103	1057.943	SPOT
17157	446434.568	2639884.471	1055.488	SPOT
17158	446448.73	2639872.357	1054.98	SPOT
17159	446449.959	2639871.404	1051.426	SPOT
17160	446450.907	2639870.259	1049.261	SPOT
17161	446453.465	2639868.672	1048.354	SPOT
17162	446454.873	2639866.893	1048.252	SPOT
17163	446180.864	2639873.239	1053.655	SPOT
17164	446165.082	2639874.713	1053.448	SPOT
17165	446152.459	2639875.684	1053.513	SPOT
17166	446144.543	2639875.738	1051.806	SPOT
17167	446141.341	2639874.643	1049.096	SPOT
17168	446138.43	2639875.21	1048.766	SPOT
17169	446134.297	2639875.22	1048.587	SPOT
17170	446130.561	2639875.89	1048.311	SPOT
17171	446125.815	2639877.05	1047.961	SPOT
17172	446122.994	2639876.71	1047.888	SPOT
17173	446518.863	2640178.277	1058.412	SPOT
17174	446508.923	2640188.426	1056.045	SPOT
17175	446505.943	2640190.198	1051.754	SPOT
17176	446502.952	2640193.839	1050.221	SPOT
17177	446500.567	2640194.764	1048.205	SPOT
17178	446496.716	2640197.875	1048.187	SPOT
17179	446492.545	2640202.166	1047.416	SPOT
17180	446487.729	2640207.119	1047.435	SPOT
17181	446484.87	2640209.837	1047.004	SPOT
17182	446090.293	2640352.136	1047.244	SPOT
17183	446083.13	2640355.085	1046.761	SPOT
17184	446078.686	2640356.205	1046.854	SPOT
17185	446072.224	2640360.396	1047.62	SPOT
17186	446065.495	2640363.587	1047.468	SPOT
17187	446059.786	2640366.35	1047.177	SPOT
17188	446055.294	2640368.356	1047.022	SPOT
17189	446051.57	2640369.876	1047.221	SPOT
17190	446047.646	2640371.261	1046.886	SPOT
17191	446045.269	2640372.1	1050.022	SPOT
17192	446031.896	2640384.618	1052.374	SPOT
17193	446030.851	2640390.943	1056.976	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
17194	446022.007	2640402.072	1057.513	SPOT
17195	449669.23	2638168.355	1063.405	SPOT
17196	449655.839	2638166.299	1063.722	SPOT
17197	449637.28	2638163.185	1062.967	SPOT
17198	449635.192	2638162.739	1062.121	SPOT
17199	449634.203	2638162.905	1059.943	SPOT
17200	449631.292	2638161.512	1060.092	SPOT
17201	449630.966	2638161.63	1056.826	SPOT
17202	449628.665	2638160.832	1056.052	SPOT
17203	449683.768	2637648.227	1066.946	SPOT
17204	449681.092	2637649.07	1064.042	SPOT
17205	449672.286	2637651.799	1062.52	SPOT
17206	449670.464	2637652.193	1060.418	SPOT
17207	449666.317	2637653.61	1059.165	SPOT
17208	449663.814	2637654.995	1058.42	SPOT
17209	449660.794	2637655.618	1058.643	SPOT
17210	449656.623	2637657.401	1058.498	SPOT
17211	449654.539	2637658.159	1058.271	SPOT
17212	449391.954	2637214.054	1067.017	SPOT
17213	449388.865	2637231.58	1066.583	SPOT
17214	449385.232	2637255.48	1066.071	SPOT
17215	449385.336	2637259.302	1063.772	SPOT
17216	449385.4	2637260.821	1060.977	SPOT
17217	449384.906	2637262.839	1058.443	SPOT
17218	449384.2	2637266.205	1057.806	SPOT
17219	449383.321	2637270.929	1058.393	SPOT
17220	449382.025	2637275.202	1058.497	SPOT
17221	449381.749	2637280.16	1058.199	SPOT
17222	449086.283	2637004.051	1066.718	SPOT
17223	449072.412	2637012.751	1066.958	SPOT
17224	449059.109	2637020.796	1065.177	SPOT
17225	449056.668	2637021.467	1063.219	SPOT
17226	449052.833	2637023.035	1061.113	SPOT
17227	449051.12	2637023.872	1059.765	SPOT
17228	449047.06	2637025.315	1058.957	SPOT
17229	449043.297	2637027.564	1058.661	SPOT
17230	449039.967	2637029.346	1058.661	SPOT
17231	449036.453	2637031.044	1059.155	SPOT
17232	449005.571	2636523.632	1074.66	SPOT
17233	449003.669	2636524.314	1070.793	SPOT
17234	448999.784	2636527.364	1067.883	SPOT
17235	448993.57	2636530.273	1066.205	SPOT
17236	448990.896	2636532.474	1063.593	SPOT
17237	448987.646	2636534.014	1062.906	SPOT
17238	448431.193	2636347.057	1069.072	SPOT
17239	448443.288	2636364.802	1069.801	SPOT
17240	448454.566	2636384.436	1069.994	SPOT
17241	448460.114	2636393.925	1066.834	SPOT
17242	448469.231	2636409.744	1066.345	SPOT
17243	448479.227	2636425.8	1066.365	SPOT
17244	448482.601	2636431.572	1063.894	SPOT
17245	448486.778	2636437.418	1063.805	SPOT
17246	448488.879	2636440.067	1061.859	SPOT
17247	448491.153	2636444.18	1061.319	SPOT
17248	448493.573	2636447.027	1060.841	SPOT
17249	448495.049	2636450.051	1060.653	SPOT
17250	448497.389	2636453.14	1060.753	SPOT
17251	448499.846	2636456.99	1060.695	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
17252	448502.099	2636459.767	1060.762	SPOT
17253	448368.426	2634985.867	1064.115	SPOT
17254	448370.512	2634989.872	1063.867	SPOT
17255	448372.685	2634992.477	1063.714	SPOT
17256	448374.843	2634995.654	1063.388	SPOT
17257	448377.199	2634998.546	1063.235	SPOT
17258	448379.494	2635000.647	1063.267	SPOT
17259	448382.107	2635003.757	1062.548	SPOT
17260	448384.392	2635005.704	1062.591	SPOT
17261	448386.532	2635008.634	1062.737	SPOT
17262	448388.743	2635011.551	1063.256	SPOT
17263	448390.726	2635014.192	1063.459	SPOT
17264	448392.531	2635017.351	1063.994	SPOT
17265	448393.68	2635019.359	1064.633	SPOT
17266	448394.356	2635022.383	1067.617	SPOT
17267	448397.467	2635026.644	1070.434	SPOT
17268	448401.715	2635034.373	1073.832	SPOT
17269	448408.452	2635047.809	1073.852	SPOT
17270	448414.988	2635060.345	1073.491	SPOT
17271	448096.045	2635344.271	1073.899	SPOT
17272	448083.235	2635337.235	1073.254	SPOT
17273	448074.294	2635333.579	1072.778	SPOT
17274	448067.797	2635330.958	1068.816	SPOT
17275	448062.704	2635328.636	1069.059	SPOT
17276	448056.768	2635326.093	1068.345	SPOT
17277	448052.657	2635324.877	1066.148	SPOT
17278	448052.039	2635324.715	1063.101	SPOT
17279	448048.676	2635322.775	1063.319	SPOT
17280	448043.04	2635320.311	1062.664	SPOT
17281	448036.664	2635317.144	1062.817	SPOT
17282	448031.393	2635314.394	1062.717	SPOT
17283	448028.357	2635313.039	1063.087	SPOT
17284	447896.048	2635780.293	1072.561	SPOT
17285	447869.063	2635780.063	1071.591	SPOT
17286	447850.632	2635779.47	1070.324	SPOT
17287	447832.558	2635779.096	1066.845	SPOT
17288	447829.62	2635778.88	1065.966	SPOT
17289	447828.377	2635778.764	1062.754	SPOT
17290	447826.062	2635779.266	1061.319	SPOT
17291	447822.729	2635780.411	1061.16	SPOT
17292	447820.484	2635780.876	1061.099	SPOT
17293	447816.41	2635781.897	1061.395	SPOT
17294	447810.787	2635781.252	1061.489	SPOT
17295	447807.433	2635780.099	1061.563	SPOT
17296	447802.97	2635780.488	1060.94	SPOT
17297	447798.599	2635780.437	1061.203	SPOT
17298	447794.446	2635781.989	1061.79	SPOT
17299	447793.443	2635781.57	1064.936	SPOT
17300	447787.592	2635782.237	1066.496	SPOT
17301	447780.539	2635782.371	1068.241	SPOT
17302	447777.141	2635782.693	1071.032	SPOT
17303	448078.257	2636194.75	1069.092	SPOT
17304	448088.196	2636192.845	1067.768	SPOT
17305	448098.746	2636190.452	1066.336	SPOT
17306	448100.889	2636189.706	1062.977	SPOT
17307	448105.268	2636188.549	1062.955	SPOT
17308	448109.328	2636187.358	1062.81	SPOT
17309	448114.472	2636186.605	1062.372	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
17310	448117.155	2636185.913	1062.344	SPOT
17311	448121.426	2636185.878	1062.533	SPOT
17312	448125.389	2636184.761	1062.257	SPOT
17313	448128.203	2636183.796	1062.451	SPOT
17314	448131.958	2636182.564	1062.199	SPOT
17315	448134.828	2636181.727	1062.092	SPOT
17316	448138.678	2636181.244	1062.121	SPOT
17317	448142.542	2636180.809	1062.474	SPOT
17318	448143.798	2636180.686	1065.428	SPOT
17319	448147.671	2636180.211	1068.212	SPOT
17320	448152.171	2636180.082	1068.49	SPOT
17321	448157.279	2636179.615	1070.107	SPOT
17322	448165.801	2636177.653	1069.898	SPOT
17323	448183.061	2636172.38	1073.064	SPOT
17324	449120.04	2634852.737	1072.398	SPOT
17325	449131.493	2634849.029	1071.806	SPOT
17326	449145.207	2634844.615	1071.35	SPOT
17327	449155.928	2634841.684	1070.537	SPOT
17328	449157.52	2634841.476	1068.234	SPOT
17329	449719.474	2634898.543	1071.518	SPOT
17330	449726.212	2634880.163	1070.626	SPOT
17331	449734.866	2634858.74	1070.584	SPOT
17332	449740.923	2634844.283	1068.443	SPOT
17333	449743.856	2634837.422	1068.502	SPOT
17334	449745.044	2634832.765	1066.475	SPOT
17335	449745.381	2634831.536	1065.854	SPOT
17336	449746.653	2634827.133	1065.098	SPOT
17337	449747.208	2634823.286	1064.735	SPOT
17338	449749.401	2634819.28	1064.185	SPOT
17339	449750.792	2634816.209	1063.857	SPOT
17340	449751.601	2634812.062	1063.53	SPOT
17341	450043.485	2635212.408	1077.883	SPOT
17342	450054.565	2635200.024	1078.321	SPOT
17343	450064.645	2635188.126	1077.002	SPOT
17344	450067.032	2635184.765	1071.888	SPOT
17345	450069.416	2635181.728	1068.988	SPOT
17346	450070.479	2635180.698	1066.774	SPOT
17347	450072.733	2635176.723	1066.33	SPOT
17348	450075	2635173.889	1065.791	SPOT
17349	450077.859	2635170.693	1065.259	SPOT
17350	450080.002	2635168.541	1065.711	SPOT
17351	450082.67	2635165.316	1065.707	SPOT
17352	450431.529	2635471.536	1076.146	SPOT
17353	450434.357	2635468.773	1073.058	SPOT
17354	450438.129	2635463.824	1070.509	SPOT
17355	450440.912	2635461.542	1067.531	SPOT
17356	450441.498	2635460.823	1065.131	SPOT
17357	450443.088	2635458.481	1064.88	SPOT
17358	450446.393	2635454.631	1065.141	SPOT
17359	450448.814	2635451.802	1065.09	SPOT
17360	450452.175	2635448.269	1065.473	SPOT
17361	450454.123	2635445.352	1065.406	SPOT
17362	450899.81	2635345.489	1073.448	SPOT
17363	450902.153	2635345.728	1078.433	SPOT
17364	450918.649	2635344.814	1078.733	SPOT
17365	450946.064	2635344.478	1078.635	SPOT
17366	450569.101	2634975.418	1075.008	SPOT
17367	450560.401	2634987.084	1076.074	SPOT

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17368	450553.268	2634998.068	1075.153	SPOT
17369	450552.17	2634999.335	1072.731	SPOT
17370	450550.964	2635000.927	1071.661	SPOT
17371	450548.568	2635003.66	1066.87	SPOT
17372	450546.634	2635006.081	1065.941	SPOT
17373	450544.65	2635008.234	1066.157	SPOT
17374	450542.169	2635011.524	1066.249	SPOT
17375	450539.992	2635015.043	1066.65	SPOT
17376	450538.354	2635017.621	1066.382	SPOT
17377	450245.029	2634609.457	1076.819	SPOT
17378	450231.369	2634610.973	1075.285	SPOT
17379	450216.686	2634613.371	1072.909	SPOT
17380	450213.991	2634613.582	1070.445	SPOT
17381	450211.975	2634614.535	1069.265	SPOT
17382	450211.15	2634614.279	1066.728	SPOT
17383	450208.345	2634614.171	1065.694	SPOT
17384	450205.947	2634614.763	1065.428	SPOT
17385	450203.688	2634615.792	1065.623	SPOT
17386	450199.23	2634616.573	1066.091	SPOT
17387	450077.503	2634132.531	1078.727	SPOT
17388	450054.955	2634126.549	1076.782	SPOT
17389	450035.315	2634124.826	1075.529	SPOT
17390	450022.384	2634124.354	1076.312	SPOT
17391	450010.463	2634125.277	1073.986	SPOT
17392	450006.386	2634125.312	1071.336	SPOT
17393	450005.032	2634124.951	1067.56	SPOT
17394	450000.723	2634124.822	1067.6	SPOT
17395	449997.118	2634124.807	1067.471	SPOT
17396	449993.263	2634124.398	1066.819	SPOT
17397	449989.866	2634124.323	1065.659	SPOT
17398	449987.234	2634122.8	1065.854	SPOT
17399	449986.685	2634117.823	1066.01	SPOT
17400	449983.04	2634115.672	1066.422	SPOT
17401	449978.607	2634116.17	1066.714	SPOT
17402	449975.759	2634116.353	1067.037	SPOT
17403	449972.049	2634117.009	1067.541	SPOT
17404	449970.001	2634116.852	1070.824	SPOT
17405	449965.533	2634117.597	1073.013	SPOT
17406	449956.362	2634118.764	1075.147	SPOT
17407	449954.67	2634118.837	1078.488	SPOT
17408	449945.919	2634117.541	1082.045	SPOT
17409	450370.644	2633882.866	1079.132	SPOT
17410	450365.516	2633900.471	1077.951	SPOT
17411	450362.834	2633906.803	1074.025	SPOT
17412	450361.876	2633910.212	1073.897	SPOT
17413	450361.372	2633911.867	1074.624	SPOT
17414	450357.64	2633920.589	1072.872	SPOT
17415	450356.076	2633924.198	1070.493	SPOT
17416	450350.313	2633940.364	1070.667	SPOT
17417	450350.183	2633941.48	1069.606	SPOT
17418	450348.06	2633950.971	1068.808	SPOT
17419	450346.154	2633958.763	1068.251	SPOT
17420	450345.328	2633961.463	1067.792	SPOT
17421	450344.269	2633964.294	1066.884	SPOT
17422	450345.012	2633967.121	1066.713	SPOT
17423	450344.297	2633969.666	1067.216	SPOT
17424	450343.709	2633972.471	1068.26	SPOT
17425	450342.997	2633973.692	1070.899	SPOT

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17426	450341.567	2633976.79	1071.616	SPOT
17427	450341.208	2633978.535	1074.488	SPOT
17428	450339.281	2633987.548	1076.067	SPOT
17429	450338.222	2634001.839	1074.524	SPOT
17430	450334.766	2634019.898	1076.285	SPOT
17431	450764.33	2634067.958	1082.987	SPOT
17432	450759.736	2634053.089	1081.118	SPOT
17433	450759.405	2634051.251	1077.969	SPOT
17434	450760.687	2634047.325	1072.821	SPOT
17435	450760.298	2634045.159	1071.04	SPOT
17436	450759.759	2634043.798	1069.088	SPOT
17437	450759.246	2634041.791	1068.421	SPOT
17438	450758.959	2634038.693	1067.548	SPOT
17439	450758.852	2634036.171	1067.673	SPOT
17440	450758.549	2634033.177	1067.92	SPOT
17441	450757.977	2634029.494	1068.109	SPOT
17442	450620.211	2633640.957	1073.274	SPOT
17443	450621.831	2633638.979	1072.259	SPOT
17444	450622.871	2633637.985	1069.876	SPOT
17445	450625.864	2633636.388	1068.826	SPOT
17446	450628.286	2633634.442	1068.312	SPOT
17447	450630.886	2633632.874	1068.101	SPOT
17448	450633.009	2633630.099	1067.841	SPOT
17449	450636.17	2633626.729	1067.866	SPOT
17450	450640.548	2633622.708	1068.434	SPOT
17451	450644.28	2633619.479	1068.682	SPOT
17452	450648.282	2633616.049	1068.362	SPOT
17453	450651.768	2633613.255	1068.582	SPOT
17454	450655.848	2633610.066	1069.695	SPOT
17455	450658.353	2633608.274	1073.293	SPOT
17456	450664.832	2633602.379	1074.603	SPOT
17457	450676.653	2633591.072	1079.16	SPOT
17458	450202.249	2633551.421	1078.518	SPOT
17459	450222.052	2633546.113	1078.108	SPOT
17460	450227.052	2633544.665	1075.754	SPOT
17461	450231.802	2633543.135	1076.259	SPOT
17462	450087.598	2633532.401	1079.906	SPOT
17463	450072.775	2633542.166	1080.179	SPOT
17464	450060.821	2633550.459	1079.466	SPOT
17465	450055.704	2633553.534	1076.71	SPOT
17466	450051.818	2633556.004	1073.159	SPOT
17467	450050.926	2633557.051	1070.47	SPOT
17468	450048.585	2633558.345	1069.467	SPOT
17469	450045.86	2633560.372	1068.593	SPOT
17470	450043.438	2633562.684	1068.802	SPOT
20000	438156.216	2654028.412	989.086	SPOT
20001	438159.685	2654027.941	987.655	SPOT
20002	438162.864	2654027.876	986.91	SPOT
20003	438166.955	2654027.93	986.064	SPOT
20004	438169.013	2654028.056	985.324	SPOT
20005	438171.174	2654030.148	984.973	SPOT
20006	438201.221	2653890.977	993.262	TOW
20007	438181.532	2653899.282	994.996	DAM B ROCK
20008	438186.368	2653902.97	995.16	DAM ROCK
20009	438190.022	2653903.403	993.92	DAM ROCK
20010	438192.567	2653905.38	993.292	DAM ROCK
20011	438195.839	2653905.87	992.581	DAM ROCK
20012	438177.015	2653947.839	988.933	TOW

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20013	442955.631	2651134.799	1019.576	RD B
20014	442954.115	2651081.624	1020.394	RD
20015	442952.619	2651037.948	1021.077	RD
20016	442950.695	2650982.458	1021.906	RD
20017	442949.834	2650945.973	1022.393	RD
20018	442948.793	2650906.097	1022.703	RD
20019	442947.566	2650882.588	1022.793	RD
20020	442945.04	2650829.51	1023.203	RD
20021	442943.921	2650774.528	1025.261	RD
20022	442942.266	2650728.467	1028.097	RD
20023	442941.109	2650669.512	1033.083	RD
20024	442938.545	2650605.132	1040.316	RD E
20025	442923.838	2650884.208	1018.32	WING B
20026	442931.412	2650885.119	1022.277	WING E ABUT B
20027	442931.653	2650883.195	1022.508	BR B
20028	442963.868	2650881.747	1022.327	BR
20029	442964.349	2650883.605	1022.282	AB E WING B
20030	442971.656	2650882.315	1018.647	WING E
20031	442966.353	2650945.4	1022.172	BR
20032	442974.092	2650944.096	1018.208	WING B
20033	442966.588	2650943.528	1021.889	WING E ABUT B
20034	442933.674	2650944.743	1022.016	WING B ABUT E
20035	442934.079	2650946.625	1022.123	BR CLOSE E
20036	442926.31	2650946.116	1018.257	WING E
20037	442966.166	2650943.31	1019.17	LB
20038	442966.014	2650943.012	1013.69	SPOT
20039	442965.829	2650939.909	1014.2	SPOT
20040	442965.606	2650934.887	1011.956	SPOT
20041	442965.451	2650932.08	1010.266	SPOT
20042	442965.276	2650928.303	1008.7	SPOT
20043	442965.161	2650925.823	1008.151	SPOT
20044	442964.981	2650920.605	1008.164	SPOT
20045	442964.763	2650914.399	1008.19	SPOT
20046	442964.637	2650909.305	1009.259	SPOT
20047	442964.428	2650903.662	1008.622	SPOT
20048	442964.033	2650896.792	1010.177	SPOT
20049	442963.983	2650893.588	1011.697	SPOT
20050	442963.927	2650887.872	1013.733	SPOT
20051	442963.775	2650883.983	1015.327	SPOT
20052	442963.79	2650883.701	1019.49	LB
20053	442083.25	2653299.142	1009.298	SPOT
20054	442092.68	2653278.386	1009.839	SPOT
20055	442096.762	2653270.803	1004.663	SPOT
20056	442101.686	2653260.69	1004.166	SPOT
20057	442107.497	2653248.167	1003.94	SPOT
20058	442109.207	2653244.211	1002.372	SPOT
20059	441709.563	2653232.24	1011.684	SPOT
20060	441713.04	2653223.575	1010.912	SPOT
20061	441716.436	2653213.674	1011.135	SPOT
20062	441717.618	2653210.719	1010.315	SPOT
20063	441718.269	2653209.215	1007.807	SPOT
20064	441720.941	2653204.583	1004.829	SPOT
20065	441721.897	2653203.351	1000.205	SPOT
20066	441723.551	2653200.6	999.526	SPOT
20067	441727.344	2653191.713	999.536	SPOT
20068	441730.638	2653185.126	999.498	SPOT
20069	441734.885	2653175.078	999.305	SPOT
20070	441739.848	2653164.37	999.657	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
20071	441742.106	2653158.262	1000.236	SPOT
20072	441387.568	2653000.86	1012.356	SPOT
20073	441396.981	2652988.76	1012.402	SPOT
20074	441403.065	2652982.333	1012.668	SPOT
20075	441406.67	2652976.518	1012.02	SPOT
20076	441411.99	2652970.328	1008.543	SPOT
20077	441421.763	2652960.088	1007.141	SPOT
20078	441431.099	2652950.621	1004.902	SPOT
20079	441433.139	2652948.489	1003.076	SPOT
20080	441433.74	2652947.847	1001.129	SPOT
20081	441433.662	2652947.653	999.531	SPOT
20082	441437.385	2652942.731	999.205	SPOT
20083	441441.111	2652937.254	998.913	SPOT
20084	441443.71	2652933.538	999.679	SPOT
20085	441446.382	2652929.851	1000.185	SPOT
20086	441448.153	2652927.287	1000.022	SPOT
20087	441451.549	2652923.313	998.892	SPOT
20088	441453.572	2652919.964	997.844	SPOT
20089	441454.635	2652918.821	997.07	SPOT
20090	441317.028	2652505.174	1006.039	SPOT
20091	441330.98	2652513.249	1005.661	SPOT
20092	441342.091	2652520.366	1005.099	SPOT
20093	441351.041	2652524.173	1004.897	SPOT
20094	441358.232	2652527.389	1004.211	SPOT
20095	441361.895	2652528.693	1003.763	SPOT
20096	441363.568	2652529.416	1002.507	SPOT
20097	441365.453	2652530.505	1002.766	SPOT
20098	441365.997	2652530.736	1001.921	SPOT
20099	441367.17	2652531.165	1001.498	SPOT
20100	441374.293	2652534.724	1001.484	SPOT
20101	441384.384	2652539.06	1000.748	SPOT
20102	441390.395	2652541.715	1000.038	SPOT
20103	441398.423	2652544.337	1000.063	SPOT
20104	441402.553	2652546.13	999.009	SPOT
20105	441405.308	2652546.979	998.173	SPOT
20106	441102.625	2652124.783	1021.048	SPOT
20107	441115.347	2652122.978	1020.265	SPOT
20108	441128.194	2652122.624	1015.86	SPOT
20109	441135.927	2652119.712	1011.79	SPOT
20110	441141.907	2652118.535	1010.216	SPOT
20111	441143.12	2652118.38	1006.975	SPOT
20112	441146.172	2652117.984	1003.997	SPOT
20113	441148.303	2652117.798	1002.44	SPOT
20114	441149.023	2652117.807	1000.132	SPOT
20115	441151.3	2652118.172	999.565	SPOT
20116	441153.83	2652118.131	999.538	SPOT
20117	441156.036	2652117.355	999.646	SPOT
20118	441158.815	2652116.907	998.97	SPOT
20119	441160.024	2652117.06	998.809	SPOT
20120	441033.647	2651749.676	1009.04	SPOT
20121	441038.631	2651750.518	1007.413	SPOT
20122	441045.744	2651751.869	1005.851	SPOT
20123	441049.543	2651752.751	1005.186	SPOT
20124	441050.985	2651753.294	1003.923	SPOT
20125	441053.279	2651753.048	1003.263	SPOT
20126	441053.519	2651753.263	1001.426	SPOT
20127	441056.293	2651753.775	1000.23	SPOT
20128	441058.923	2651752.828	999.834	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
20129	441061.055	2651753.332	1000.237	SPOT
20130	441063.002	2651753.824	1000.075	SPOT
20131	441066.604	2651754.19	1000.239	SPOT
20132	441201.095	2651406.758	1012.535	SPOT
20133	441218.791	2651411.939	1012.128	SPOT
20134	441229.698	2651414.584	1011.886	SPOT
20135	441235.253	2651416.049	1011.644	SPOT
20136	441237.114	2651417.086	1010.292	SPOT
20137	441238.588	2651417.519	1009.35	SPOT
20138	441239.665	2651417.978	1005.266	SPOT
20139	441241.644	2651418.094	1003.824	SPOT
20140	441243.182	2651418.23	1003.421	SPOT
20141	441245.409	2651419.083	1001.999	SPOT
20142	441245.92	2651419.867	1000.171	SPOT
20143	441252.407	2650987.485	1012.415	SPOT
20144	441260.37	2650986.234	1010.54	SPOT
20145	441262.337	2650986.197	1009.444	SPOT
20146	441264.632	2650985.445	1008.253	SPOT
20147	441265.981	2650985.472	1006.242	SPOT
20148	441268.219	2650985.042	1005.925	SPOT
20149	441268.715	2650984.765	1003.257	SPOT
20150	441272.679	2650983.272	1002.674	SPOT
20151	441277.274	2650983.02	1002.824	SPOT
20152	441282.434	2650982.205	1002.848	SPOT
20153	441286.067	2650981.511	1002.624	SPOT
20154	441492.749	2650549.7	1003.217	SPOT
20155	441490.129	2650548.064	1002.786	SPOT
20156	441485.311	2650542.77	1003.589	SPOT
20157	441484.106	2650541.513	1004.651	SPOT
20158	441481.531	2650538.6	1005.954	SPOT
20159	441478.425	2650536.568	1009.769	SPOT
20160	441475.449	2650534.164	1011.362	SPOT
20161	441874.592	2650288.338	1012.646	SPOT
20162	441874.342	2650294.907	1011.657	SPOT
20163	441874.984	2650300.522	1010.53	SPOT
20164	441874.875	2650303.144	1008.268	SPOT
20165	441874.773	2650304.533	1005.596	SPOT
20166	441874.949	2650306.514	1005.015	SPOT
20167	441874.828	2650309.814	1003.779	SPOT
20168	441875.043	2650315.779	1002.771	SPOT
20169	441875.98	2650322.551	1004.07	SPOT
20170	441877.284	2650327.642	1004.038	SPOT
20171	442355.264	2650312.413	1005.831	SPOT
20172	442356.115	2650309.825	1006.185	SPOT
20173	442357.179	2650307.495	1007.348	SPOT
20174	442358.355	2650300.763	1007.451	SPOT
20175	442359.404	2650296.264	1007.292	SPOT
20176	442355.726	2650313.47	1005.25	SPOT
20177	442355.251	2650315.536	1004.691	SPOT
20178	442354.388	2650318.868	1003.7	SPOT
20179	442354.409	2650320.279	1003.164	SPOT
20180	442353.692	2650324.139	1003.294	SPOT
20181	442352.767	2650328.389	1004.15	SPOT
20182	442352.286	2650335.649	1004.191	SPOT
20183	442351.507	2650342.531	1004.3	SPOT
20184	442350.738	2650348.654	1004.734	SPOT
20185	442488.214	2650677.292	1013.26	SPOT
20186	442474.989	2650669.394	1012.009	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
20187	442464.999	2650665.386	1011.88	SPOT
20188	442459.795	2650663.047	1008.445	SPOT
20189	442448.978	2650657.439	1007.74	SPOT
20190	442447.246	2650655.807	1006.764	SPOT
20191	442441.863	2650653.188	1005.669	SPOT
20192	442436.755	2650650.408	1004.841	SPOT
20193	442432.759	2650647.839	1004.164	SPOT
20194	442428.076	2650645.309	1004.486	SPOT
20195	442423.411	2650642.699	1004.427	SPOT
20196	442420.622	2650640.48	1004.162	SPOT
20197	442417.514	2650638.969	1004.665	SPOT
20198	442415.409	2650637.587	1005.151	SPOT
20199	442639.063	2651099.912	1012.723	SPOT
20200	442628.087	2651110.261	1011.954	SPOT
20201	442616.407	2651123.825	1011.667	SPOT
20202	442612.821	2651129.745	1010.937	SPOT
20203	442610.94	2651131.307	1006.714	SPOT
20204	442739.146	2650892.566	1013.61	SPOT
20205	442752.263	2650908.193	1013.946	SPOT
20206	442759.882	2650916.939	1013.978	SPOT
20207	442763.556	2650921.867	1013.119	SPOT
20208	442764.046	2650922.977	1009.4	SPOT
20209	442765.517	2650925.957	1007.187	SPOT
20210	442767.429	2650929.391	1005.297	SPOT
20211	442768.347	2650932.53	1004.799	SPOT
20212	442768.841	2650934.381	1004.702	SPOT
20213	442770.413	2650937.596	1005.041	SPOT
20214	442771.918	2650940.227	1005.717	SPOT
20215	442774.115	2650944.327	1006.051	SPOT
20216	442934.629	2651069.407	1019.145	SPOT
20217	444350.736	2649793.601	1023.596	SPOT
20218	444353.854	2649779.66	1022.429	SPOT
20219	444358.1	2649761.703	1019.812	SPOT
20220	444362.407	2649745.129	1017.697	SPOT
20221	444365.874	2649729.644	1016.584	SPOT
20222	444368.9	2649718.31	1016.186	SPOT
20223	444369.875	2649715.299	1015.145	SPOT
20224	444371.333	2649710.733	1014.658	SPOT
20225	444372.922	2649705.332	1014.384	SPOT
20226	444373.47	2649702.721	1014.546	SPOT
20227	444123.943	2649430.272	1023.984	SPOT
20228	444133.564	2649435.538	1022.897	SPOT
20229	444142.791	2649441.559	1019.226	SPOT
20230	444145.217	2649442.488	1017.233	SPOT
20231	444152.287	2649445.924	1016.406	SPOT
20232	444162.449	2649449.884	1015.194	SPOT
20233	444167.315	2649452.271	1014.967	SPOT
20234	444168.907	2649453.476	1014.922	SPOT
20235	444473.633	2649166.318	1015.723	SPOT
20236	444464.933	2649165.187	1015.912	SPOT
20237	444457.068	2649162.931	1016.251	SPOT
20238	444447.426	2649162.286	1015.948	SPOT
20239	444444.089	2649162.434	1019.427	SPOT
20240	444442.025	2649162.197	1020.632	SPOT
20241	444431.924	2649159.08	1021.153	SPOT
20242	444412.223	2649149.998	1021.067	SPOT
20243	444410.135	2649155.628	1021.065	SPOT
20244	444729.555	2650069.149	1021.154	SPOT

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20245	444741.028	2650063.413	1019.623	SPOT
20246	444750.966	2650057.789	1018.273	SPOT
20247	444760.688	2650052.218	1018.371	SPOT
20248	444768.371	2650045.753	1016.802	SPOT
20249	444769.591	2650045.123	1013.912	SPOT
20250	444423.929	2650636.46	1018.171	SPOT
20251	444423.826	2650647.206	1017.661	SPOT
20252	444423.347	2650660.649	1016.328	SPOT
20253	444423.386	2650668.356	1014.822	SPOT
20254	444423.393	2650669.03	1013.946	SPOT
20255	444423.1	2650671.299	1012.93	SPOT
20256	444422.668	2650679.238	1012.261	SPOT
20257	444423.396	2650685.666	1012.796	SPOT
20258	444423.851	2650690.159	1011.635	SPOT
20259	444423.607	2650694.296	1010.854	SPOT
20260	444423.364	2650697.265	1010.805	SPOT
20261	444424.152	2650702.063	1011.612	SPOT
20262	444424.047	2650706.107	1012.432	SPOT
20263	444381.348	2651164.122	1018.252	SPOT
20264	444401.975	2651155.914	1017.538	SPOT
20265	444422.892	2651147.306	1016.567	SPOT
20266	444438.263	2651141.228	1015.136	SPOT
20267	444449.676	2651137.071	1014.183	SPOT
20268	444450.877	2651136.542	1013.191	SPOT
20269	444452.806	2651136.325	1012.229	SPOT
20270	444458.922	2651134.662	1011.583	SPOT
20271	444464.683	2651132.695	1011.002	SPOT
20272	444466.856	2651131.502	1010.93	SPOT
20273	444083.975	2651327.885	1021.42	BR B
20274	444093.511	2651321.207	1021.379	BR
20275	444099.004	2651328.902	1020.322	LB
20276	444100.592	2651330.683	1019.746	SPOT
20277	444104.323	2651336.427	1018.526	SPOT
20278	444104.747	2651337.011	1016.973	SPOT
20279	444105.659	2651338.59	1015.087	SPOT
20280	444107.661	2651340.014	1012.722	SPOT
20281	444139.303	2651385.774	1019.649	BR
20282	444129.63	2651393.084	1020.427	BR CLOSE E
20283	444134.791	2651379.417	1018.898	LB
20284	444132.554	2651375.025	1018.1	SPOT
20285	444129.337	2651371.328	1016.156	SPOT
20286	444125.966	2651368.43	1014.984	SPOT
20287	444124.146	2651365.584	1011.614	SPOT
20288	444122.203	2651362.689	1011.889	SPOT
20289	444119.831	2651359.492	1011.013	SPOT
20290	444118.169	2651357.202	1010.393	SPOT
20291	444114.089	2651351.775	1009.974	SPOT
20292	444111.48	2651348.027	1008.794	SPOT
20293	444109.549	2651345.363	1009.06	SPOT
20294	444108.529	2651343.699	1010.45	SPOT
20295	443765.165	2651916.119	1019.005	SPOT
20296	443780.206	2651909.413	1019.1	SPOT
20297	443789.097	2651905.463	1019.164	SPOT
20298	443791.8	2651903.969	1017.504	SPOT
20299	443794.614	2651902.563	1017.501	SPOT
20300	443797.033	2651902.235	1015.692	SPOT
20301	443800.979	2651900.72	1014.922	SPOT
20302	443805.427	2651898.887	1014.4	SPOT

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20303	443810.893	2651895.474	1013.736	SPOT
20304	443813.551	2651894.15	1013.061	SPOT
20305	443814.898	2651893.374	1010.669	SPOT
20306	443816.23	2651892.616	1010.349	SPOT
20307	443520.324	2651953.556	1015.465	SPOT
20308	443516.475	2651958.456	1015.746	SPOT
20309	443510.925	2651963.225	1015.76	SPOT
20310	443505.77	2651967.288	1014.757	SPOT
20311	443504.35	2651969.053	1013.068	SPOT
20312	443502.824	2651969.781	1011.717	SPOT
20313	443502.205	2651970.613	1009.7	SPOT
20314	443498.324	2651973.742	1009.824	SPOT
20315	443494.615	2651976.937	1009.246	SPOT
20316	443491.244	2651980.199	1008.89	SPOT
20317	443488.781	2651982.538	1008.292	SPOT
20318	443486.525	2651984.617	1007.425	SPOT
20319	443297.368	2651605.959	1015.416	SPOT
20320	443283.402	2651608.972	1014.845	SPOT
20321	443273.313	2651610.448	1014.536	SPOT
20322	443267.272	2651610.868	1013.886	SPOT
20323	443262.553	2651611.536	1012.2	SPOT
20324	443259.503	2651612.046	1010.939	SPOT
20325	443256.457	2651612.035	1009.69	SPOT
20326	443249.985	2651612.783	1008.69	SPOT
20327	443244.31	2651613.369	1007.821	SPOT
20328	443242.245	2651613.957	1007.366	SPOT
20329	443238.79	2651614.601	1007.633	SPOT
20330	443405.231	2651381.664	1014.339	SPOT
20331	443398.988	2651381.04	1013.055	SPOT
20332	443393.916	2651380.654	1011.989	SPOT
20333	443392.26	2651379.88	1009.686	SPOT
20334	443388.273	2651378.147	1008.36	SPOT
20335	443383.863	2651376.338	1008.187	SPOT
20336	443376.597	2651374.574	1008.627	SPOT
20337	443369.554	2651372.606	1009.081	SPOT
20338	443359.987	2651370.47	1008.995	SPOT
20339	443350.019	2651368.031	1009.108	SPOT
20340	443339.889	2651366.617	1009.49	SPOT
20341	443338.489	2651366.256	1010.929	SPOT
20342	443332.512	2651365.696	1012.825	SPOT
20343	443326.085	2651364.096	1014.108	SPOT
20344	443311.454	2651362.06	1015.474	SPOT
20345	443292.753	2651360.181	1016.744	SPOT
20346	443290.305	2651360.614	1019.718	SPOT
20347	443344.169	2651339.416	1010.462	SPOT
20348	443344.629	2651334.934	1009.957	SPOT
20349	443345.528	2651330.808	1009.105	SPOT
20350	443346.354	2651325.986	1007.725	SPOT
20351	443347.162	2651320.706	1006.581	SPOT
20352	443347.952	2651316.364	1006.692	SPOT
20353	443348.72	2651311.834	1006.624	SPOT
20354	443349.562	2651307.132	1007.981	SPOT
20355	443350.212	2651303.34	1009.67	SPOT
20356	443350.226	2651302.314	1011.216	SPOT
20357	443141.468	2650933.289	1027.789	SPOT
20358	443137.244	2650938.581	1026.563	SPOT
20359	443131.081	2650945.438	1022.892	SPOT
20360	443126.082	2650952.193	1017.8	SPOT

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20361	443124.136	2650955.698	1015.972	SPOT
20362	443121.524	2650959.95	1012.507	SPOT
20363	443121.698	2650959.445	1013.565	SPOT
20364	443119.498	2650962.339	1011.286	SPOT
20365	443118.326	2650964.009	1010.4	SPOT
20366	443117.553	2650965.259	1008.201	SPOT
20367	443116.6	2650967.239	1008.442	SPOT
20368	443115.925	2650968.834	1008.962	SPOT
20369	443111.146	2650976.479	1009.117	SPOT
20370	443105.489	2650984.403	1008.817	SPOT
20371	443102.692	2650988.311	1008.759	SPOT
20372	443100.383	2650991.805	1008.636	SPOT
20373	447827.644	2648896.871	1030.333	SPOT
20374	447844.945	2648896.441	1030.132	SPOT
20375	447862.298	2648894.965	1029.874	SPOT
20376	447870.458	2648893.98	1029.639	SPOT
20377	447874.807	2648893.551	1028.881	SPOT
20378	447876.915	2648893.497	1027.215	SPOT
20379	447717.017	2648654.614	1034.337	SPOT
20380	447718.543	2648647.87	1033.858	SPOT
20381	447720.078	2648636.268	1033.49	SPOT
20382	447720.159	2648632.951	1032.248	SPOT
20383	447721.627	2648627.41	1030.898	SPOT
20384	447722.244	2648624.456	1028.883	SPOT
20385	447722.804	2648623.51	1027.018	SPOT
20386	447723.288	2648619.483	1026.091	SPOT
20387	447723.611	2648618.603	1023.159	SPOT
20388	447724.351	2648613.107	1022.845	SPOT
20389	447724.856	2648607.83	1023.18	SPOT
20390	447725.404	2648602.593	1023.177	SPOT
20391	447480.431	2648162.403	1035.164	SPOT
20392	447491.364	2648166.491	1035.11	SPOT
20393	447496.936	2648168.633	1034.798	SPOT
20394	447500.659	2648170.204	1033.911	SPOT
20395	447502.88	2648170.133	1032.048	SPOT
20396	447503.615	2648170.464	1029.664	SPOT
20397	447509.862	2648171.524	1026.13	SPOT
20398	447517.617	2648174.506	1026.388	SPOT
20399	447519.719	2648175.342	1027.039	SPOT
20400	447522.58	2648176.42	1026.207	SPOT
20401	447526.538	2648177.552	1025.033	SPOT
20402	447528.908	2648178.485	1024.353	SPOT
20403	447531.483	2648179.41	1023.769	SPOT
20404	447679.256	2647884.108	1032.742	SPOT
20405	447688.951	2647888.092	1033.625	SPOT
20406	447697.993	2647891.026	1033.471	SPOT
20407	447699.606	2647891.65	1030.819	SPOT
20408	447700.791	2647892.454	1029.002	SPOT
20409	447703.712	2647893.356	1027.839	SPOT
20410	447704.877	2647893.914	1024.849	SPOT
20411	447708.227	2647895.007	1023.46	SPOT
20412	447710.122	2647895.689	1022.967	SPOT
20413	447713.527	2647896.678	1023.414	SPOT
20414	447718.913	2647898.194	1023.79	SPOT
20415	447577.189	2647680.705	1035.266	SPOT
20416	447580.42	2647671.535	1034.552	SPOT
20417	447581.702	2647666.399	1033.695	SPOT
20418	447581.891	2647665.124	1030.991	SPOT

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20419	447584.218	2647659.502	1028.864	SPOT
20420	447585.273	2647656.599	1027.61	SPOT
20421	447585.812	2647655.635	1025.893	SPOT
20422	447586.298	2647654.322	1024.343	SPOT
20423	447587.233	2647650.474	1023.779	SPOT
20424	447588.179	2647647.478	1023.545	SPOT
20425	447589.26	2647643.651	1023.832	SPOT
20426	447590.554	2647638.253	1024.479	SPOT
20427	447090.925	2647491.595	1034.754	SPOT
20428	447099.592	2647486.216	1035.025	SPOT
20429	447107.876	2647480.335	1034.787	SPOT
20430	447108.773	2647479.554	1031.283	SPOT
20431	447114.698	2647476.882	1027.856	SPOT
20432	447115.252	2647476.609	1026.616	SPOT
20433	447116.745	2647475.854	1025.074	SPOT
20434	447118.712	2647474.137	1023.735	SPOT
20435	447120.04	2647472.941	1023.13	SPOT
20436	447120.452	2647472.101	1022.799	SPOT
20437	447121.163	2647471.417	1022.688	SPOT
20438	447158.025	2648873.81	1028.483	SPOT
20439	447152.927	2648874.008	1027.708	SPOT
20440	447149.998	2648873.791	1026.107	SPOT
20441	447144.136	2648874.953	1026.038	SPOT
20442	447137.498	2648877.109	1024.372	SPOT
20443	447132.07	2648878.307	1023.423	SPOT
20444	447125.559	2648878.832	1023.103	SPOT
20445	447120.772	2648879.934	1022.09	SPOT
20446	447116.956	2648881.167	1021.589	SPOT
20447	447113.085	2648881.959	1020.609	SPOT
20448	447110.427	2648883.214	1020.34	SPOT
20449	447108.787	2648883.963	1020.143	SPOT
20450	447107.327	2648884.884	1020.428	SPOT
20451	447104.324	2648884.235	1021.103	SPOT
20452	446887.984	2648300.359	1032.52	SPOT
20453	446886.087	2648314.38	1032.436	SPOT
20454	446884.036	2648324.776	1031.564	SPOT
20455	446883.478	2648327.095	1027.652	SPOT
20456	446882.321	2648330.848	1025.161	SPOT
20457	446881.656	2648331.613	1021.125	SPOT
20458	446880.941	2648334.838	1019.415	SPOT
20459	446880.16	2648338.893	1019.488	SPOT
20460	446879.847	2648342.819	1019.899	SPOT
20461	446879.473	2648345.685	1020.097	SPOT
20462	446416.339	2648336.976	1031.62	SPOT
20463	446431.761	2648351.901	1031.538	SPOT
20464	446434.748	2648354.531	1026.34	SPOT
20465	446439.169	2648359.185	1023.492	SPOT
20466	446442.322	2648360.502	1022.9	SPOT
20467	446442.368	2648361.225	1020.12	SPOT
20468	446445.336	2648363.24	1020.471	SPOT
20469	446447.435	2648364.97	1019.479	SPOT
20470	446450.495	2648366.805	1019.629	SPOT
20471	446242.711	2648660.215	1026.193	SPOT
20472	446232.288	2648670.919	1025.718	SPOT
20473	446228.472	2648674.367	1024.883	SPOT
20474	446223.452	2648679.954	1024.997	SPOT
20475	446221.331	2648682.477	1024.278	SPOT
20476	446219.214	2648684.602	1022.704	SPOT

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20477	446217.295	2648686.342	1021.106	SPOT
20478	446213.106	2648689.727	1019.808	SPOT
20479	446209.978	2648693.741	1019.595	SPOT
20480	446207.502	2648696.488	1019.708	SPOT
20481	446206.195	2648699.41	1019.72	SPOT
20482	446205.474	2648700.971	1019.78	SPOT
20483	445889.504	2648300.484	1029.759	SPOT
20484	445882.071	2648311.543	1029.512	SPOT
20485	445873.83	2648321.352	1028.202	SPOT
20486	445872.207	2648322.841	1024.672	SPOT
20487	445869.482	2648325.639	1021.557	SPOT
20488	445868.992	2648326.698	1018.985	SPOT
20489	445866.859	2648329.611	1018.396	SPOT
20490	445865.014	2648331.808	1018.187	SPOT
20491	445863	2648334.835	1018.159	SPOT
20492	445829.044	2647977.8	1024.364	SPOT
20493	445816.953	2647976.896	1024.467	SPOT
20494	445806.888	2647976.425	1023.736	SPOT
20495	445800.845	2647975.493	1023.832	SPOT
20496	445797.339	2647975.124	1024.728	SPOT
20497	445791.948	2647974.896	1024.108	SPOT
20498	445790.358	2647974.027	1020.833	SPOT
20499	445788.086	2647973.145	1018.914	SPOT
20500	445785.971	2647972.575	1018.154	SPOT
20501	445780.395	2647971.585	1018.341	SPOT
20502	445774.798	2647971.188	1018.511	SPOT
20503	445312.815	2647755.601	1032.272	SPOT
20504	445313.921	2647762.698	1030.659	SPOT
20505	445314.109	2647770.945	1030.179	SPOT
20506	445315.455	2647779.679	1027.87	SPOT
20507	445315.667	2647781.861	1025.997	SPOT
20508	445315.936	2647787.064	1021.94	SPOT
20509	445316.185	2647790.923	1020.172	SPOT
20510	445316.949	2647793.205	1018.994	SPOT
20511	445317.074	2647797.013	1018.954	SPOT
20512	445318.497	2647801.1	1018.153	SPOT
20513	445319.121	2647804.965	1017.804	SPOT
20514	445319.414	2647807.996	1017.219	SPOT
20515	444875.926	2647894.005	1028.61	SPOT
20516	444877.412	2647903.047	1025.862	SPOT
20517	444878.262	2647908.897	1023.53	SPOT
20518	444879.158	2647914.922	1022.807	SPOT
20519	444879.698	2647916.458	1021.329	SPOT
20520	444880.408	2647919.013	1021.241	SPOT
20521	444880.382	2647922.163	1020.618	SPOT
20522	444880.738	2647924.361	1019.399	SPOT
20523	444880.631	2647926.434	1018.174	SPOT
20524	444881.412	2647933.914	1018.378	SPOT
20525	444883.078	2647941.777	1018.224	SPOT
20526	444883.798	2647949.014	1018.275	SPOT
20527	444886.697	2647960.465	1018.607	SPOT
20528	444888.914	2647967.145	1018.588	SPOT
20529	444776.205	2648321.812	1022.079	SPOT
20530	444786.98	2648310.074	1021.769	SPOT
20531	444792.805	2648303.717	1021.417	SPOT
20532	444798.145	2648296.185	1020.29	SPOT
20533	444799.117	2648294.796	1018.227	SPOT
20534	444800.516	2648292.953	1015.907	SPOT

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20535	444803.45	2648289.635	1015.289	SPOT
20536	444806.743	2648285.048	1016.018	SPOT
20537	444808.759	2648282.124	1016.608	SPOT
20538	444811.475	2648278.403	1016.049	SPOT
20539	444814.413	2648273.912	1016.344	SPOT
20540	444816.42	2648270.976	1016.252	SPOT
20541	444604.403	2648734.807	1021.564	SPOT
20542	444612.258	2648747.357	1021.372	SPOT
20543	444617.943	2648756.03	1020.735	SPOT
20544	444618.849	2648757.376	1017.864	SPOT
20545	444620.266	2648760.576	1016.51	SPOT
20546	444625.055	2648768.917	1016.334	SPOT
20547	444630.95	2648776.865	1016.443	SPOT
20548	444638.588	2648785.279	1016.318	SPOT
20549	447108.4	2647125.678	1036.337	SPOT
20550	447123.299	2647120.061	1036.374	SPOT
20551	447137.345	2647113.119	1036.042	SPOT
20552	447138.565	2647112.363	1033.252	SPOT
20553	447140.908	2647110.484	1031.62	SPOT
20554	447141.939	2647110.027	1028.569	SPOT
20555	447144.4	2647108.241	1027.676	SPOT
20556	447146.522	2647107.663	1024.578	SPOT
20557	447150.237	2647105.492	1023.575	SPOT
20558	447151.8	2647104.503	1023.924	SPOT
20559	447154.79	2647102.886	1024.502	SPOT
20560	447159.724	2647100.465	1025.264	SPOT
20561	446922.829	2646763.988	1035.988	SPOT
20562	446927.847	2646756.871	1035.889	SPOT
20563	446932.364	2646749.333	1036.304	SPOT
20564	446935.045	2646744.431	1036.148	SPOT
20565	446935.673	2646743.629	1033.03	SPOT
20566	446937.563	2646740.132	1030.323	SPOT
20567	446939.82	2646735.804	1028.646	SPOT
20568	446939.907	2646735.212	1026.976	SPOT
20569	446942.714	2646730.938	1026.327	SPOT
20570	446945.001	2646727.193	1026.123	SPOT
20571	446947.578	2646723.68	1025.794	SPOT
20572	446741.617	2646308.124	1037.108	SPOT
20573	446759.707	2646305.939	1037.483	SPOT
20574	446772.97	2646306.4	1036.017	SPOT
20575	446775.215	2646306.369	1033.079	SPOT
20576	446777.302	2646306.292	1032.037	SPOT
20577	446777.925	2646306.187	1031.152	SPOT
20578	446778.695	2646306.057	1030.241	SPOT
20579	446779.445	2646305.961	1028.104	SPOT
20580	446784.668	2646304.856	1027.782	SPOT
20581	446794.259	2646304.398	1027.486	SPOT
20582	446801.628	2646304.002	1027.339	SPOT
20583	446803.701	2646303.973	1027.377	SPOT
20584	446498.497	2645978.021	1042.31	SPOT
20585	446508.435	2645975.725	1038.727	SPOT
20586	446509.052	2645975.173	1035.738	SPOT
20587	446514.099	2645973.856	1031.72	SPOT
20588	446518.566	2645971.294	1029.152	SPOT
20589	446519.468	2645971.074	1028.398	SPOT
20590	446521.277	2645970.125	1027.778	SPOT
20591	446523.13	2645968.539	1027.348	SPOT
20592	446525.576	2645967.439	1027.761	SPOT

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20593	446529.601	2645965.356	1028	SPOT
20594	446532.679	2645963.707	1028.036	SPOT
20595	446407.197	2645568.438	1038.353	SPOT
20596	446415.228	2645563.768	1036.819	SPOT
20597	446417.562	2645563.615	1034.847	SPOT
20598	446481.306	2645037.957	1039.759	SPOT
20599	446485.967	2645040.915	1037.222	SPOT
20600	446491.396	2645045.031	1035.577	SPOT
20601	446492.168	2645045.637	1034.739	SPOT
20602	446492.709	2645046.204	1032.144	SPOT
20603	446495.656	2645047.336	1031.381	SPOT
20604	446497.817	2645049.151	1030.987	SPOT
20605	446500.507	2645050.852	1030.341	SPOT
20606	446504.167	2645053.178	1030.382	SPOT
20607	446508.399	2645054.989	1031.344	SPOT
20608	446510.495	2645056.399	1032.129	SPOT
20609	446515.173	2645059.12	1032.158	SPOT
20610	446518.721	2645060.814	1031.888	SPOT
20611	446838.281	2644906.879	1040.284	SPOT
20612	446836.016	2644914.853	1040.123	SPOT
20613	446833.049	2644923.564	1039.335	SPOT
20614	446829.647	2644932.278	1037.565	SPOT
20615	446826.609	2644940.507	1036.595	SPOT
20616	446825.763	2644942.379	1035.484	SPOT
20617	446825.217	2644944.631	1034.957	SPOT
20618	446824.801	2644945.553	1032.368	SPOT
20619	446824.032	2644946.918	1032.849	SPOT
20620	446822.823	2644950.523	1032.673	SPOT
20621	446821.999	2644952.977	1032.012	SPOT
20622	446820.696	2644955.378	1031.535	SPOT
20623	446819.998	2644956.629	1031.446	SPOT
20624	446819.478	2644958.095	1031.38	SPOT
20625	446818.042	2644960.744	1031.579	SPOT
20626	446817.309	2644964.322	1031.182	SPOT
20627	446816.732	2644966.293	1031.267	SPOT
20628	446815.201	2644970.008	1031.459	SPOT
20629	446814.038	2644974.505	1031.665	SPOT
20630	447192.953	2645067.255	1040.965	SPOT
20631	447199.022	2645075.069	1040.132	SPOT
20632	447206.03	2645084.165	1038.496	SPOT
20633	447207.781	2645086.198	1037.654	SPOT
20634	447207.987	2645086.72	1036.254	SPOT
20635	447208.53	2645087.171	1035.671	SPOT
20636	447209.067	2645087.838	1033.693	SPOT
20637	447212.386	2645092.54	1033.914	SPOT
20638	447219.429	2645098.962	1033.979	SPOT
20639	447223.673	2645104.022	1033.549	SPOT
20640	447227.401	2645107.753	1033.185	SPOT
20641	447231.214	2645111.23	1032.81	SPOT
20642	447235.286	2645115.806	1032.472	SPOT
20643	447237.368	2645118.373	1031.74	SPOT
20644	447238.605	2645119.545	1031.067	SPOT
20645	447239.375	2645120.296	1030.752	SPOT
20646	447471.985	2644631.884	1040.695	SPOT
20647	447477.381	2644641.401	1041.331	SPOT
20648	447482.251	2644650.448	1042.026	SPOT
20649	447483.744	2644653.816	1039.76	SPOT
20650	447483.853	2644656.237	1037.362	SPOT

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20651	447485.21	2644658.403	1036.449	SPOT
20652	447485.152	2644659.753	1033.169	SPOT
20653	447485.692	2644660.904	1033.078	SPOT
20654	447486.302	2644663.705	1032.595	SPOT
20655	447487.696	2644665.536	1032.282	SPOT
20656	447489.262	2644668.451	1032.56	SPOT
20657	447949.541	2644431.719	1045.943	SPOT
20658	447951.604	2644441.28	1045.812	SPOT
20659	447954.512	2644455.146	1041.677	SPOT
20660	447958.703	2644480.201	1039.833	SPOT
20661	447962.51	2644500.515	1038.493	SPOT
20662	447964.27	2644508.622	1038.746	SPOT
20663	447965.409	2644513.226	1037.825	SPOT
20664	447965.676	2644515.762	1036.703	SPOT
20665	447966.311	2644518.669	1035.104	SPOT
20666	447966.032	2644523.402	1034.658	SPOT
20667	447967.271	2644531.771	1033.573	SPOT
20668	447967.613	2644538.396	1033.648	SPOT
20669	448408.584	2644309.84	1041.346	SPOT
20670	448408.771	2644310.46	1040.317	SPOT
20671	448404.441	2644304.998	1041.889	SPOT
20672	448397.068	2644296.543	1041.338	SPOT
20673	448752.534	2644078.715	1046.432	SPOT
20674	448758.944	2644083.873	1045.977	SPOT
20675	448773.495	2644095.491	1044.298	SPOT
20676	448763.37	2644087.455	1044.418	SPOT
20677	448686.868	2643765.933	1051.174	RD B
20678	448727.075	2643767.48	1051.65	RD
20679	448774.572	2643791.65	1051.715	RD
20680	448795.715	2643822.084	1052.172	RD
20681	448821.317	2643855.387	1052.703	RD
20682	448852.78	2643877.821	1054.002	RD
20683	448871.565	2643887.073	1056.229	RD
20684	448880.671	2643890.95	1056.793	RD
20685	448950.044	2643917.26	1055.249	RD
20686	448981.112	2643931.774	1059.018	RD
20687	449019.208	2643951.465	1063.151	RD E
20688	448872.151	2643907.995	1052.488	WING B
20689	448882.829	2643902.8	1055.451	WING E ABUT B
20690	448889.856	2643884.206	1057.348	WING B ABUT E
20691	448885.713	2643873.695	1052.279	WING E
20692	448950.246	2643936.873	1052.659	WING B
20693	448945.834	2643925.713	1054.038	WING ABUT B
20694	448953.108	2643906.509	1053.267	WING ABUT E
20695	448963.537	2643902.273	1051.777	WING E
20696	448953.227	2643908.058	1054.777	BR B
20697	448947.409	2643924.573	1055.919	BR
20698	448878.02	2643898.798	1057.304	BR
20699	448883.428	2643883.429	1056.959	BR CLOSE
20700	448895.792	2643713.805	1044.809	SPOT
20701	448914.914	2643723.001	1043.731	SPOT
20702	448923.02	2643724.874	1044.683	SPOT
20703	448926.229	2643725.867	1044.586	SPOT
20704	448931.04	2643726.254	1041.433	SPOT
20705	448933.133	2643726.583	1040.484	SPOT
20706	448937.047	2643728.251	1039.617	SPOT
20707	448938.752	2643728.999	1038.397	SPOT
20708	448939.884	2643730.148	1036.646	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
20709	448941.706	2643730.732	1036.395	SPOT
20710	448950.821	2643735.166	1036.371	SPOT
20711	448958.272	2643738.31	1036.305	SPOT
20712	448965.324	2643741.591	1036.125	SPOT
20713	448974.636	2643744.453	1036.061	SPOT
20714	448980.487	2643746.627	1036.413	SPOT
20715	448705.601	2643337.649	1048.377	SPOT
20716	448716.336	2643323.942	1048.162	SPOT
20717	448720.496	2643317.171	1047.922	SPOT
20718	448723.117	2643314.164	1047.259	SPOT
20719	448725.048	2643311.908	1045.418	SPOT
20720	448725.739	2643310.937	1043.556	SPOT
20721	448727.589	2643307.999	1041.232	SPOT
20722	448728.066	2643307.248	1039.053	SPOT
20723	448728.726	2643306.118	1037.132	SPOT
20724	448729.874	2643304.282	1036.59	SPOT
20725	448733.225	2643302.223	1035.974	SPOT
20726	448738.074	2643295.89	1035.639	SPOT
20727	448742.161	2643292.132	1035.804	SPOT
20728	448746.833	2643287.008	1036.055	SPOT
20729	448750.254	2643282.07	1036.19	SPOT
20730	448753.461	2643278.272	1036.398	SPOT
20731	448756.734	2643273.852	1036.848	SPOT
20732	448757.743	2643272.765	1039.431	SPOT
20733	448284.158	2643216.01	1048.694	SPOT
20734	448284.757	2643202.542	1048.163	SPOT
20735	448286.413	2643190.224	1047.213	SPOT
20736	448286.859	2643185.627	1046.985	SPOT
20737	448286.657	2643182.991	1045.325	SPOT
20738	448286.86	2643181.904	1042.44	SPOT
20739	448287.27	2643180.124	1041.201	SPOT
20740	448288.192	2643177.228	1039.682	SPOT
20741	448288.4	2643175.692	1038.84	SPOT
20742	448288.408	2643175.121	1036.56	SPOT
20743	448288.522	2643174.3	1036.184	SPOT
20744	448288.552	2643171.544	1035.585	SPOT
20745	448288.708	2643169.463	1035.332	SPOT
20746	448288.634	2643164.953	1035.356	SPOT
20747	448286.882	2643159.834	1035.497	SPOT
20748	448287.979	2643155.341	1035.715	SPOT
20749	448288.256	2643148.453	1036.223	SPOT
20750	448288.106	2643139.136	1036.463	SPOT
20751	448288.083	2643137.335	1037.504	SPOT
20752	447859.701	2643110.047	1045.693	SPOT
20753	447853.386	2643099.195	1045.15	SPOT
20754	447851.281	2643094.172	1043.784	SPOT
20755	447846.577	2643086.719	1043.318	SPOT
20756	447841.64	2643077.618	1042.505	SPOT
20757	447841.347	2643076.118	1040.179	SPOT
20758	447840.321	2643072.199	1039.258	SPOT
20759	447839.477	2643071.069	1037.021	SPOT
20760	447839.029	2643067.651	1036.517	SPOT
20761	447836.806	2643063.263	1036.377	SPOT
20762	447835.665	2643060.674	1037.419	SPOT
20763	447835.016	2643058.959	1038.118	SPOT
20764	447834.418	2643056.278	1037.656	SPOT
20765	447832.737	2643053.397	1037.094	SPOT
20766	447431.778	2642936.447	1047.916	SPOT

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20767	447431.578	2642928.87	1047.792	SPOT
20768	447431.421	2642924.405	1046.005	SPOT
20769	447431.793	2642917.145	1044.621	SPOT
20770	447430.669	2642905.693	1042.79	SPOT
20771	447430.873	2642898.445	1041.533	SPOT
20772	447429.94	2642893.228	1042.681	SPOT
20773	447430.027	2642891.772	1040.521	SPOT
20774	447430.068	2642889.26	1038.365	SPOT
20775	447430.021	2642885.491	1037.956	SPOT
20776	447429.734	2642879.536	1037.91	SPOT
20777	447428.968	2642872.324	1037.999	SPOT
20778	447428.535	2642863.233	1037.475	SPOT
20779	447427.998	2642857.237	1037.115	SPOT
20780	447427.792	2642852.898	1036.923	SPOT
20781	447427.934	2642851.259	1037.258	SPOT
20782	447281.388	2643075.045	1050.262	SPOT
20783	447275.713	2643057.002	1050.035	SPOT
20784	447264.2	2643050.404	1046.005	SPOT
20785	447244.522	2643040.609	1044.014	SPOT
20786	447230.969	2643035.442	1043.439	SPOT
20787	447207.633	2643023.824	1043.875	SPOT
20788	447196.3	2643018.592	1043.609	SPOT
20789	447191.171	2643016.173	1042.917	SPOT
20790	447188.3	2643014.779	1041.163	SPOT
20791	447186.538	2643013.983	1038.881	SPOT
20792	447182.01	2643011.653	1036.879	SPOT
20793	447178.146	2643008.312	1037.623	SPOT
20794	447170.185	2643004.651	1037.806	SPOT
20795	447162.261	2643002.224	1037.299	SPOT
20796	446852.072	2643182.534	1043.759	SPOT
20797	446832.65	2643171.837	1043.747	SPOT
20798	446824.566	2643165.771	1042.726	SPOT
20799	446815.21	2643160.432	1041.894	SPOT
20800	446811.174	2643157.255	1040.823	SPOT
20801	446805.915	2643154.871	1040.531	SPOT
20802	446799.42	2643150.929	1040.192	SPOT
20803	446794.484	2643148.74	1039.246	SPOT
20804	446788.492	2643146.604	1038.354	SPOT
20805	446784.643	2643144.881	1038.348	SPOT
20806	446593.713	2643574.939	1047.598	SPOT
20807	446588.001	2643565.342	1047.803	SPOT
20808	446585.241	2643562.12	1047.605	SPOT
20809	446582.225	2643558.35	1046.085	SPOT
20810	446577.121	2643550.772	1044.947	SPOT
20811	446574.048	2643546.339	1044.157	SPOT
20812	446572.817	2643544.377	1042.482	SPOT
20813	446572.579	2643543.66	1039.737	SPOT
20814	446571.684	2643541.884	1038.709	SPOT
20815	446569.616	2643539.772	1037.73	SPOT
20816	446568.439	2643537.911	1037.549	SPOT
20817	446567.444	2643536.168	1037.288	SPOT
20818	446190.183	2643241.951	1048.823	SPOT
20819	446198.527	2643231.194	1048.409	SPOT
20820	446202.609	2643225.714	1048.018	SPOT
20821	446203.616	2643223.483	1046.344	SPOT
20822	446206.396	2643220.251	1044.814	SPOT
20823	446208.171	2643217.487	1043.995	SPOT
20824	446209.196	2643215.726	1040.278	SPOT

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20825	446211.502	2643212.162	1039.648	SPOT
20826	446214.109	2643208.229	1039.062	SPOT
20827	446215.997	2643205.6	1039.318	SPOT
20828	446216.61	2643203.928	1039.323	SPOT
20829	445877.433	2642740.584	1047.444	SPOT
20830	445888.994	2642741.873	1047.617	SPOT
20831	445898.089	2642740.044	1047.469	SPOT
20832	445904.248	2642739.382	1044.269	SPOT
20833	445909.052	2642741.247	1042.031	SPOT
20834	445910.793	2642742.231	1041.332	SPOT
20835	445918.061	2642743.867	1040.782	SPOT
20836	445922.032	2642745.372	1040.433	SPOT
20837	446068.391	2642331.191	1048.787	SPOT
20838	446084.338	2642334.216	1048.196	SPOT
20839	446093.213	2642335.128	1047.388	SPOT
20840	446097.448	2642336.504	1044.87	SPOT
20841	446099.969	2642336.685	1043.488	SPOT
20842	446100.81	2642336.871	1040.874	SPOT
20843	446105.873	2642337.128	1040.485	SPOT
20844	446110.097	2642335.655	1040.714	SPOT
20845	446113.643	2642335.478	1039.57	SPOT
20846	446115.838	2642335.647	1039.915	SPOT
20847	445910.176	2642255.849	1051.372	SPOT
20848	445900.096	2642247.107	1050.852	SPOT
20849	445895.903	2642242.825	1048.075	SPOT
20850	445889.54	2642235.603	1046.732	SPOT
20851	445885.708	2642230.67	1045.072	SPOT
20852	445883.457	2642228.521	1043.328	SPOT
20853	445879.413	2642223.678	1041.75	SPOT
20854	445875.819	2642220.303	1041.045	SPOT
20855	445872.675	2642217.981	1040.975	SPOT
20856	445389.489	2642077.119	1053.958	SPOT
20857	445396.436	2642078.246	1054.199	SPOT
20858	445402.801	2642078.054	1053.8	SPOT
20859	445404.306	2642077.971	1050.137	SPOT
20860	445410.816	2642077.386	1045.331	SPOT
20861	445409.182	2642077.856	1047.038	SPOT
20862	445418.145	2642078.25	1044.996	SPOT
20863	445418.707	2642078.253	1042.62	SPOT
20864	445423.578	2642078.098	1041.891	SPOT
20865	445429.568	2642078.145	1041.394	SPOT
20866	445433.783	2642078.365	1041.688	SPOT
20867	445485.966	2641627.183	1057.567	SPOT
20868	445496.769	2641628.308	1057.384	SPOT
20869	445501.504	2641628.858	1054.879	SPOT
20870	445509.755	2641630.849	1050.571	SPOT
20871	445514.123	2641632.424	1048.93	SPOT
20872	445520.297	2641631.831	1048.567	SPOT
20873	445525.403	2641632.051	1047.908	SPOT
20874	445528.61	2641632.254	1045.82	SPOT
20875	445531.915	2641632.454	1045.65	SPOT
20876	445533.043	2641632.031	1045.066	SPOT
20877	445533.607	2641632.076	1042.393	SPOT
20878	445534.274	2641632.457	1041.913	SPOT
20879	445537.646	2641631.924	1042.304	SPOT
20880	445541.436	2641632.267	1042.031	SPOT
20881	445888.176	2641265.844	1052.856	SPOT
20882	445890.244	2641274.481	1052.068	SPOT

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20883	445892.051	2641283.428	1052.272	SPOT
20884	445892.422	2641285.781	1048.127	SPOT
20885	445893.702	2641290.263	1046.024	SPOT
20886	445894.226	2641291.839	1043.407	SPOT
20887	445895.507	2641296.536	1042.641	SPOT
20888	445896.452	2641302.057	1043.043	SPOT
20889	445897.299	2641305.973	1043.36	SPOT
20890	445897.912	2641309.123	1043.453	SPOT
20891	446191.112	2641245.113	1049.939	SPOT
20892	446207.438	2641249.074	1049.462	SPOT
20893	446221.592	2641251.677	1049.69	SPOT
20894	446223.696	2641252.472	1048.757	SPOT
20895	446224.437	2641252.611	1045.205	SPOT
20896	446227.449	2641252.993	1044.27	SPOT
20897	446236.215	2641255.096	1044.584	SPOT
20898	446243.592	2641256.42	1044.825	SPOT
20899	446062.164	2640899.933	1051.958	SPOT
20900	446066.757	2640891.866	1050.659	SPOT
20901	446073.247	2640882.634	1050.014	SPOT
20902	446081.057	2640871.394	1049.095	SPOT
20903	446084.838	2640865.596	1049.196	SPOT
20904	446087.694	2640861.887	1048.379	SPOT
20905	446089.066	2640859.792	1045.507	SPOT
20906	446090.979	2640856.776	1044.82	SPOT
20907	446094.479	2640851.775	1045.55	SPOT
20908	446096.435	2640849.804	1045.383	SPOT
20909	446101.202	2640844.294	1044.491	SPOT
20910	446105.423	2640838.663	1044.653	SPOT
20911	445789.774	2640883.343	1060.682	SPOT
20912	445785.464	2640868.142	1060.315	SPOT
20913	445778.997	2640851.044	1060.467	SPOT
20914	445534.789	2640487.355	1054.098	SPOT
20915	445547.404	2640484.1	1054.711	SPOT
20916	445555.967	2640482.283	1051.913	SPOT
20917	445560.578	2640479.079	1050.759	SPOT
20918	445565.734	2640477.88	1050.188	SPOT
20919	445567.505	2640477.825	1046.787	SPOT
20920	445570.019	2640477.181	1047.532	SPOT
20921	445572.919	2640476.088	1047.627	SPOT
20922	445574.67	2640475.958	1046.997	SPOT
20923	445580.217	2640474.98	1046.797	SPOT
20924	445581.927	2640474.227	1045.936	SPOT
20925	445586.192	2640472.902	1045.54	SPOT
20926	445588.164	2640472.491	1045.457	SPOT
20927	435160.3	2654875.597	1104.602	CHK HECP 8
20928	449897.535	2638716.649	1066.261	SPOT
20929	449903.729	2638711.798	1066.188	SPOT
20930	449906.876	2638709.088	1065.079	SPOT
20931	449909.958	2638708.229	1062.571	SPOT
20932	449913.853	2638706	1058.949	SPOT
20933	449918.045	2638703.805	1057.884	SPOT
20934	449928.98	2638697.603	1057.108	SPOT
20935	449935.585	2638693.97	1057.079	SPOT
20936	449938.655	2638692.493	1056.784	SPOT
20937	449504.792	2638718.255	1066.834	SPOT
20938	449507.106	2638726.985	1065.822	SPOT
20939	449506.736	2638734.878	1064.272	SPOT
20940	449506.52	2638741.396	1062.173	SPOT

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20941	449506.899	2638745.293	1060.819	SPOT
20942	449507.105	2638746.53	1058.252	SPOT
20943	449507.465	2638748.737	1056.707	SPOT
20944	449507.133	2638752.328	1055.566	SPOT
20945	449506.144	2638756.967	1055.437	SPOT
20946	449505.299	2638761.767	1055.34	SPOT
20947	449505.255	2638767.879	1055.09	SPOT
20948	449166.822	2638729.646	1062.056	SPOT
20949	449153.857	2638734.067	1060.777	SPOT
20950	449148.71	2638736.349	1059.556	SPOT
20951	449144.083	2638738.159	1060.168	SPOT
20952	449139.341	2638739.181	1059.277	SPOT
20953	449137.243	2638740.071	1059.095	SPOT
20954	449134.631	2638741.134	1057.486	SPOT
20955	449132.681	2638742.082	1055.68	SPOT
20956	449128.464	2638742.151	1054.87	SPOT
20957	449121.287	2638744.686	1054.848	SPOT
20958	449116.322	2638746.116	1054.426	SPOT
20959	449112.485	2638748.307	1054.612	SPOT
20960	449109.601	2638749.996	1055.125	SPOT
20961	448796.363	2638480.624	1073.705	SPOT
20962	448801.924	2638491.67	1073.318	SPOT
20963	448807.39	2638499.826	1073.009	SPOT
20964	448807.345	2638500.083	1072.881	SPOT
20965	448808.6	2638502.109	1069.836	SPOT
20966	448811.398	2638507.541	1066.573	SPOT
20967	448814.953	2638514.954	1062.356	SPOT
20968	448816.888	2638519.151	1060.157	SPOT
20969	448819.19	2638521.927	1058.276	SPOT
20970	448710.147	2638916.583	1066.732	SPOT
20971	448723.606	2638919.269	1066.344	SPOT
20972	448732.64	2638919.856	1062.698	SPOT
20973	448738.254	2638921.32	1061.312	SPOT
20974	448742.035	2638921.528	1060.444	SPOT
20975	448743.444	2638922.116	1056.993	SPOT
20976	448745.649	2638922.743	1055.133	SPOT
20977	448748.233	2638922.923	1054.294	SPOT
20978	448752.357	2638923.974	1053.946	SPOT
20979	448756.45	2638924.816	1053.818	SPOT
20980	448759.831	2638925.724	1053.91	SPOT
20981	449026.479	2639243.846	1060.961	SPOT
20982	449038.04	2639237.057	1061.199	SPOT
20983	449042.548	2639233.691	1061.564	SPOT
20984	449048.569	2639229.704	1060.858	SPOT
20985	449050.407	2639226.735	1058.524	SPOT
20986	449056.169	2639222.766	1057.838	SPOT
20987	449064.543	2639217.622	1056.994	SPOT
20988	449066.079	2639216.879	1056.924	SPOT
20989	449069.696	2639215.066	1055.545	SPOT
20990	449072.969	2639213.048	1054.088	SPOT
20991	449077.542	2639210.262	1053.304	SPOT
20992	449082.424	2639207.064	1052.84	SPOT
20993	449086.396	2639205.129	1052.373	SPOT
20994	449088.811	2639203.088	1052.571	SPOT
20995	449181.308	2639554.897	1064.231	SPOT
20996	449192.4	2639552.198	1062.976	SPOT
20997	449202.29	2639550.36	1061.905	SPOT
20998	449208.907	2639548.967	1059.612	SPOT

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20999	449228.561	2639544.751	1058.874	SPOT
21000	449246.867	2639540.988	1058.972	SPOT
21001	449256.748	2639538.993	1058.585	SPOT
21002	449261.797	2639538.181	1058.03	SPOT
21003	449263.434	2639538.006	1054.508	SPOT
21004	449269.019	2639536.534	1054.096	SPOT
21005	449272.745	2639535.567	1053.357	SPOT
21006	449279.628	2639533.66	1052.273	SPOT
21007	449285.852	2639531.938	1051.624	SPOT
21008	449286.499	2639531.712	1051.99	SPOT
21009	449289.215	2639530.847	1052.301	SPOT
21010	449291.527	2639530.508	1052.991	SPOT
21011	448823.23	2639620.588	1060.431	SPOT
21012	448823.288	2639635.696	1061.259	SPOT
21013	448823.033	2639647.955	1060.583	SPOT
21014	448822.993	2639651.293	1059.814	SPOT
21015	448822.437	2639654.605	1059.135	SPOT
21016	448822.3	2639657.614	1056.741	SPOT
21017	448822.521	2639661.227	1055.665	SPOT
21018	448823.025	2639661.839	1053.168	SPOT
21019	448822.42	2639666.743	1052.075	SPOT
21020	448821.506	2639672.066	1052.085	SPOT
21021	448821.376	2639678.561	1052.495	SPOT
21022	448820.693	2639686.597	1052.883	SPOT
21023	448820.276	2639694.393	1053.548	SPOT
21024	448820.591	2639697.395	1054.424	SPOT
21025	448821.103	2639705.081	1054.708	SPOT
21026	448820.655	2639707.316	1056.73	SPOT
21027	448820.805	2639710.448	1057.765	SPOT
21028	448377.387	2639658.521	1059.631	SPOT
21029	448372.185	2639672.899	1058.738	SPOT
21030	448369.503	2639680.588	1058.582	SPOT
21031	448368.124	2639683.775	1058.311	SPOT
21032	448367.297	2639687.007	1057.1	SPOT
21033	448367.069	2639688.79	1054.993	SPOT
21034	448366.682	2639690.169	1053.116	SPOT
21035	448365.693	2639696.026	1052.865	SPOT
21036	448364.276	2639699.765	1052.87	SPOT
21037	448363.743	2639701.712	1052.674	SPOT
21038	447867.279	2639455.461	1059.662	SPOT
21039	447870.345	2639465.032	1059.721	SPOT
21040	447873.093	2639472.855	1059.958	SPOT
21041	447873.702	2639474.122	1057.08	SPOT
21042	447877.044	2639484.073	1054.881	SPOT
21043	447877.207	2639485.213	1053.406	SPOT
21044	447878.724	2639488.808	1052.911	SPOT
21045	447882.565	2639499.662	1052.361	SPOT
21046	447884.835	2639504.761	1051.904	SPOT
21047	447429.163	2639832.327	1060.553	SPOT
21048	447441.721	2639828.945	1060.422	SPOT
21049	447450.482	2639826.5	1060.41	SPOT
21050	447451.624	2639826.222	1055.626	SPOT
21051	447457.009	2639825.731	1052.522	SPOT
21052	447459.674	2639824.827	1050.275	SPOT
21053	447462.861	2639824.007	1049.467	SPOT
21054	447463.45	2639823.354	1049.541	SPOT
21055	447468.193	2639822.173	1050.476	SPOT
21056	447474.717	2639819.845	1051.215	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
21057	447390.285	2639903.495	1057.568	SPOT
21058	447381.096	2639914.139	1057.205	SPOT
21059	447373.791	2639923.157	1057.203	SPOT
21060	447370.283	2639927.827	1056.788	SPOT
21061	447369.433	2639929.089	1056.016	SPOT
21062	447367.758	2639930.026	1054.872	SPOT
21063	447366.946	2639931.349	1054.101	SPOT
21064	447366.222	2639932.097	1051.073	SPOT
21065	447364.362	2639934.536	1050.396	SPOT
21066	447358.746	2639940.961	1050.102	SPOT
21067	447353.049	2639948.655	1049.91	SPOT
21068	447348.654	2639954.954	1049.92	SPOT
21069	447206.897	2639452.337	1060.85	SPOT
21070	447199.969	2639464.077	1061.169	SPOT
21071	447196.672	2639470.18	1061.058	SPOT
21072	447196.208	2639471.432	1057.246	SPOT
21073	447194.481	2639473.752	1055.417	SPOT
21074	447193.677	2639474.889	1054.161	SPOT
21075	447193.305	2639475.151	1053.118	SPOT
21076	447191.851	2639476.767	1052.131	SPOT
21077	447191.004	2639477.972	1049.589	SPOT
21078	447188.683	2639481.201	1049.23	SPOT
21079	447184.423	2639488.207	1049.197	SPOT
21080	447180.616	2639495.244	1050.114	SPOT
21081	446880.752	2639651.423	1059.684	SPOT
21082	446886.974	2639654.822	1058.882	SPOT
21083	446891.957	2639657.263	1057.156	SPOT
21084	446901.806	2639663.666	1056.801	SPOT
21085	446906.159	2639666.407	1056.704	SPOT
21086	446907.591	2639667.708	1055.131	SPOT
21087	446909.103	2639668.265	1052.919	SPOT
21088	446916.161	2639672.69	1052.535	SPOT
21089	446918.725	2639674.34	1050.93	SPOT
21090	446923.402	2639676.298	1050.111	SPOT
21091	446926.546	2639678.405	1049.266	SPOT
21092	446929.755	2639680.5	1049.171	SPOT
21093	446935.7	2639682.78	1050.33	SPOT
21094	446939.556	2639684.486	1050.448	SPOT
21095	446945.3	2639686.963	1049.544	SPOT
21096	446513.264	2639820.012	1056.289	SPOT
21097	446507.124	2639825.767	1056.178	SPOT
21098	446500.062	2639831.589	1055.406	SPOT
21099	446496.54	2639834.171	1054.413	SPOT
21100	446493.299	2639837.499	1053.759	SPOT
21101	446491.274	2639839.509	1052.801	SPOT
21102	446487.215	2639843.194	1053.826	SPOT
21103	446484.128	2639846.702	1052.024	SPOT
21104	446481.655	2639848.258	1051.116	SPOT
21105	446479.978	2639849.213	1050.485	SPOT
21106	446470.792	2639855.379	1049.857	SPOT
21107	446464.244	2639859.909	1048.418	SPOT
21108	446459.675	2639863.198	1048.352	SPOT
21109	446059.322	2639882.376	1058.393	SPOT
21110	446083.039	2639880.141	1057.339	SPOT
21111	446096.779	2639879.949	1057.289	SPOT
21112	446103.077	2639879.141	1057.099	SPOT
21113	446104.458	2639879.363	1053.336	SPOT
21114	446109.278	2639878.439	1051.681	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
21115	446110.567	2639878.588	1049.564	SPOT
21116	446113.94	2639878.732	1048.103	SPOT
21117	446117.364	2639877.77	1048.219	SPOT
21118	446119.98	2639876.728	1048.138	SPOT
21119	446417.311	2640266.371	1055.944	SPOT
21120	446434.187	2640255.097	1054.723	SPOT
21121	446447.521	2640244.194	1052.536	SPOT
21122	446459.302	2640233.807	1051.872	SPOT
21123	446469.411	2640225.469	1051.394	SPOT
21124	446471.242	2640223.387	1050.033	SPOT
21125	446473.833	2640221.374	1048.589	SPOT
21126	446475.229	2640220.291	1046.231	SPOT
21127	446478.999	2640216.3	1046.297	SPOT
21128	446482.165	2640212.87	1046.62	SPOT
21129	446125.569	2640334.553	1052.84	SPOT
21130	446111.966	2640342.711	1052.001	SPOT
21131	446099.796	2640349.225	1052.104	SPOT
21132	446097.721	2640349.845	1051.289	SPOT
21133	446093.722	2640350.588	1049.678	SPOT
21134	449547.744	2638147.641	1066.443	SPOT
21135	449556.451	2638149.217	1066.867	SPOT
21136	449562.702	2638148.116	1063.022	SPOT
21137	449574.737	2638152.588	1063.259	SPOT
21138	449579.493	2638153.487	1061.393	SPOT
21139	449585.858	2638154.251	1061.856	SPOT
21140	449591.271	2638154.289	1060.887	SPOT
21141	449594.197	2638154.311	1060.582	SPOT
21142	449597.133	2638154.99	1059.074	SPOT
21143	449604.671	2638156.472	1057.431	SPOT
21144	449610.046	2638157.401	1056.193	SPOT
21145	449615.677	2638158.425	1056.021	SPOT
21146	449620.269	2638159.379	1055.949	SPOT
21147	449623.076	2638160.217	1056.563	SPOT
21148	449572.437	2637686.982	1068.677	SPOT
21149	449593.042	2637680.433	1068.164	SPOT
21150	449602.013	2637677.139	1067.495	SPOT
21151	449607.57	2637675.021	1065.995	SPOT
21152	449612.923	2637673.264	1063.325	SPOT
21153	449614.749	2637671.283	1062.503	SPOT
21154	449618.131	2637670.561	1063.908	SPOT
21155	449623.923	2637668.458	1064.539	SPOT
21156	449629.903	2637666.084	1064.069	SPOT
21157	449631.031	2637665.824	1060.601	SPOT
21158	449632.549	2637665.449	1058.28	SPOT
21159	449636.784	2637664.818	1057.556	SPOT
21160	449644.79	2637662.459	1058.097	SPOT
21161	449651.815	2637659.247	1058.187	SPOT
21162	449364.703	2637365.481	1070.984	SPOT
21163	449365.992	2637359.117	1070.102	SPOT
21164	449367.478	2637347.496	1070.081	SPOT
21165	449369.013	2637339.702	1070.396	SPOT
21166	449371.99	2637331.181	1067.246	SPOT
21167	449372.626	2637326.495	1065.853	SPOT
21168	449374.227	2637317.619	1066.2	SPOT
21169	449375.218	2637311.166	1066.078	SPOT
21170	449375.614	2637307.79	1063.492	SPOT
21171	449376.562	2637304.568	1061.648	SPOT
21172	449376.426	2637303.864	1058.679	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
21173	449377.048	2637300.901	1057.598	SPOT
21174	449379.353	2637296.354	1057.723	SPOT
21175	449379.76	2637294.228	1058.934	SPOT
21176	449379.983	2637292.48	1059.254	SPOT
21177	449380.362	2637289.23	1058.554	SPOT
21178	449381.232	2637283.358	1058.135	SPOT
21179	448977.16	2637062.724	1073.524	SPOT
21180	448986.015	2637059.827	1073.446	SPOT
21181	448992.22	2637057.001	1072.641	SPOT
21182	448996.468	2637053.918	1069.65	SPOT
21183	449001.772	2637051.069	1068.307	SPOT
21184	449009.052	2637048.496	1067.626	SPOT
21185	449011.83	2637046.783	1067.24	SPOT
21186	449013.397	2637046.356	1063.292	SPOT
21187	449013.995	2637046.122	1061.114	SPOT
21188	449015.544	2637045.301	1060.509	SPOT
21189	449017.565	2637043.977	1058.978	SPOT
21190	449024.723	2637039.722	1059.215	SPOT
21191	449031.124	2637034.782	1059.366	SPOT
21192	449035.013	2637032.676	1059.529	SPOT
21193	448899.007	2636566.808	1068.778	SPOT
21194	448908.864	2636563.494	1068.747	SPOT
21195	448918.029	2636559.431	1067.799	SPOT
21196	448923.326	2636557.613	1065.902	SPOT
21197	448928.207	2636555.744	1066.675	SPOT
21198	448932.657	2636554.071	1067.044	SPOT
21199	448935.611	2636552.945	1066.364	SPOT
21200	448939.098	2636551.802	1065.303	SPOT
21201	448942.241	2636550.768	1063.89	SPOT
21202	448944.058	2636550.218	1061.988	SPOT
21203	448949.414	2636548.402	1060.727	SPOT
21204	448960.769	2636543.473	1060.637	SPOT
21205	448969.382	2636539.975	1060.273	SPOT
21206	448977.655	2636536.923	1059.71	SPOT
21207	448982.446	2636534.899	1059.88	SPOT
21208	448986.044	2636533.187	1060.257	SPOT
21209	448986.979	2636533.087	1062.665	SPOT
21210	448989.921	2636531.804	1063.252	SPOT
21211	448536.579	2636512.774	1075.51	SPOT
21212	448528.216	2636501.959	1075.497	SPOT
21213	448522.616	2636493.4	1075.52	SPOT
21214	448519.879	2636489.154	1075.109	SPOT
21215	448518.826	2636488.049	1071.66	SPOT
21216	448516.708	2636485.758	1070.869	SPOT
21217	448516.526	2636484.712	1068.534	SPOT
21218	448515.353	2636482.807	1068.622	SPOT
21219	448514.679	2636481.97	1064.657	SPOT
21220	448512.557	2636478.568	1063.479	SPOT
21221	448512.198	2636477.381	1061.457	SPOT
21222	448511.407	2636474.353	1060.522	SPOT
21223	448510.025	2636472.249	1060.661	SPOT
21224	448508.86	2636469.947	1060.331	SPOT
21225	448507.122	2636466.789	1060.336	SPOT
21226	448505.874	2636464.88	1060.466	SPOT
21227	448503.841	2636462.306	1060.751	SPOT
21228	448343.442	2634941.266	1071.037	SPOT
21229	448349.055	2634950.667	1069.825	SPOT
21230	448352.877	2634958.29	1069.797	SPOT

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21231	448358.693	2634966.842	1070.352	SPOT
21232	448360.092	2634969.214	1070.903	SPOT
21233	448362.266	2634973.722	1069.74	SPOT
21234	448365.219	2634979.729	1068.526	SPOT
21235	448367.438	2634983.002	1067.806	SPOT
21236	448368.308	2634984.752	1066.561	SPOT
21237	447993.422	2635291.745	1070.171	SPOT
21238	447995.525	2635293.214	1067.943	SPOT
21239	447997.194	2635294.237	1066.963	SPOT
21240	447999.143	2635295.819	1064.449	SPOT
21241	448001.451	2635297.183	1063.383	SPOT
21242	448007.936	2635301.343	1063.865	SPOT
21243	448014.317	2635305.802	1064.344	SPOT
21244	448019.602	2635308.676	1063.976	SPOT
21245	448025.121	2635311.68	1063.321	SPOT
21246	448786.391	2634752.432	1072.007	SPOT
21247	448779.646	2634739.749	1072.16	SPOT
21248	448786.809	2634753.704	1068.883	SPOT
21249	448789.164	2634759.835	1068.201	SPOT
21250	448790.297	2634761.843	1067.389	SPOT
21251	448791.107	2634764.504	1066.664	SPOT
21252	448791.571	2634765.435	1064.098	SPOT
21253	448792.924	2634769.592	1063.489	SPOT
21254	448793.929	2634773.22	1063.308	SPOT
21255	448796.657	2634779.049	1063.999	SPOT
21256	448798.371	2634784.339	1064.127	SPOT
21257	448801.672	2634790.015	1064.359	SPOT
21258	448803.393	2634794.847	1065.167	SPOT
21259	448804.675	2634797.44	1066.945	SPOT
21260	448809.086	2634808.652	1067.32	SPOT
21261	448813.556	2634818.328	1068.533	SPOT
21262	448823.305	2634838.078	1070.412	SPOT
21263	449253.086	2634815.814	1070.462	SPOT
21264	449236.344	2634820.125	1070.07	SPOT
21265	449226.081	2634823.294	1070.305	SPOT
21266	449219.413	2634824.358	1069.478	SPOT
21267	449215.976	2634825.327	1068.022	SPOT
21268	449209.51	2634827.473	1068.415	SPOT
21269	449206.268	2634827.994	1067.529	SPOT
21270	449203.773	2634828.472	1067.232	SPOT
21271	449201.792	2634828.984	1065.5	SPOT
21272	449199.276	2634828.96	1064.442	SPOT
21273	449193.079	2634830.537	1064.535	SPOT
21274	449184.823	2634833.101	1064.636	SPOT
21275	449175.738	2634835.919	1064.528	SPOT
21276	449167.66	2634838.679	1064.859	SPOT
21277	449163.086	2634839.97	1065.961	SPOT
21278	449162.219	2634839.862	1067.85	SPOT
21279	449771.186	2634770.444	1076.848	SPOT
21280	449768.165	2634775.631	1076.633	SPOT
21281	449764.863	2634781.521	1074.406	SPOT
21282	449762.523	2634786.463	1073.366	SPOT
21283	449761.155	2634790.627	1073.843	SPOT
21284	449760.074	2634793.027	1074.012	SPOT
21285	449759.6	2634793.976	1070.396	SPOT
21286	449757.453	2634798.073	1067.66	SPOT
21287	449756.658	2634800.042	1066.385	SPOT
21288	449756.286	2634800.497	1064.105	SPOT

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21289	449755.193	2634802.795	1063.68	SPOT
21290	449754.831	2634803.9	1063.022	SPOT
21291	449753.916	2634806.475	1063.189	SPOT
21292	449752.434	2634810.439	1063.449	SPOT
21293	450137.097	2635103.999	1074.756	SPOT
21294	450126.502	2635115.889	1074.81	SPOT
21295	450121.531	2635121.991	1074.255	SPOT
21296	450118.962	2635124.828	1073.181	SPOT
21297	450115.308	2635129.144	1072.078	SPOT
21298	450109.585	2635136.048	1071.943	SPOT
21299	450108.013	2635137.725	1071.326	SPOT
21300	450105.833	2635140.055	1071.041	SPOT
21301	450103.953	2635142.766	1069.297	SPOT
21302	450102.921	2635144.152	1068.734	SPOT
21303	450102.272	2635144.577	1066.184	SPOT
21304	450097.566	2635148.808	1065.75	SPOT
21305	450091.162	2635154.456	1065.434	SPOT
21306	450086.781	2635159.654	1065.498	SPOT
21307	450084.629	2635162.844	1065.816	SPOT
21308	450496.292	2635395.217	1075.149	SPOT
21309	450489.75	2635402.612	1074.628	SPOT
21310	450482.426	2635409.24	1072.817	SPOT
21311	450479.12	2635413.409	1072.235	SPOT
21312	450475.67	2635418.362	1072.584	SPOT
21313	450472.286	2635423.266	1072.294	SPOT
21314	450469.987	2635426.263	1070.692	SPOT
21315	450469.152	2635427.414	1067.435	SPOT
21316	450467.588	2635429.031	1065.962	SPOT
21317	450464.626	2635433.412	1065.331	SPOT
21318	450460.652	2635437.953	1065.555	SPOT
21319	450456.131	2635443.189	1065.651	SPOT
21320	450798.557	2635344.867	1073.715	SPOT
21321	450815.203	2635345.364	1073.372	SPOT
21322	450824.01	2635345.365	1072.184	SPOT
21323	450832.916	2635344.82	1071.75	SPOT
21324	450837.899	2635344.705	1070.245	SPOT
21325	450843.941	2635343.966	1070.322	SPOT
21326	450851.004	2635344.407	1070.144	SPOT
21327	450853.679	2635345.264	1069.689	SPOT
21328	450855.535	2635345.212	1068.079	SPOT
21329	450857.872	2635345.702	1066.947	SPOT
21330	450866.071	2635345.902	1066.544	SPOT
21331	450869.5	2635345.399	1066.711	SPOT
21332	450870.629	2635345.608	1065.798	SPOT
21333	450878.213	2635345.294	1065.615	SPOT
21334	450884.74	2635345.148	1065.269	SPOT
21335	450890.623	2635345.278	1066.263	SPOT
21336	450891.79	2635345.013	1068.658	SPOT
21337	450496.898	2635079.355	1078.45	SPOT
21338	450504.676	2635068.791	1078.498	SPOT
21339	450507.927	2635064.172	1076.56	SPOT
21340	450514.623	2635055.699	1074.601	SPOT
21341	450517.324	2635050.584	1073.858	SPOT
21342	450518.853	2635048.377	1074.231	SPOT
21343	450521.946	2635044.448	1072.929	SPOT
21344	450523.28	2635042.028	1071.768	SPOT
21345	450523.892	2635040.783	1067.407	SPOT
21346	450528.28	2635034.802	1066.877	SPOT

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21347	450534.501	2635026.042	1066.27	SPOT
21348	450535.889	2635022.799	1065.808	SPOT
21349	450114.56	2634628.679	1080.54	SPOT
21350	450132.009	2634626.04	1080.569	SPOT
21351	450147.278	2634624.005	1080.81	SPOT
21352	450151.89	2634623.838	1079.567	SPOT
21353	450154.554	2634623.779	1075.806	SPOT
21354	450157.048	2634623.423	1073.193	SPOT
21355	450159.585	2634623.105	1072.051	SPOT
21356	450161.575	2634623.098	1070.2	SPOT
21357	450177.459	2634621.253	1069.93	SPOT
21358	450179.311	2634620.971	1067.3	SPOT
21359	450184.55	2634619.46	1066.731	SPOT
21360	450190.509	2634618.515	1066.788	SPOT
21361	450194.821	2634617.672	1066.518	SPOT
21362	450735.189	2633939.324	1077.547	SPOT
21363	450740.545	2633968.778	1076.38	SPOT
21364	450740.447	2633972.274	1074.502	SPOT
21365	450743.101	2633982.255	1075.292	SPOT
21366	450747.11	2633996.529	1075.041	SPOT
21367	450749.714	2634005.129	1074.818	SPOT
21368	450750.25	2634007.211	1072.152	SPOT
21369	450750.982	2634009.141	1071.346	SPOT
21370	450750.981	2634010.77	1068.852	SPOT
21371	450752.794	2634017.649	1068.668	SPOT
21372	450754.385	2634022.508	1068.478	SPOT
21373	450755.745	2634029.342	1068.214	SPOT
21374	450590.361	2633667.431	1077.506	SPOT
21375	450603.209	2633656.122	1077.421	SPOT
21376	450610.7	2633648.777	1077.683	SPOT
21377	450617.164	2633643.79	1077.952	SPOT
21378	450330.988	2633532.402	1076.341	SPOT
21379	450324.902	2633532.975	1076.122	SPOT
21380	450317.098	2633534.204	1075.044	SPOT
21381	450306.188	2633534.175	1075.257	SPOT
21382	450293.38	2633533.73	1074.704	SPOT
21383	450284.133	2633534.307	1074.241	SPOT
21384	450281.89	2633534.357	1073.19	SPOT
21385	450276.848	2633534.65	1072.887	SPOT
21386	450275.844	2633534.761	1070.048	SPOT
21387	450270.681	2633535.122	1069.118	SPOT
21388	450265.514	2633536.205	1069.017	SPOT
21389	450257.305	2633537.426	1069.036	SPOT
21390	450251.242	2633538.491	1068.823	SPOT
21391	450245.546	2633540.065	1070.118	SPOT
21392	450237.972	2633541.614	1070.717	SPOT
21393	450233.761	2633542.573	1072.541	SPOT
21394	449962.46	2633625.102	1100.693	SPOT
21395	449971.616	2633616.088	1100.002	SPOT
21396	449974.48	2633614.605	1098.037	SPOT
21397	449983.476	2633608.454	1091.964	SPOT
21398	449995.356	2633599.921	1081.507	SPOT
21399	449999.919	2633596.262	1079.092	SPOT
21400	450011.009	2633588.366	1077.73	SPOT
21401	450012.78	2633587.435	1076.218	SPOT
21402	450016.05	2633585.252	1074.736	SPOT
21403	450017.556	2633584.355	1071.384	SPOT
21404	450020.651	2633581.721	1069.959	SPOT

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
21405	450022.725	2633580.503	1070.631	SPOT
21406	450029.668	2633573.79	1070.28	SPOT
21407	450036.659	2633568.26	1069.802	SPOT
21408	450041.516	2633564.189	1069.147	SPOT
PRS4218992351	455489.208	2628800.023	1161.836	

APPENDIX D

Stability Analysis Report

DRAFT

SITES TECHNICAL MEMORANDUM

Forest River Dam No. 1 (Matejcek Dam)
Walsh County, North Dakota

National Inventory of Dams ID: ND00043

Prepared For
HOUSTON ENGINEERING, INC.
Fargo, North Dakota

Houston Project No. R007135-0033

Owner
WALSH COUNTY WATER RESOURCE DISTRICT
Grafton, North Dakota

Prepared By

Gannett Fleming

Excellence Delivered As Promised

GF Project No. 064799

Greenwood Village, Colorado
October 2019

Gannett Fleming

SITES TECHNICAL MEMORANDUM
Forest River Dam No. 1 (Matejcek Dam)
Walsh County, North Dakota

1. INTRODUCTION

This technical memorandum summarizes analyses completed using the Natural Resources Conservation Service's (NRCS) Water Resources Site Analysis Computer Program (commonly referred to as SITES) for Forest River Dam No. 1, hereinafter referred to as Matejcek Dam. The analyses were completed by Gannett Fleming, Inc. as part of a subconsultant services agreement with Houston Engineering, Inc. and conducted pursuant to the NRCS Statement of Work for its Cooperative Agreement 67-63633-18-XXX with the Walsh County Water Resource District (WCWRD). The purpose of the Statement of Work is to develop a Supplemental Watershed Plan-Environmental Assessment (EA) for Matejcek Dam. The purpose of the SITES analysis was to evaluate the hydrologic and hydraulic adequacy of the existing principal and auxiliary spillways.

Matejcek Dam is in Sections 23 and 24 of Township 155N, Range 57W. County Road 14 runs approximately north-south on the crest of the dam and provides access to the project. Matejcek Dam is an earth embankment approximately 86.6 feet high[1] and 1,175 feet long. The embankment was constructed from August 7, 1964 to August 19, 1966 to provide flood control and recreation. Below Matejcek Dam, the Middle South Branch of the Forest River flows eastward and joins the Forest River just west of Fordville. The Forest River flows generally eastward and northward to its confluence with the Red River, which forms the border between North Dakota and Minnesota. The Red River flows northward into Canada and Lake Winnipeg, which is drained by the Nelson River into Hudson Bay.

2. SITES MODEL INPUTS AND ASSUMPTIONS

Hydrologic and hydraulic analyses were conducted to determine whether the dam meets current NRCS and North Dakota state dam safety criteria. State hydrologic and hydraulic recommendations are consistent with NRCS criteria. For the purposes of this memorandum, only NRCS criteria will be discussed. NRCS design precipitation and other hydrologic parameters have become more stringent since the dam was designed in the 1960s. As part of this assessment, updated hydraulic analyses using the NRCS SITES model were performed to determine the required auxiliary spillway crest and top of dam elevations. The model was also used to analyze the stability and integrity of the auxiliary spillway. This section summarizes the input data required to complete the SITES analysis for Matejcek Dam.

a. Dam and Reservoir Geometry

The SITES analysis requires several inputs to describe the geometry of the existing dam. These include the stage-storage relationship of the reservoir, dimensions and elevations of the principal

[1] The height of the dam is based on the original As-Built Drawings (using El. 1366.0 feet for dam top and El. 1279.45 feet for downstream channel bottom).

spillway riser and conduit, and dimensions and profile of the auxiliary spillway among other things. This information was obtained from topographic survey of the dam completed by Houston Engineering, Inc. in 2019 supplemented with additional information from the 1966 As-Built Drawings and design documentation. A summary of these values and their respective sources is included in *Attachment A – SITES Input Summary*.

b. Hydrology

Hydrologic analyses were completed for the Matejcek Dam watershed as well as for several downstream watersheds by Houston Engineering, Inc. The watershed's hydrologic response was analyzed by Houston Engineering using the U.S. Army Corps of Engineers' (USACE) Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) software. Gannett Fleming extracted inflow hydrographs inputs required for the SITES model from this HEC-HMS model. Table 1 includes a summary of the flood events modeled within HEC-HMS that were used as input hydrographs in the SITES model.

Table 1. Summary of Hydrologic Events Modeled in SITES

NRCS Event	HEC-HMS Run	Event Description	Peak Inflow (cfs)
Principal Spillway Hydrograph (PSH)	PSH_Runoff_Volume_A	100-year Runoff Volume with Distribution A from NEH Part 630, Chapter 21, Figure 21-7	2,208
	PSH_Runoff_Volume_B	100-year Runoff Volume with Distribution B from NEH Part 630, Chapter 21, Figure 21-7	4,394
	PSH_Runoff_Volume_C	100-year Runoff Volume with Distribution C from NEH Part 630, Chapter 21, Figure 21-7	3,764
	Synth_24H_100Y	100-year Synthetic Rainfall using NOAA Atlas 14 and a 24-hour Nested Distribution (AMC II)	2,409
	Synth_4D_100Y	100-year Synthetic Rainfall using NOAA Atlas 14 and a 4-day Nested Distribution (AMC II)	2,624
	Synth_10D_100Y	100-year Synthetic Rainfall using NOAA Atlas 14 and a 10-day Nested Distribution (AMC II)	2,007
Spillway Design Hydrograph (SDH)	ASH_6H_100Y	6-hour distribution from NEH Figure 21-9, rainfall depths from TR-60 Table 2-5	4,647
	ASH_24H_100Y	24-hour distribution from NEH Figure 21-9, rainfall depths from TR-60 Table 2-5	9,378
	ASH_48H_100Y	48-hour distribution from NEH Figure 21-9, rainfall depths from TR-60 Table 2-5	9,618
Freeboard Hydrograph (FBH)	PMP_HMR52_6H	6-hour Probable Maximum Precipitation using HMR51/52 for depths and distribution	24,475
	PMP_HMR52_24H	24-hour Probable Maximum Precipitation using HMR51/52 for depths and distribution	34,252
	PMP_HMR52_48H	48-hour Probable Maximum Precipitation using HMR51/52 for depths and distribution	35,866
	PMP_HMR52	72-hour Probable Maximum Precipitation using HMR51/52 for depths and distribution	36,918

c. Geologic Profile and Parameters

Two test borings were completed at the control section of the existing auxiliary spillway to inform the auxiliary spillway integrity analysis within the SITES model. GF-2 and GF-3 were drilled on the inside and outside edge of the existing spillway, respectively. The stratigraphy of these borings was very similar with exception of a five-foot-thick layer of lacustrine in GF-2. In order to analyze the most conservative geologic profile, the inside edge (right side looking downstream) was selected for analysis. This profile includes the more erodible lacustrine layer and is shorter in length than the outside edge.

An overview of the geologic profile inputs based on GF-2 and used in the SITES analysis is included in *Attachment A – SITES Input Summary*. The material parameters used in the SITES analysis are also summarized in Table 2. Headcut erodibility index was determined for the various layers identified in the borings following guidelines given in National Engineering Handbook, Chapter 52, *Field Procedures for Headcut Erodibility Index*. Other parameters were developed from laboratory test data and correlation with published values. Calculations for these parameters are included in the *Geotechnical Engineering Report* prepared by Gannett Fleming (dated October 19, 2019).

Table 2. Assumed Parameters for Auxiliary Spillway Integrity Analysis

Material Description	Dry Density (lb/ft^3)	Headcut Index (K_h)	Percent Clay	Plasticity Index	D_{75} / Rep. Diameter (mm)
Topsoil	100	0.05	14	2	0.05
Outwash	92	0.04	14	0	2
Till #1	95	0.10	20	13	0.1
Lacustrine	100	0.05	20	0	0.5
Till #2	95	0.10	20	13	0.1
Rock	121	2.00	0	n/a	34.9

3. SITES ANALYSIS RESULTS

The SITES analyses involved evaluation of the required auxiliary spillway and top of dam elevations in accordance with procedures outlined in *Technical Release 210-60 – Earth Dams and Reservoirs* (TR 210-60). The SITES input and output summaries for existing condition, high hazard criteria for the 6-hour, 24-hour, 48-hour, and 72-hour duration freeboard hydrograph storms and the principal spillway hydrograph are presented in *Attachment B – SITES Model Output*.

a. Spillway Discharge Rating Curves

Using the geometry of the principal and auxiliary spillways as well as energy loss coefficients input in the program, the SITES model calculates discharge rating curves to be used in evaluation of the existing dam. Table 3 provides a summary of the stage-discharge relationships estimated in SITES for both the principal and auxiliary spillways.

Table 3. Stage-Discharge Rating Curves from SITES

Elevation (feet NAVD)	Principal Spillway Discharge (cfs)	Auxiliary Spillway Discharge (cfs)	Total Discharge (cfs)
1335.43	0.0	0.0	0.0
1335.62	2.9	0.0	2.9
1335.82	8.2	0.0	8.2
1336.01	15.1	0.0	15.1
1342.30	133.6	0.0	133.6
1348.59	188.3	0.0	188.3
1354.88	230.4	0.0	230.4
1355.73	323.7	0.0	323.7
1356.58	490.0	0.0	490.0
1357.43	703.7	0.0	703.7
1358.88	712.5	0.0	712.5
1360.34	721.0	0.0	721.0
1361.79	729.5	0.0	729.5
1363.70	740.5	2221.8	2962.2
1365.61	751.3	6913.8	7665.0
1369.05	770.3	20108.4	20878.7
1373.25	793.0	42221.9	43015.0
1380.90	832.7	99945.1	100777.8
1390.45	879.8	193539.0	194418.8
1400.00	924.4	312659.5	313583.9

b. Principal Spillway Hydrograph

The SITES analyses included evaluation of the required auxiliary spillway crest elevation based on both rainfall and runoff Principal Spillway Hydrograph (PSH) events. NRCS criteria dictate that for high hazard dams, earthen or vegetated auxiliary spillways should not activate for any storm more frequent than the 100-year storm event (with a duration of at least 10 days). It is also

required that both the rainfall loss and runoff methods be evaluated, and the more conservative PSH be applied. Compliance with these criteria was assessed by estimating the PSH for multiple runoff distributions provided in Chapter 21 of the NRCS *National Engineering Handbook* (Part 630) as well as 1-day, 4-day, and 10-day synthetic rainfall events. The 4-day event was included based on engineering judgment given the relatively large size and anticipated hydrologic response of the watershed.

The necessary auxiliary spillway crest elevation was determined for each of these PSH events by routing the inflow hydrograph through the reservoir assuming all flow is discharged through the principal spillway. In this case, the runoff loss method (Distribution C) resulted in the highest reservoir elevation with the required auxiliary spillway crest elevation exceeding the existing auxiliary spillway crest elevation by more than 45 feet. Therefore, this NRCS criterion is not met. Table 4 summarizes the PSH routing results for all six hydrographs that were analyzed.

As part of this analysis, TR 210-60 stipulates that the principal spillway must pass 85 percent of the PSH runoff volume within 10 days. This is commonly referred to as the 10-day drawdown criterion. The existing principal spillway does not meet this requirement for any of the PSH hydrographs that were analyzed (See Table 4). Since this criterion is not met, the NRCS requires that the retarding storage volume remaining after 10 days be added to the initial retarding storage volume to determine the required auxiliary spillway crest elevation. This adjustment is automatically accounted for within the SITES analysis and is reflected in the results shown in Table 4. Even if the 10-day drawdown criterion was waived and the PSH routings started at normal pool elevation, the existing auxiliary spillway crest would still need to be raised for all six PSH hydrographs. The amount the crest would need to be raised in this case would range from 1.9 feet for the 1-day rainfall PSH to over 30.4 feet for the runoff PSH (Distribution C).

Table 4. Principal Spillway Hydrograph SITES Output

Parameter	Existing Condition	SITES Analysis Output for 100-year PSH Events					
		Runoff (Dist. A)	Runoff (Dist. B)	Runoff (Dist. C)	Rainfall (1-day)	Rainfall (4-day)	Rainfall (10-day)
Time to Drawdown 85% of Flood Storage (days)	-	23.5	17.5	18.3	25.3	22.6	26.3
Req'd Auxiliary Spillway Crest Elevation (feet NAVD)	1,361.79	1,391.88	1,405.18	1,407.53	1,374.48	1,382.23	1,374.78
Req'd Flood Storage Volume (acre-feet)	5,003	13,924	16,912	17,441	10,013	11,755	10,082
Amount Auxiliary Spillway Crest Needs to be Raised (feet)	-	30.09	43.39	45.74	12.69	20.44	12.99

The NRCS also requires that the starting pool elevation for the Spillway Design Hydrograph (SDH) and Freeboard Hydrograph (FBH) events start at the 10-day drawdown pool elevation. This starting pool elevation has been adjusted within SITES for both the SDH and FBH runs. Sensitivity analysis indicates that FBH results are not sensitive to this increase in the starting pool elevation.

c. Freeboard Hydrograph

The SITES analyses included evaluation of the required top of dam elevation based on the FBH event. NRCS criteria dictate that for high hazard dams, the auxiliary spillway should pass the 6-hour and 24-hour Probable Maximum Flood (PMF) events without overtopping the dam embankment. Compliance with these criteria was assessed by estimating the FBH for the 6-hour and 24-hour PMF events based on the methodologies and precipitation depths documented in NOAA's Hydrometeorological Report Nos. 51 and 52. Given the relatively large size and anticipated hydrologic response of the watershed, the longer duration 48-hour and 72-hour PMP events were also analyzed using the same methodology.

The necessary top of dam elevation was determined for each of these FBH events by routing the inflow hydrograph through the reservoir assuming all flow is discharged through the existing principal and auxiliary spillways. In the case that the reservoir elevation exceeds the existing top of dam, the auxiliary spillway discharge rating curve is extrapolated. All flow is assumed to pass through the spillways without overtopping of the dam. In this case, the 72-hour FBH resulted in the highest reservoir elevation with the required top of dam elevation exceeding the existing top of dam elevation by approximately 4.1 feet. Therefore, this NRCS criterion is not met. Table 5 summarizes the FBH routing results for all four hydrographs that were analyzed. All hydrographs indicate that the existing auxiliary spillway capacity is insufficient to pass the FBH.

Table 5. Freeboard Hydrograph SITES Output

Parameter	Existing Condition	SITES Analysis Output for Probable Maximum Flood Events			
		6-hour	24-hour	48-hour	72-hour
Req'd Top of Dam Elevation (feet NAVD)	1,368.0	1,369.74	1,371.59	1,371.90	1,372.09
Peak Inflow (cfs)	-	24,475	34,252	35,866	36,918
Peak Outflow (Combined Principal and Auxiliary Spillway Discharge) (cfs)	-	24,398	34,152	35,795	36,829
Amount Dam Crest Needs to be Raised to Pass FBH (feet)	-	1.74	3.59	3.90	4.09

d. Auxiliary Spillway Stability and Integrity

TR 210-60 requires that the auxiliary spillway pass the 6-hour and 24-hour FBH events without breaching the control section of the auxiliary spillway. The soil and vegetation within the auxiliary spillway must also remain stable during the smaller, 6-hour SDH event. The SITES model includes calculations to estimate both the integrity of the auxiliary spillway during the FBH event as well as the stability of the spillway during passage of the SDH.

Based on the geologic profile and parameters outlined in Table 2, the SITES auxiliary spillway analysis shows that the auxiliary spillway will completely breach during passage of the 6-hour FBH, including a headcut that is approximately 78 feet deep. For the longer duration 24-hour, 48-hour, and 72-hour storms, the analysis shows similar results with complete breaching of the auxiliary spillway crest. Figure 1 shows a plot of the auxiliary spillway profile from SITES. The black hatching on this figure represents the anticipated extent of headcutting and erosion during passage of the 6-hour FBH.

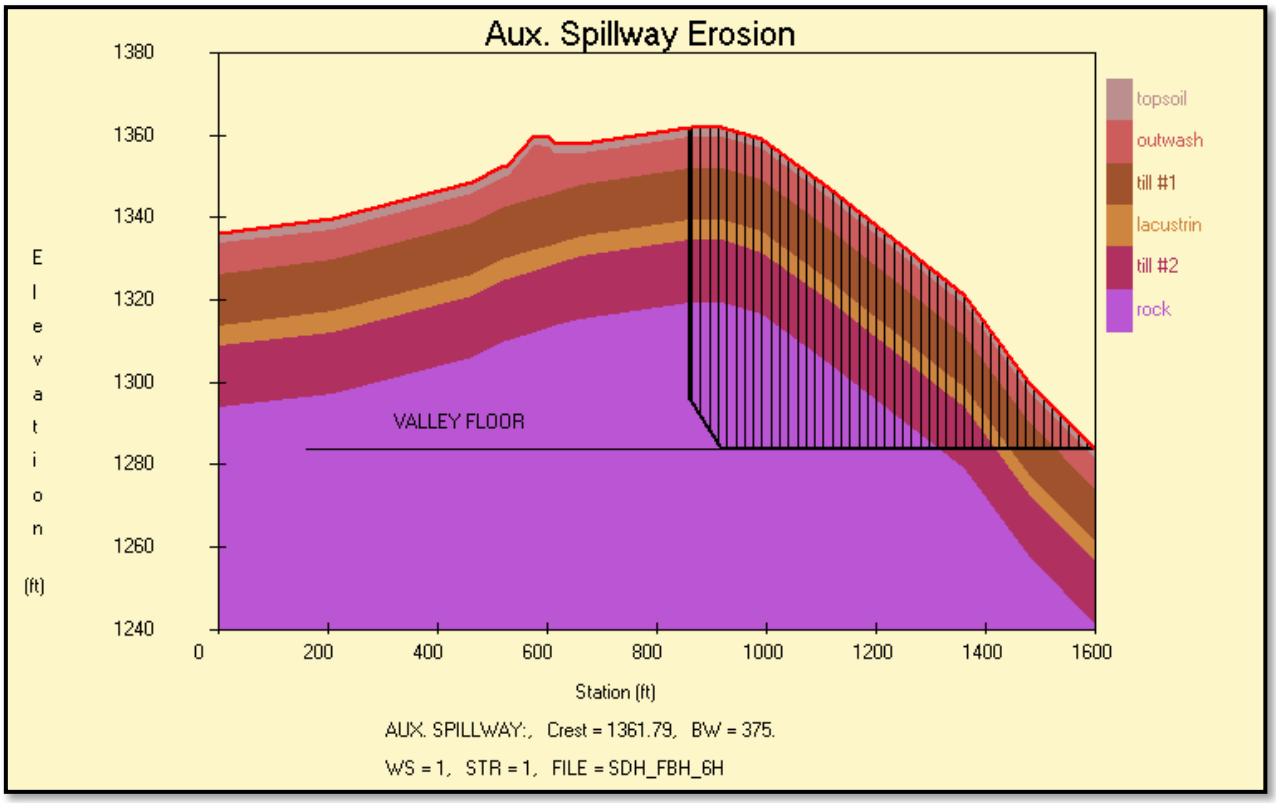


Figure 1. Plot of Auxiliary Spillway Profile and Extent of Erosion from Integrity Analysis for 6-hour Freeboard Hydrograph Obtained from SITES Model Output

SITES auxiliary spillway integrity analysis can be highly sensitive to the parameters assigned to the various geologic layers. For this reason, sensitivity analysis was completed to confirm the finding that the existing auxiliary spillway integrity is deficient. Most of the variables estimated in Table 2 were estimated using laboratory testing of boring samples, and are therefore relatively

certain. However, the headcut and representative diameter (for rock or larger materials that would not be captured in a small diameter borehole) are more subjective. These two parameters were increased for all geologic layers to determine if there is any variability in the results. The sensitivity analysis found that even if these two variables are increased by two orders of magnitude, the spillway will still breach during passage of the FBH.

With regards to auxiliary spillway stability, the SITES analysis indicates that sod stripping will likely occur during SDH events longer than or equal to the 24-hour SDH. However, current NRCS guidance indicates that stability criteria need only be met for the short duration 6-hour event. During the 6-hour SDH event, the maximum stress in the auxiliary spillway is 0.79 pounds per square foot which corresponds to a maximum exit velocity of 14.3 feet per second. Since the existing spillway does not have adequate capacity or integrity to pass the FBH, it is likely that the spillway will need to be modified or replaced. If the replacement alternative consists of an earthen or vegetated spillway, the exit channel should be designed in accordance with the SDH stability criteria.

4. SUMMARY OF IDENTIFIED DEFICIENCIES

Hydrologic and hydraulic analyses were conducted to determine whether the dam meets current NRCS and North Dakota state dam safety criteria. State hydrologic and hydraulic recommendations are consistent with NRCS criteria. The following hydrologic and hydraulic design deficiencies have been identified based on the existing conditions SITES analysis for Matejcek Dam:

1. The principal spillway is required by NRCS TR 210-60 to empty the retarding pool to less than 15 percent of the retarding storage volume in no more than 10 days. This criterion is violated for all PSH events that were analyzed.
2. The control section of the auxiliary spillway is 45.74 feet lower than the required flood pool elevation of the controlling PSH event for a high hazard structure with a vegetated auxiliary spillway.
3. For a high hazard structure, the dam would need to be raised 4.09 feet to pass the 72-hour FBH event without overtopping the dam (assuming the auxiliary spillway crest remains unchanged). If only the 6-hour and 24-hour FBH events are considered, the dam would still need to be raised by 3.59 feet to prevent overtopping.
4. The existing auxiliary spillway does not have adequate integrity to pass any of the analyzed FBH events without fully breaching through the control section.

Rehabilitation alternatives to bring the dam into compliance with current design criteria and address these deficiencies need to be identified. The following should be considered in evaluating and conceptualizing potential rehabilitation alternatives.

Primary deficiencies related to the PSH event include insufficient flood storage and inadequate principal spillway capacity to meet the 10-day drawdown requirement. While flood storage could be increased by raising the auxiliary spillway crest, it is likely not feasible to raise the spillway crest sufficiently to store the controlling PSH event given the magnitude of the deficiency. The principal spillway could be modified or replaced to increase its capacity to pass the PSH and meet

the drawdown criterion; however, consideration would have to be given to the downstream impacts of increased outflows from the larger principal spillway during more frequent flood events. Similarly, an additional principal spillway could be constructed to provide added capacity and redundancy in conjunction with the existing principal spillway.

A more realistic approach to resolving these deficiencies relating to the PSH event would be to replace the existing vegetated auxiliary spillway with a structural spillway. This spillway would likely consist of a roller-compacted concrete (RCC) stepped chute spillway. NRCS PSH requirements apply specifically to earthen or vegetated spillway where activation could result in erosion or headcutting. Frequency of activation of such spillways is important when considering both long-term maintenance as well as potential failure modes for the dam. PSH criteria do not apply to structural spillways since by nature these spillways are more durable and can withstand frequent use without excessive maintenance. If a structural spillway were installed, the existing auxiliary spillway crest elevation and corresponding flood storage and benefits could be maintained or even slightly increased if desired. Deficiencies related to the PSH events would no longer apply.

Matejcek Dam must also be modified to pass the FBH event without overtopping and without breaching the auxiliary spillway. Widening the existing auxiliary spillway was considered; however, it was found that the spillway would need to be significantly widened from 375 feet to 900 feet to pass the 72-hour FBH event and would still breach due to lack of spillway integrity. If the spillway were widened, it would also need to be armored.

Alternatively, the spillway capacity could be increased by improving the weir crest shape and efficiency. The current broad-crested weir configuration is the least efficient spillway crest type. Using a more efficient crest type (e.g. sharp-crested, ogee-crested, labyrinth weir) would result in a smaller weir width and overall spillway footprint. This could be applied in conjunction with the structural RCC spillway discussed previously and would address both the auxiliary spillway capacity and integrity deficiencies. This new structural spillway could be installed in the location of the existing spillway or over the existing dam embankment.

An additional means of safely passing the FBH that should be considered is raising the dam and armoring the existing auxiliary spillway with RCC. This alternative would result in increased downstream risks but would also allow for increased depth of flow in the existing auxiliary spillway and a corresponding increase in discharge capacity. Various combinations of raising the dam and increasing spillway capacity with a structural spillway could be considered to achieve a balance of materials or minimize cost.

Note that articulated concrete blocks (ACBs) are allowed by the NRCS to armor earthen auxiliary spillways. These could also be considered to armor the existing auxiliary spillway in lieu of RCC. However, NRCS does not consider an ACB-armored spillway as a structural spillway. Therefore, PSH criteria relating to activation frequency of the auxiliary spillway would still apply.

5. REFERENCES

Houston Engineering, Inc. (2019). *HEC-HMS Model of Forest River Watershed* (sent by email by Paul LeClaire of HEI on October 4, 2019).

North Dakota State Water Commission, Dam Safety Program (2019). *Website – Regulatory Program: Dam Safety* (www.swc.nd.gov/reg_approp/damsafety/).

United States Department of Agriculture, Natural Resources Conservation Service (2019). *Technical Release 210-60 – Earth Dams and Reservoirs.*

Gannett Fleming

ATTACHMENT A
SITES INPUT SUMMARY

Gannett Fleming

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

SITES INPUT DATA SHEET

STATE:	ND	COUNTY:	Walsh	HAZARD CLASS:	High	PROJECT:	Matejcek Dam		
BY:	GLR	DATE:	10/15/2019	CHECKED:	JBP	DATE:	10/15/2019	JOB NO.	64799
SUBJECT:	SITES INPUT DATA					SHEET	1	OF	2

Hydrologic inputs derived from HEC-HMS model of the Forest River watershed provided by Houston Engineering (dated October 4, 2019).
Dam geometry and stage-storage information derived from survey of Matejcek Dam completed by Houston Engineering in 2019.

Sub-Watershed ID: 1	Area (Sq. Mi.)	Base Flow (csm)
	121.15	0.145

USGS 05084000 (Forest River near Fordville, ND)

Data from 2019 survey (present day, top of sediment condition)

Elevation (Ft.)	Storage Vol. (Ac.Ft.)	
1293.00	0.0	
1309.76	267.8	Low Level Drawdown
1316.00	549.4	
1324.00	1093.6	
1332.00	1870.6	
1335.43	2270.6	Principal Spillway - 1st Stage
1336.00	2340.3	
1340.00	2881.6	
1344.00	3500.1	
1348.00	4205.1	
1352.00	4991.2	
1354.88	5608.4	Principal Spillway - 2nd Stage
1356.00	5860.1	
1360.00	6815.1	
1361.79	7273.5	Auxiliary Spillway Crest
1364.00	7865.9	
1368.00	9012.1	Top of Dam
1370.00	9616.3	
1380.00	12785.7	
1400.00	19125.0	Extrapolated

Principal Spillway Hydrographs (PSH):

HEC-HMS Run Name	Hydrologic Analysis Description	Peak Inflow (cfs)
PSH_Runoff_Volume_A	100-year Runoff Volume with Distribution A from NEH Part 630, Chapter 21, Figure 21-7	2208
PSH_Runoff_Volume_B	100-year Runoff Volume with Distribution B from NEH Part 630, Chapter 21, Figure 21-7	4394
PSH_Runoff_Volume_C	100-year Runoff Volume with Distribution C from NEH Part 630, Chapter 21, Figure 21-7	3764
Synth_24H_100Y	100-year Synthetic Rainfall using NOAA Atlas 14 and a 24-hour Nested Distribution (AMC	2409
Synth_4D_100Y	100-year Synthetic Rainfall using NOAA Atlas 14 and a 4-day Nested Distribution (AMC II)	2624
Synth_10D_100Y	100-year Synthetic Rainfall using NOAA Atlas 14 and a 10-day Nested Distribution (AMC I	2007

Spillway Design Hydrographs (SDH):

HEC-HMS Run Name	Hydrologic Analysis Description	Peak Inflow (cfs)
ASH_6H_100Y	6-hour distribution from NEH Figure 21-9, rainfall depths from TR-60 Table 2-5	4647
ASH_24H_100Y	24-hour distribution from NEH Figure 21-9, rainfall depths from TR-60 Table 2-5	9378
ASH_48H_100Y	48-hour distribution from NEH Figure 21-9, rainfall depths from TR-60 Table 2-5	9618

Freeboard Hydrographs (FBH):

HEC-HMS Run Name	Hydrologic Analysis Description	Peak Inflow (cfs)
PMP_HMR52_6H	6-hour Probable Maximum Precipitation using HMR51/52 for depths and distribution	24475
PMP_HMR52_24H	24-hour Probable Maximum Precipitation using HMR51/52 for depths and distribution	34252
PMP_HMR52_48H	48-hour Probable Maximum Precipitation using HMR51/52 for depths and distribution	35866
PMP_HMR52	72-hour Probable Maximum Precipitation using HMR51/52 for depths and distribution	36918

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U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

SITES INPUT DATA SHEET

STATE:	ND	COUNTY:	Walsh	HAZARD CLASS:	High	PROJECT:	Matejcek Dam		
BY:	GLR	DATE:	10/15/2019	CHECKED:	JBP	DATE:	10/15/2019	JOB NO.	64799
SUBJECT:	SITES INPUT DATA					SHEET	2	OF	2

Flood Pool Sediment =	1309.76	Ft.	2019 Survey
Permanent Pool =	1335.43	Ft.	2019 Survey
Elevation to Start Routing =	1336.15	Ft.	Corresponds to 17.6 cfs baseflow

Two Stage Inlet, Rectangular Conduit

High Stage Crest El. =	1354.88	Ft.	2019 Survey
Weir Length =	36.33	Ft.	As-Built Drawings
Low Stage Crest El. =	1335.43	Ft.	2019 Survey
Orifice Height =	1.00	Ft.	As-Built Drawings
Orifice Width =	11.00	Ft.	As-Built Drawings
Entrance Loss Coefficient =	0.75		Conservative value
Number of Conduits =	1		As-Built Drawings
Conduit Length =	339.17	Ft.	As-Built Drawings
Conduit Width =	4.50	Ft.	As-Built Drawings
Conduit Height =	4.58	Ft.	As-Built Drawings
Mannings 'n' Conduit =	0.013		Concrete pipe
Elevation HGL at Outlet =	1298.72	Ft.	invert of outlet + 1/2 conduit diameter, 2019 Survey
Elevation Valley Floor =	1283.71	Ft.	2019 Survey

ASW Inlet Template — 2019 Survey

Station (Ft.)	Elevation (Ft.)	
0.00	1336.13	
209.20	1339.55	
463.14	1348.40	
514.58	1352.02	
526.13	1352.42	
574.66	1359.73	
602.20	1359.43	
613.05	1358.04	
661.33	1357.77	
860.77	1361.79	Control Section
918.06	1361.79	Control Section
990.05	1358.90	
1114.15	1346.93	
1360.32	1321.24	
1479.46	1300.00	
1599.75	1283.71	

Sta. of Const. Exit Channel =	1599.75		As-Built Drawings
Dia. Surface Material =	0.002	In.	assumed

Reach Station Beginning	Reach Station Beginning	Veg. Retrd Curve Index	Veg. Cover Factor	Maintenance Code	Potential Root Depth, Ft.	
0	574.66	0.035	0.5	3	1	assumed - grass cover
574.66	602.2	0.013	0	1		assumed - pavement
602.2	1599.75	0.035	0.5	1	1	assumed - grass cover

Sideslope Ratio =	3	:1	As-Built Drawings
Bottom Width(s) =	375	Ft.	As-Built Drawings, 2019 Survey

Matejcek Dam Auxiliary Spillway Profile

Along Inside Edge of Spillway

Calc by EJB 10/10/19
Check by KEC/GLR 10/10/19

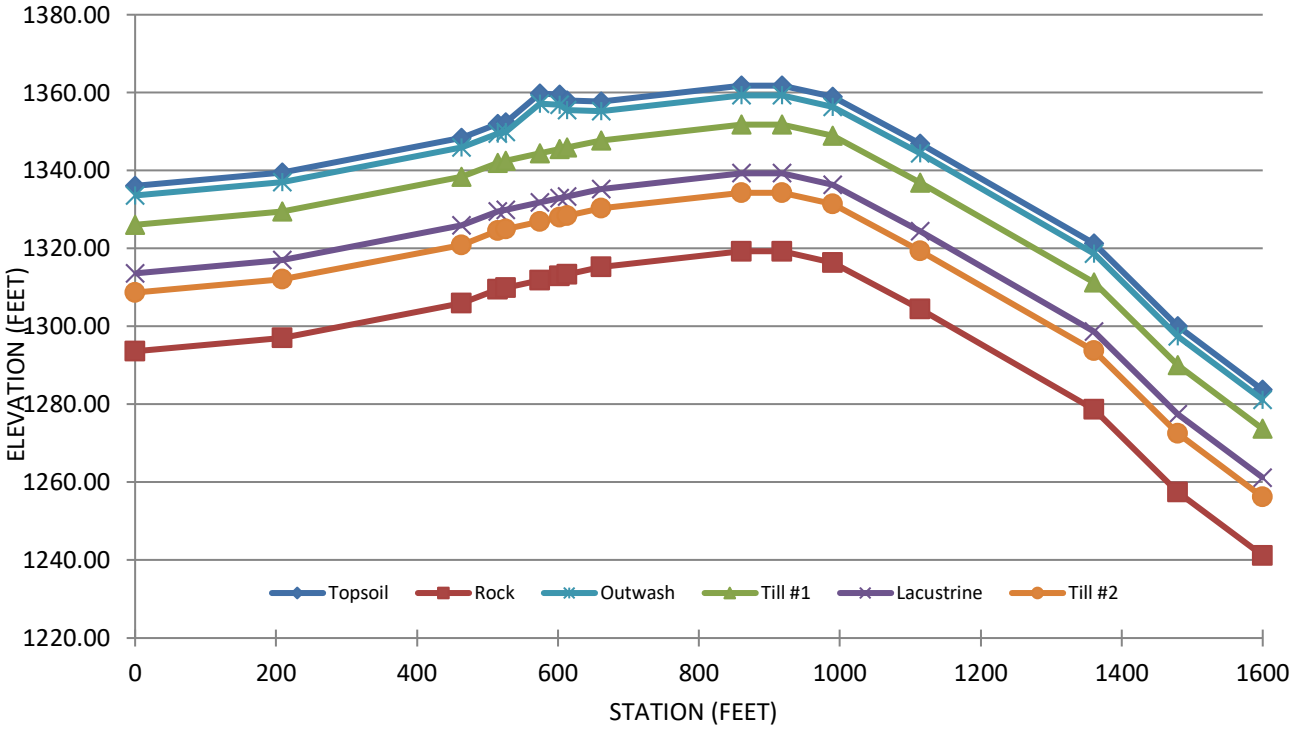
Parameter	Topsoil	Outwash	Till #1	Lacustrine	Till #2	Rock
Dry Density (pcf)	100	92	95	100	95	121
Headcut Index (Kh)	0.05	0.04	0.10	0.05	0.10	2.00
Percent Clay (%)	14	14	20	20	20	0
Plasticity Index (PI)	2	0	13	0	13	n/a
D75 (mm)	0.05	2	0.1	0.5	0.1	34.9

Station (feet)	Elevation (feet)					
0	1336.13	1333.63	1326.13	1313.63	1308.63	1293.63
209.2	1339.55	1337.05	1329.55	1317.05	1312.05	1297.05
463.14	1348.40	1345.90	1338.40	1325.90	1320.90	1305.90
514.58	1352.02	1349.52	1342.02	1329.52	1324.52	1309.52
526.13	1352.42	1349.92	1342.48	1329.98	1324.98	1309.98
574.66	1359.73	1357.23	1344.38	1331.88	1326.88	1311.88
602.2	1359.43	1356.93	1345.46	1332.96	1327.96	1312.96
613.05	1358.04	1355.54	1345.88	1333.38	1328.38	1313.38
661.33	1357.77	1355.27	1347.77	1335.27	1330.27	1315.27
860.77	1361.79	1359.29	1351.79	1339.29	1334.29	1319.29
918.06	1361.79	1359.29	1351.79	1339.29	1334.29	1319.29
990.05	1358.90	1356.40	1348.90	1336.40	1331.40	1316.40
1114.15	1346.93	1344.43	1336.93	1324.43	1319.43	1304.43
1360.32	1321.24	1318.74	1311.24	1298.74	1293.74	1278.74
1479.46	1300.00	1297.50	1290.00	1277.50	1272.50	1257.50
1599.75	1283.71	1281.21	1273.71	1261.21	1256.21	1241.21

Matejcek Dam Auxiliary Spillway Profile

Along Inside Edge of Spillway

Calc by EJB 10/10/19
Check by KEC/GLR 10/10/19



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ATTACHMENT B
SITES MODEL OUTPUT

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SITES MODEL OUTPUT

100-year PSH Runoff (Distribution A)

```
**********************************************************************************
SITES XEQ 10/15/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
   VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
   TIME 11:56:35
************************** 80-80 LIST OF INPUT Data ***************************

SITES    01/01/20051       Matejcek                121.15    A1
SAVMOV   0   101
SAVMOV   101  1                                    1
*       Hydrologic inputs derived from HEC-HMS model of the Forest
*       River watershed provided by Houston Engineering (dated
*       October 4, 2019).
*       Dam geometry and stage-storage information derived from
*       survey of Matejcek Dam completed by Houston Engineering
*       in 2019.
STRUCTURE 1       Matejcek 2019 Present Day Condition
            1293.00                    0.0
            1309.76                    267.8
            1316.00                    549.4
            1324.00                    1093.6
            1332.00                    1870.6
            1335.43                    2270.6
            1336.00                    2340.3
            1340.00                    2881.6
            1344.00                    3500.1
            1348.00                    4205.1
            1352.00                    4991.2
            1354.88                    5608.4
            1356.00                    5860.1
            1360.00                    6815.1
            1361.79                    7273.5
            1364.00                    7865.9
            1368.00                    9012.1
            1370.00                    9616.3
            1380.00                    12785.7
            1400.00                    19125
ENDTABLE
HYD      1             PSH_Runoff_A

WSDATA   2C 1           121.15
PDIRECT
POOLDATA  ELEV           1335.43   1309.76              TR
PSINLET   ELEV     0.75     36.33     1354.88   1       11
PSDATA   1       339.17    4.5      4.58     0.013     1298.72
GRAPHICS  I
GO,DESIGN LCPN
SAVMOV   2   101  1             1
ENDJOB
```

```
********************************************************************************
1SITES XEQ 10/15/2019 ---------- COMMENT PAGE ------------------------------
     VER 2005.1.8                Matejcek              WSID = 1


 Hydrologic inputs derived from HEC-HMS model of the Forest
 River watershed provided by Houston Engineering (dated
 October 4, 2019).

 Dam geometry and stage-storage information derived from
 survey of Matejcek Dam completed by Houston Engineering
 in 2019.

1SITES ---------------------------------------------------------------------
 XEQ 10/15/2019               Matejcek                  WSID= 1
 VER 2005.1.8         Matejcek 2019 Present Day Condition        SUBW= 1
 TIME 11:56:35          SITE = 1              PASS=    1     PART=   1

 ***************************   BASIC Data    ********************************
 HUMID- SUBHUMID CLIMATE AREA                  DESIGN CLASS  C

 STORM DISTRIBUTION USED FOR AUXILIARY SPILLWAY IS;
 NRCS DESIGN STORM RAINFALL DISTRIBUTION  (CHAPTER 21, NEH4 & TR-60).

 INFLOW HYDROGRAPH(S) ENTERED

 PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY      Q-SD          Q-FB
           0.00          0.00          0.00          0.00

 WSDATA -       CN          DA-SM          TC/L          -/H          QRF
           0.00        121.15          0.00          0.00          0.00

 SITEDATA- PERM POOL     CREST PS       FP SED       VALLEY FL       378?
           0.00       1335.43       1309.76          0.00           NO

         BASEFLOW      INITIAL EL     EXTRA VOL      SITE TYPE
           0.00          0.00          0.00         DESIGN

 PSDATA -  NO. COND        COND L         DIA/W          -/H
           1.00        339.17          4.50          4.58

            PS N           KE         WEIR L        TW EL
           0.013          0.75          36.33       1298.72

         2ND STG         ORF H         ORF L      START AUX.
         1354.88          1.00         11.00          0.00

 ASCRESTS -   AUX.1         AUX.2         AUX.3         AUX.4         AUX.5
```

0.00 0.00 0.00 0.00 0.00

AUX.Data - REF.NO. RETARD. Ci TIE STATION INLET LENGTH
0 0.00 0.00 0

AUX.Data - INLET N SIDE SLOPE EXIT N EXIT SLOPE ACTUAL AUX?
0.000 0.00 0.000 0.000 NO

BTM WIDTH - BW1 BW2 BW3 BW4 BW5
0.00 0.00 0.00 0.00 0.00

1********** DETAILED LIST OF BASIC Data **********
WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS		DELTA H WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000 0.0300 0.1000 0.1900 0.3100
0.4700 0.6600 0.8200 0.9300 0.9900
1.0000 0.9900 0.9300 0.8600 0.7800
0.6800 0.5600 0.4600 0.3900 0.3300
0.2800 0.2410 0.2070 0.1740 0.1470
0.1260 0.1070 0.0910 0.0770 0.0660

0.0550 0.0470 0.0400 0.0340 0.0290
0.0250 0.0210 0.0180 0.0150 0.0130
0.0110 0.0090 0.0080 0.0070 0.0060
0.0050 0.0040 0.0030 0.0020 0.0010
0.0000

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000 0.008 0.016 0.025 0.033
0.043 0.052 0.063 0.074 0.086
0.099 0.112 0.126 0.142 0.160
0.180 0.205 0.255 0.345 0.437
0.530 0.603 0.633 0.660 0.684
0.705 0.724 0.742 0.759 0.775
0.790 0.804 0.818 0.831 0.844
0.856 0.868 0.879 0.890 0.900
0.910 0.920 0.930 0.939 0.948
0.957 0.966 0.975 0.983 0.992
1.000

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 11:56:35 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

INFLOW HYDROGRAPH PROVIDED IN LOCATION 1, PEAK= 2208.20 CFS, AT 782.00 HRS.
TITLE = PSH_Runoff_A

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1335.43 FT 2270.6 ACFT 0.00 AC 0.0 CFS

NRCS-PSH RAINFALL 1-DAY = 0.00 IN 10-DAY = 0.00 IN DA = 121.15 SM
RUNOFF 1-DAY = 0.00 IN 10-DAY = 0.00 IN

CLIMATIC INDEX = 1.00 CN 10-DAY = 0. CN 1-DAY = 0.

AREAL CORRECTION 1 DAY =0.9321 AREAL CORRECTION 10 DAY =0.9661

PEAK = 2208.2 CFS, AT 782.0 HRS.

ROUTED RESULT - HYD TYPE EMAX VOL-MAX AMAX QMAX
NRCS-PSH 1379.93 FT 12763.2 ACFT 0.00 AC 827.0 CFS

PS STORAGE 10492.6 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

DRAWDOWN (DDT) TEST 1345.95 FT 3844.5 ACFT 164.27 CFS
CONTROL IS 0.150 DETENTION STORAGE

TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS 553.56 CFS, ELEV = 1356.83
(ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

TIME TO DDT TEST DISCHARGE IS 23.54 DAYS - DRAWDOWN STOPPED.

***** NOTE - CREST OF AUX. RAISED TO HOLD 3788.12 ACFT NOT EVACUATED IN
DRAWDOWN TIME LIMIT. TOTAL STORAGE REQUIRED = 16551.32 ACFT,
NEW ELEVATION OF AUXILIARY SPILLWAY CREST = 1391.88 FT.

****

RATING TABLE DEVELOPED, SITE = 1 :
WITH PS DEVELOPED BY PROGRAM AND NO AUX. DATA GIVEN.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1371.62	784.28	784.28	0.00	10129.47	0.00
12	1385.81	857.22	857.22	0.00	14627.13	0.00
13	1400.00	924.42	924.42	0.00	19125.00	0.00

1SITES ----------

XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 11:56:35 SITE = 1 PASS= 1 PART= 3

AUX. CREST 1391.88 FT 16551.3 ACFT 0.00 AC 886.0 CFS

PS STORAGE 14280.7 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1356.83 FT 6058.7 ACFT 0.00 AC 553.6 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.
AUX. AREAL CORRECTION USED =0.7765

***** MESSAGE - NO INPUT DATA GIVEN FOR AUXILIARY SPILLWAY CREST AND/OR
BOTTOM WIDTH. NO AUXILIARY SPILLWAY ROUTINGS PERFORMED.

Inflow Hyd 1 PSH-Peak = 826.99 CFS at 880.00 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.
---
1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
1 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****
SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
---------- DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/15/2019	11:56:35

>>> SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS <<<
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_A.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_A.OUT
DATED 10/15/2019 11:56:35

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_A.DRG
DATED 10/15/2019 11:56:35

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_A.DHY
DATED 10/15/2019 11:56:35

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_A.DEM
DATED 10/15/2019 11:56:35

Gannett Fleming

SITES MODEL OUTPUT

100-year PSH Runoff (Distribution B)

```
*******************************************************************************
 SITES XEQ 10/15/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
    VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
    TIME 12:00:45
 ************************* 80-80 LIST OF INPUT Data **************************
 SITES    01/01/20051       Matejcek                 121.15    A1
 SAVMOV   0    101
 SAVMOV   101  1                                     1
 *        Hydrologic inputs derived from HEC-HMS model of the Forest
 *        River watershed provided by Houston Engineering (dated
 *        October 4, 2019).
 *        Dam geometry and stage-storage information derived from
 *        survey of Matejcek Dam completed by Houston Engineering
 *        in 2019.
 STRUCTURE 1       Matejcek 2019 Present Day Condition
             1293.00                    0.0
             1309.76                    267.8
             1316.00                    549.4
             1324.00                    1093.6
             1332.00                    1870.6
             1335.43                    2270.6
             1336.00                    2340.3
             1340.00                    2881.6
             1344.00                    3500.1
             1348.00                    4205.1
             1352.00                    4991.2
             1354.88                    5608.4
             1356.00                    5860.1
             1360.00                    6815.1
             1361.79                    7273.5
             1364.00                    7865.9
             1368.00                    9012.1
             1370.00                    9616.3
             1380.00                    12785.7
             1400.00                    19125
 ENDTABLE
 HYD      1             PSH_Runoff_B
WSDATA    2C 1           121.15
 PDIRECT
 POOLDATA  ELEV           1335.43   1309.76              TR
 PSINLET   ELEV     0.75     36.33     1354.88   1       11
 PSDATA    1       339.17    4.5      4.58     0.013     1298.72
 GRAPHICS  I
 GO,DESIGN LCPN
 SAVMOV    2    101  1             1
 ENDJOB

*******************************************************************************
```

1SITES XEQ 10/15/2019 ---------- COMMENT PAGE ----------
VER 2005.1.8 Matejcek WSID = 1

Hydrologic inputs derived from HEC-HMS model of the Forest River watershed provided by Houston Engineering (dated October 4, 2019).

Dam geometry and stage-storage information derived from survey of Matejcek Dam completed by Houston Engineering in 2019.

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:00:45 SITE = 1 PASS= 1 PART= 1

********** BASIC Data **********
HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

STORM DISTRIBUTION USED FOR AUXILIARY SPILLWAY IS;
NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. -	Q-PS,1-DAY	Q-PS,10-DAY	Q-SD	Q-FB
	0.00	0.00	0.00	0.00

WSDATA -	CN	DA-SM	TC/L	-/H	QRF
	0.00	121.15	0.00	0.00	0.00

SITEDATA-	PERM POOL	CREST PS	FP SED	VALLEY FL	378?
	0.00	1335.43	1309.76	0.00	NO

BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE
0.00	0.00	0.00	DESIGN

PSDATA -	NO. COND	COND L	DIA/W	-/H
	1.00	339.17	4.50	4.58

PS N	KE	WEIR L	TW EL
0.013	0.75	36.33	1298.72

2ND STG	ORF H	ORF L	START AUX.
1354.88	1.00	11.00	0.00

ASCRESTS -	AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
	0.00	0.00	0.00	0.00	0.00

AUX.Data - REF.NO. RETARD. Ci TIE STATION INLET LENGTH
0 0.00 0.00 0

AUX.Data - INLET N SIDE SLOPE EXIT N EXIT SLOPE ACTUAL AUX?
0.000 0.00 0.000 0.000 NO

BTM WIDTH - BW1 BW2 BW3 BW4 BW5
0.00 0.00 0.00 0.00 0.00

1********** DETAILED LIST OF BASIC Data **********
WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS		DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290

0.0250 0.0210 0.0180 0.0150 0.0130
0.0110 0.0090 0.0080 0.0070 0.0060
0.0050 0.0040 0.0030 0.0020 0.0010
0.0000

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000 0.008 0.016 0.025 0.033
0.043 0.052 0.063 0.074 0.086
0.099 0.112 0.126 0.142 0.160
0.180 0.205 0.255 0.345 0.437
0.530 0.603 0.633 0.660 0.684
0.705 0.724 0.742 0.759 0.775
0.790 0.804 0.818 0.831 0.844
0.856 0.868 0.879 0.890 0.900
0.910 0.920 0.930 0.939 0.948
0.957 0.966 0.975 0.983 0.992
1.000

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:00:45 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

INFLOW HYDROGRAPH PROVIDED IN LOCATION 1, PEAK= 4394.30 CFS, AT 977.00 HRS.
TITLE = PSH_Runoff_B

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1335.43 FT 2270.6 ACFT 0.00 AC 0.0 CFS

NRCS-PSH RAINFALL 1-DAY = 0.00 IN 10-DAY = 0.00 IN DA = 121.15 SM
RUNOFF 1-DAY = 0.00 IN 10-DAY = 0.00 IN

CLIMATIC INDEX = 1.00 CN 10-DAY = 0. CN 1-DAY = 0.

AREAL CORRECTION 1 DAY =0.9321 AREAL CORRECTION 10 DAY =0.9661

PEAK = 4394.3 CFS, AT 977.0 HRS.

ROUTED RESULT - HYD TYPE EMAX VOL-MAX AMAX QMAX
NRCS-PSH 1391.99 FT 16584.6 ACFT 0.00 AC 886.5 CFS

PS STORAGE 14314.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

DRAWDOWN (DDT) TEST 1349.08 FT 4417.7 ACFT 191.50 CFS
CONTROL IS 0.150 DETENTION STORAGE

TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS 709.70 CFS, ELEV = 1358.48
(ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

TIME TO DDT TEST DISCHARGE IS 17.54 DAYS - DRAWDOWN STOPPED.

***** NOTE - CREST OF AUX. RAISED TO HOLD 4182.09 ACFT NOT EVACUATED IN
DRAWDOWN TIME LIMIT. TOTAL STORAGE REQUIRED = 20766.72 ACFT,
NEW ELEVATION OF AUXILIARY SPILLWAY CREST = 1405.18 FT.

****

RATING TABLE DEVELOPED, SITE = 1 :
WITH PS DEVELOPED BY PROGRAM AND NO AUX. DATA GIVEN.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1371.62	784.28	784.28	0.00	10129.47	0.00
12	1385.81	857.22	857.22	0.00	14627.13	0.00
13	1400.00	924.42	924.42	0.00	19125.00	0.00

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:00:45 SITE = 1 PASS= 1 PART= 3

AUX. CREST 1405.18 FT 20766.7 ACFT 0.00 AC 949.0 CFS

PS STORAGE 18496.1 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1358.48 FT 6452.7 ACFT 0.00 AC 709.7 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.
AUX. AREAL CORRECTION USED =0.7765

***** MESSAGE - NO INPUT DATA GIVEN FOR AUXILIARY SPILLWAY CREST AND/OR
BOTTOM WIDTH. NO AUXILIARY SPILLWAY ROUTINGS PERFORMED.

Inflow Hyd 1 PSH-Peak = 886.47 CFS at 1028.00 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.
---

1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
1 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/15/2019	12:00:45

>>> SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS <<<
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_B.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_B.OUT
DATED 10/15/2019 12:00:45

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_B.DRG
DATED 10/15/2019 12:00:45

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_B.DHY
DATED 10/15/2019 12:00:45

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_B.DEM
DATED 10/15/2019 12:00:45

Gannett Fleming

SITES MODEL OUTPUT

100-year PSH Runoff (Distribution C)

```
**************************************************************************
SITES XEQ 10/15/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
   VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
   TIME 12:05:43
************************* 80-80 LIST OF INPUT Data **************************
SITES    01/01/20051       Matejcek                 121.15    A1
SAVMOV   0    101
SAVMOV   101  1                                     1
*       Hydrologic inputs derived from HEC-HMS model of the Forest
*       River watershed provided by Houston Engineering (dated
*       October 4, 2019).
*       Dam geometry and stage-storage information derived from
*       survey of Matejcek Dam completed by Houston Engineering
*       in 2019.
STRUCTURE 1       Matejcek 2019 Present Day Condition
            1293.00                     0.0
            1309.76                     267.8
            1316.00                     549.4
            1324.00                     1093.6
            1332.00                     1870.6
            1335.43                     2270.6
            1336.00                     2340.3
            1340.00                     2881.6
            1344.00                     3500.1
            1348.00                     4205.1
            1352.00                     4991.2
            1354.88                     5608.4
            1356.00                     5860.1
            1360.00                     6815.1
            1361.79                     7273.5
            1364.00                     7865.9
            1368.00                     9012.1
            1370.00                     9616.3
            1380.00                     12785.7
            1400.00                     19125
ENDTABLE
HYD      1             PSH_Runoff_C
WSDATA   2C 1          121.15
PDIRECT
POOLDATA  ELEV          1335.43  1309.76              TR
PSINLET   ELEV    0.75    36.33    1354.88  1       11
PSDATA   1      339.17   4.5     4.58    0.013    1298.72
GRAPHICS  I
GO,DESIGN LCPN
SAVMOV   2    101  1             1
ENDJOB

**************************************************************************
```

1SITES XEQ 10/15/2019 ---------- COMMENT PAGE ----------
VER 2005.1.8 Matejcek WSID = 1

Hydrologic inputs derived from HEC-HMS model of the Forest River watershed provided by Houston Engineering (dated October 4, 2019).

Dam geometry and stage-storage information derived from survey of Matejcek Dam completed by Houston Engineering in 2019.

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:05:43 SITE = 1 PASS= 1 PART= 1

********** BASIC Data **********
HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

STORM DISTRIBUTION USED FOR AUXILIARY SPILLWAY IS;
NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. - Q-PS,1-DAY	Q-PS,10-DAY	Q-SD	Q-FB
0.00	0.00	0.00	0.00

WSDATA - CN	DA-SM	TC/L	-/H	QRF
0.00	121.15	0.00	0.00	0.00

SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
0.00	1335.43	1309.76	0.00	NO

BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE
0.00	0.00	0.00	DESIGN

PSDATA - NO. COND	COND L	DIA/W	-/H
1.00	339.17	4.50	4.58

PS N	KE	WEIR L	TW EL
0.013	0.75	36.33	1298.72

2ND STG	ORF H	ORF L	START AUX.
1354.88	1.00	11.00	0.00

ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
0.00	0.00	0.00	0.00	0.00

AUX.Data - REF.NO. RETARD. Ci TIE STATION INLET LENGTH
0 0.00 0.00 0

AUX.Data - INLET N SIDE SLOPE EXIT N EXIT SLOPE ACTUAL AUX?
0.000 0.00 0.000 0.000 NO

BTM WIDTH - BW1 BW2 BW3 BW4 BW5
0.00 0.00 0.00 0.00 0.00

1********** DETAILED LIST OF BASIC Data **********
WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS		DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S	
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00	

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130

0.0110 0.0090 0.0080 0.0070 0.0060
0.0050 0.0040 0.0030 0.0020 0.0010
0.0000

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000 0.008 0.016 0.025 0.033
0.043 0.052 0.063 0.074 0.086
0.099 0.112 0.126 0.142 0.160
0.180 0.205 0.255 0.345 0.437
0.530 0.603 0.633 0.660 0.684
0.705 0.724 0.742 0.759 0.775
0.790 0.804 0.818 0.831 0.844
0.856 0.868 0.879 0.890 0.900
0.910 0.920 0.930 0.939 0.948
0.957 0.966 0.975 0.983 0.992
1.000

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:05:43 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

INFLOW HYDROGRAPH PROVIDED IN LOCATION 1, PEAK= 3763.70 CFS, AT 872.00 HRS.
TITLE = PSH_Runoff_C

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1335.43 FT 2270.6 ACFT 0.00 AC 0.0 CFS

NRCS-PSH RAINFALL 1-DAY = 0.00 IN 10-DAY = 0.00 IN DA = 121.15 SM
RUNOFF 1-DAY = 0.00 IN 10-DAY = 0.00 IN

CLIMATIC INDEX = 1.00 CN 10-DAY = 0. CN 1-DAY = 0.

AREAL CORRECTION 1 DAY =0.9321 AREAL CORRECTION 10 DAY =0.9661

PEAK = 3763.7 CFS, AT 872.0 HRS.

ROUTED RESULT - HYD TYPE EMAX VOL-MAX AMAX QMAX
NRCS-PSH 1392.23 FT 16662.9 ACFT 0.00 AC 887.6 CFS

PS STORAGE 14392.3 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

DRAWDOWN (DDT) TEST 1349.14 FT 4429.4 ACFT 191.88 CFS
CONTROL IS 0.150 DETENTION STORAGE

TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS 725.07 CFS, ELEV = 1361.19
(ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

TIME TO DDT TEST DISCHARGE IS 18.33 DAYS - DRAWDOWN STOPPED.

***** NOTE - CREST OF AUX. RAISED TO HOLD 4849.29 ACFT NOT EVACUATED IN
DRAWDOWN TIME LIMIT. TOTAL STORAGE REQUIRED = 21512.17 ACFT,
NEW ELEVATION OF AUXILIARY SPILLWAY CREST = 1407.53 FT.

****

RATING TABLE DEVELOPED, SITE = 1 :
WITH PS DEVELOPED BY PROGRAM AND NO AUX. DATA GIVEN.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1371.62	784.28	784.28	0.00	10129.47	0.00
12	1385.81	857.22	857.22	0.00	14627.13	0.00
13	1400.00	924.42	924.42	0.00	19125.00	0.00

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:05:43 SITE = 1 PASS= 1 PART= 3

AUX. CREST 1407.53 FT 21512.2 ACFT 0.00 AC 960.1 CFS

PS STORAGE 19241.6 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1361.19 FT 7119.9 ACFT 0.00 AC 725.1 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.
AUX. AREAL CORRECTION USED =0.7765

***** MESSAGE - NO INPUT DATA GIVEN FOR AUXILIARY SPILLWAY CREST AND/OR
BOTTOM WIDTH. NO AUXILIARY SPILLWAY ROUTINGS PERFORMED.

Inflow Hyd 1 PSH-Peak = 887.63 CFS at 950.00 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.
---

1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
1 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
---------- DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/15/2019	12:05:43

>>> SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS <<<
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_C.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_C.OUT
DATED 10/15/2019 12:05:43

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_C.DRG
DATED 10/15/2019 12:05:43

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_C.DHY
DATED 10/15/2019 12:05:43

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Runoff_Volume_C.DEM
DATED 10/15/2019 12:05:43

Gannett Fleming

SITES MODEL OUTPUT

100-year PSH Rainfall (24-hour Synthetic)

```
********************************************************************************
 SITES XEQ 10/15/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
    VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
    TIME 12:10:03
************************** 80-80 LIST OF INPUT Data **************************

 SITES    01/01/20051       Matejcek              121.15    A1
 SAVMOV   0   101
 SAVMOV   101  1                                  1
 *        Hydrologic inputs derived from HEC-HMS model of the Forest
 *        River watershed provided by Houston Engineering (dated
 *        October 4, 2019).
 *        Dam geometry and stage-storage information derived from
 *        survey of Matejcek Dam completed by Houston Engineering
 *        in 2019.
 STRUCTURE 1       Matejcek 2019 Present Day Condition
             1293.00                    0.0
             1309.76                    267.8
             1316.00                    549.4
             1324.00                    1093.6
             1332.00                    1870.6
             1335.43                    2270.6
             1336.00                    2340.3
             1340.00                    2881.6
             1344.00                    3500.1
             1348.00                    4205.1
             1352.00                    4991.2
             1354.88                    5608.4
             1356.00                    5860.1
             1360.00                    6815.1
             1361.79                    7273.5
             1364.00                    7865.9
             1368.00                    9012.1
             1370.00                    9616.3
             1380.00                    12785.7
             1400.00                    19125
 ENDTABLE
 HYD      1             PSH_Rain_Synth_24H
WSDATA    2C 1           121.15
 PDIRECT
 POOLDATA  ELEV           1335.43   1309.76              TR
 PSINLET   ELEV     0.75     36.33    1354.88   1       11
 PSDATA    1       339.17    4.5      4.58     0.013    1298.72
 GRAPHICS  I
 GO,DESIGN LCPN
 SAVMOV    2    101  1             1
 ENDJOB
********************************************************************************
```

1SITES XEQ 10/15/2019 ---------- COMMENT PAGE ----------
VER 2005.1.8 Matejcek WSID = 1

Hydrologic inputs derived from HEC-HMS model of the Forest River watershed provided by Houston Engineering (dated October 4, 2019).

Dam geometry and stage-storage information derived from survey of Matejcek Dam completed by Houston Engineering in 2019.

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:10:03 SITE = 1 PASS= 1 PART= 1

********** BASIC Data **********
HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

STORM DISTRIBUTION USED FOR AUXILIARY SPILLWAY IS;
NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. - Q-PS,1-DAY	Q-PS,10-DAY	Q-SD	Q-FB
0.00	0.00	0.00	0.00

WSDATA - CN	DA-SM	TC/L	-/H	QRF
0.00	121.15	0.00	0.00	0.00

SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
0.00	1335.43	1309.76	0.00	NO

BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE
0.00	0.00	0.00	DESIGN

PSDATA - NO. COND	COND L	DIA/W	-/H
1.00	339.17	4.50	4.58

PS N	KE	WEIR L	TW EL
0.013	0.75	36.33	1298.72

2ND STG	ORF H	ORF L	START AUX.
1354.88	1.00	11.00	0.00

ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
0.00	0.00	0.00	0.00	0.00

AUX.Data - REF.NO. RETARD. Ci TIE STATION INLET LENGTH
0 0.00 0.00 0

AUX.Data - INLET N SIDE SLOPE EXIT N EXIT SLOPE ACTUAL AUX?
0.000 0.00 0.000 0.000 NO

BTM WIDTH - BW1 BW2 BW3 BW4 BW5
0.00 0.00 0.00 0.00 0.00

1********** DETAILED LIST OF BASIC Data **********
WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS		DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S	
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00	

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130

0.0110 0.0090 0.0080 0.0070 0.0060
0.0050 0.0040 0.0030 0.0020 0.0010
0.0000

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000 0.008 0.016 0.025 0.033
0.043 0.052 0.063 0.074 0.086
0.099 0.112 0.126 0.142 0.160
0.180 0.205 0.255 0.345 0.437
0.530 0.603 0.633 0.660 0.684
0.705 0.724 0.742 0.759 0.775
0.790 0.804 0.818 0.831 0.844
0.856 0.868 0.879 0.890 0.900
0.910 0.920 0.930 0.939 0.948
0.957 0.966 0.975 0.983 0.992
1.000

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:10:03 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

INFLOW HYDROGRAPH PROVIDED IN LOCATION 1, PEAK= 2409.10 CFS, AT 751.00 HRS.
TITLE = PSH_Rain_Synth_24H

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1335.43 FT 2270.6 ACFT 0.00 AC 0.0 CFS

NRCS-PSH RAINFALL 1-DAY = 0.00 IN 10-DAY = 0.00 IN DA = 121.15 SM
RUNOFF 1-DAY = 0.00 IN 10-DAY = 0.00 IN

CLIMATIC INDEX = 1.00 CN 10-DAY = 0. CN 1-DAY = 0.

AREAL CORRECTION 1 DAY =0.9321 AREAL CORRECTION 10 DAY =0.9661

PEAK = 2409.1 CFS, AT 751.0 HRS.

```
ROUTED RESULT - HYD TYPE      EMAX        VOL-MAX       AMAX        QMAX
           NRCS-PSH   1363.65 FT    7772.0 ACFT      0.00 AC    735.9 CFS

   PS STORAGE    5501.4 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

DRAWDOWN (DDT) TEST      1341.39 FT    3095.8 ACFT    114.87 CFS
   CONTROL IS 0.150 DETENTION STORAGE

   TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS   228.10 CFS,  ELEV =  1354.53
   (ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

   TIME TO DDT TEST DISCHARGE IS 25.29 DAYS - DRAWDOWN STOPPED.

***** NOTE - CREST OF AUX. RAISED TO HOLD  3263.43 ACFT NOT EVACUATED IN
         DRAWDOWN TIME LIMIT.  TOTAL STORAGE REQUIRED = 11035.46 ACFT,
         NEW ELEVATION OF AUXILIARY SPILLWAY CREST    =  1374.48 FT.

 ********************************************************************************
RATING TABLE DEVELOPED, SITE = 1    :
 WITH PS DEVELOPED BY PROGRAM AND NO AUX. DATA GIVEN.

RATING TABLE NUMBER  1
     ELEV.   Q-TOTAL   Q-PS    Q-AUX.   VOLUME     AREA
     FEET      CFS      CFS      CFS     AC-FT     ACRE
  1  1335.43     0.00     0.00     0.00   2270.60     0.00
  2  1335.62     2.91     2.91     0.00   2294.32     0.00
  3  1335.82     8.24     8.24     0.00   2318.04     0.00
                          TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT
  4  1336.01    15.14    15.14     0.00   2341.92     0.00
  5  1342.30   133.61   133.61     0.00   3237.45     0.00
  6  1348.59   188.34   188.34     0.00   4321.19     0.00
  7  1354.88   230.42   230.42     0.00   5608.40     0.00
  8  1355.73   323.73   323.73     0.00   5799.34     0.00
  9  1356.58   489.99   489.99     0.00   5998.39     0.00
                           FULL CONDUIT FLOW, ELEV = 1357.43 FT
 10  1357.43   703.72   703.72     0.00   6201.23     0.00
 11  1371.62   784.28   784.28     0.00  10129.47     0.00
 12  1385.81   857.22   857.22     0.00  14627.13     0.00
 13  1400.00   924.42   924.42     0.00  19125.00     0.00

1SITES ------------------------------------------------------------------------
 XEQ 10/15/2019                Matejcek                  WSID= 1
 VER 2005.1.8         Matejcek 2019 Present Day Condition         SUBW= 1
 TIME 12:10:03          SITE = 1              PASS=    1     PART=   3

 AUX. CREST     1374.48 FT   11035.5 ACFT      0.00 AC     799.0 CFS
```

PS STORAGE 8764.8 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1354.53 FT 5534.0 ACFT 0.00 AC 228.1 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.
AUX. AREAL CORRECTION USED =0.7765

***** MESSAGE - NO INPUT DATA GIVEN FOR AUXILIARY SPILLWAY CREST AND/OR
BOTTOM WIDTH. NO AUXILIARY SPILLWAY ROUTINGS PERFORMED.

Inflow Hyd 1 PSH-Peak = 735.93 CFS at 807.00 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.
---

1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
1 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
---------- DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/15/2019	12:10:03

>>> SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS <<<
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ AUX.CREST WIDTH (IN/FT)	BTM. ELEV (FT)	MAX. WIDTH (FT)	MAX. HP (FT)	EMB. ELEV (FT)	INTEGR.* VOL. (CY)	EXIT* DIST. (FT)	TYPE VEL. (FT/SEC)	HYD

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_24H.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_24H.OUT
DATED 10/15/2019 12:10:03

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_24H.DRG DATED 10/15/2019 12:10:03

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_24H.DHY DATED 10/15/2019 12:10:03

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_24H.DEM DATED 10/15/2019 12:10:03

Gannett Fleming

SITES MODEL OUTPUT

100-year PSH Rainfall (4-day Synthetic)

```
********************************************************************************
 SITES XEQ 10/15/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
    VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
    TIME 12:17:09
************************* 80-80 LIST OF INPUT Data **************************

 SITES    01/01/20051       Matejcek              121.15    A1
 SAVMOV   0   101
 SAVMOV   101  1                                  1
 *        Hydrologic inputs derived from HEC-HMS model of the Forest
 *        River watershed provided by Houston Engineering (dated
 *        October 4, 2019).
 *        Dam geometry and stage-storage information derived from
 *        survey of Matejcek Dam completed by Houston Engineering
 *        in 2019.
 STRUCTURE 1       Matejcek 2019 Present Day Condition
             1293.00                    0.0
             1309.76                    267.8
             1316.00                    549.4
             1324.00                    1093.6
             1332.00                    1870.6
             1335.43                    2270.6
             1336.00                    2340.3
             1340.00                    2881.6
             1344.00                    3500.1
             1348.00                    4205.1
             1352.00                    4991.2
             1354.88                    5608.4
             1356.00                    5860.1
             1360.00                    6815.1
             1361.79                    7273.5
             1364.00                    7865.9
             1368.00                    9012.1
             1370.00                    9616.3
             1380.00                    12785.7
             1400.00                    19125
 ENDTABLE
 HYD      1             PSH_Rain_Synth_4D
WSDATA    2C 1           121.15
 PDIRECT
 POOLDATA  ELEV           1335.43   1309.76              TR
 PSINLET   ELEV     0.75     36.33    1354.88   1       11
 PSDATA    1       339.17    4.5      4.58     0.013    1298.72
 GRAPHICS  I
 GO,DESIGN LCPN
 SAVMOV    2    101  1             1
 ENDJOB
********************************************************************************
```

1SITES XEQ 10/15/2019 ---------- COMMENT PAGE ----------
VER 2005.1.8 Matejcek WSID = 1

Hydrologic inputs derived from HEC-HMS model of the Forest River watershed provided by Houston Engineering (dated October 4, 2019).

Dam geometry and stage-storage information derived from survey of Matejcek Dam completed by Houston Engineering in 2019.

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:17:09 SITE = 1 PASS= 1 PART= 1

********** BASIC Data **********
HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

STORM DISTRIBUTION USED FOR AUXILIARY SPILLWAY IS;
NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. - Q-PS,1-DAY	Q-PS,10-DAY	Q-SD	Q-FB
0.00	0.00	0.00	0.00

WSDATA - CN	DA-SM	TC/L	-/H	QRF
0.00	121.15	0.00	0.00	0.00

SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
0.00	1335.43	1309.76	0.00	NO

BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE
0.00	0.00	0.00	DESIGN

PSDATA - NO. COND	COND L	DIA/W	-/H
1.00	339.17	4.50	4.58

PS N	KE	WEIR L	TW EL
0.013	0.75	36.33	1298.72

2ND STG	ORF H	ORF L	START AUX.
1354.88	1.00	11.00	0.00

ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
0.00	0.00	0.00	0.00	0.00

AUX.Data - REF.NO. RETARD. Ci TIE STATION INLET LENGTH
0 0.00 0.00 0

AUX.Data - INLET N SIDE SLOPE EXIT N EXIT SLOPE ACTUAL AUX?
0.000 0.00 0.000 0.000 NO

BTM WIDTH - BW1 BW2 BW3 BW4 BW5
0.00 0.00 0.00 0.00 0.00

1********** DETAILED LIST OF BASIC Data **********
WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS		DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S	
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00	

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130

0.0110 0.0090 0.0080 0.0070 0.0060
0.0050 0.0040 0.0030 0.0020 0.0010
0.0000

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000 0.008 0.016 0.025 0.033
0.043 0.052 0.063 0.074 0.086
0.099 0.112 0.126 0.142 0.160
0.180 0.205 0.255 0.345 0.437
0.530 0.603 0.633 0.660 0.684
0.705 0.724 0.742 0.759 0.775
0.790 0.804 0.818 0.831 0.844
0.856 0.868 0.879 0.890 0.900
0.910 0.920 0.930 0.939 0.948
0.957 0.966 0.975 0.983 0.992
1.000

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:17:09 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

INFLOW HYDROGRAPH PROVIDED IN LOCATION 1, PEAK= 2623.90 CFS, AT 787.00 HRS.
TITLE = PSH_Rain_Synth_4D

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1335.43 FT 2270.6 ACFT 0.00 AC 0.0 CFS

NRCS-PSH RAINFALL 1-DAY = 0.00 IN 10-DAY = 0.00 IN DA = 121.15 SM
RUNOFF 1-DAY = 0.00 IN 10-DAY = 0.00 IN

CLIMATIC INDEX = 1.00 CN 10-DAY = 0. CN 1-DAY = 0.

AREAL CORRECTION 1 DAY =0.9321 AREAL CORRECTION 10 DAY =0.9661

PEAK = 2623.9 CFS, AT 787.0 HRS.

ROUTED RESULT - HYD TYPE EMAX VOL-MAX AMAX QMAX
NRCS-PSH 1371.87 FT 10209.6 ACFT 0.00 AC 785.6 CFS

PS STORAGE 7939.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

DRAWDOWN (DDT) TEST 1343.75 FT 3461.5 ACFT 144.92 CFS
CONTROL IS 0.150 DETENTION STORAGE

TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS 228.73 CFS, ELEV = 1354.63
(ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

TIME TO DDT TEST DISCHARGE IS 22.58 DAYS - DRAWDOWN STOPPED.

***** NOTE - CREST OF AUX. RAISED TO HOLD 3283.57 ACFT NOT EVACUATED IN
DRAWDOWN TIME LIMIT. TOTAL STORAGE REQUIRED = 13493.18 ACFT,
NEW ELEVATION OF AUXILIARY SPILLWAY CREST = 1382.23 FT.

****

RATING TABLE DEVELOPED, SITE = 1 :
WITH PS DEVELOPED BY PROGRAM AND NO AUX. DATA GIVEN.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1371.62	784.28	784.28	0.00	10129.47	0.00
12	1385.81	857.22	857.22	0.00	14627.13	0.00
13	1400.00	924.42	924.42	0.00	19125.00	0.00

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:17:09 SITE = 1 PASS= 1 PART= 3

AUX. CREST 1382.23 FT 13493.2 ACFT 0.00 AC 838.8 CFS

PS STORAGE 11222.6 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1354.63 FT 5554.2 ACFT 0.00 AC 228.7 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.
AUX. AREAL CORRECTION USED =0.7765

***** MESSAGE - NO INPUT DATA GIVEN FOR AUXILIARY SPILLWAY CREST AND/OR
BOTTOM WIDTH. NO AUXILIARY SPILLWAY ROUTINGS PERFORMED.

Inflow Hyd 1 PSH-Peak = 785.58 CFS at 852.00 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.
---

1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
1 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/15/2019	12:17:09

>>> SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS <<<
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_4D.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_4D.OUT
DATED 10/15/2019 12:17:09

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_4D.DRG DATED 10/15/2019 12:17:09

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_4D.DHY DATED 10/15/2019 12:17:09

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_4D.DEM DATED 10/15/2019 12:17:09

Gannett Fleming

SITES MODEL OUTPUT

100-year PSH Rainfall (10-day Synthetic)

```
********************************************************************************
 SITES XEQ 10/15/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
    VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
    TIME 12:21:52
************************** 80-80 LIST OF INPUT Data **************************

 SITES    01/01/20051       Matejcek              121.15    A1
 SAVMOV   0   101
 SAVMOV   101  1                                  1
 *        Hydrologic inputs derived from HEC-HMS model of the Forest
 *        River watershed provided by Houston Engineering (dated
 *        October 4, 2019).
 *        Dam geometry and stage-storage information derived from
 *        survey of Matejcek Dam completed by Houston Engineering
 *        in 2019.
 STRUCTURE 1       Matejcek 2019 Present Day Condition
             1293.00                    0.0
             1309.76                    267.8
             1316.00                    549.4
             1324.00                    1093.6
             1332.00                    1870.6
             1335.43                    2270.6
             1336.00                    2340.3
             1340.00                    2881.6
             1344.00                    3500.1
             1348.00                    4205.1
             1352.00                    4991.2
             1354.88                    5608.4
             1356.00                    5860.1
             1360.00                    6815.1
             1361.79                    7273.5
             1364.00                    7865.9
             1368.00                    9012.1
             1370.00                    9616.3
             1380.00                    12785.7
             1400.00                    19125
 ENDTABLE
 HYD      1             PSH_Rain_Synth_10D
WSDATA    2C 1           121.15
 PDIRECT
 POOLDATA  ELEV           1335.43   1309.76              TR
 PSINLET   ELEV     0.75     36.33    1354.88   1       11
 PSDATA    1       339.17    4.5      4.58     0.013    1298.72
 GRAPHICS  I
 GO,DESIGN LCPN
 SAVMOV    2    101  1             1
 ENDJOB
********************************************************************************
```

1SITES XEQ 10/15/2019 ---------- COMMENT PAGE ----------
VER 2005.1.8 Matejcek WSID = 1

Hydrologic inputs derived from HEC-HMS model of the Forest River watershed provided by Houston Engineering (dated October 4, 2019).

Dam geometry and stage-storage information derived from survey of Matejcek Dam completed by Houston Engineering in 2019.

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:21:52 SITE = 1 PASS= 1 PART= 1

********** BASIC Data **********
HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

STORM DISTRIBUTION USED FOR AUXILIARY SPILLWAY IS;
NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. -	Q-PS,1-DAY	Q-PS,10-DAY	Q-SD	Q-FB
	0.00	0.00	0.00	0.00

WSDATA -	CN	DA-SM	TC/L	-/H	QRF
	0.00	121.15	0.00	0.00	0.00

SITEDATA-	PERM POOL	CREST PS	FP SED	VALLEY FL	378?
	0.00	1335.43	1309.76	0.00	NO

BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE
0.00	0.00	0.00	DESIGN

PSDATA -	NO. COND	COND L	DIA/W	-/H
	1.00	339.17	4.50	4.58

PS N	KE	WEIR L	TW EL
0.013	0.75	36.33	1298.72

2ND STG	ORF H	ORF L	START AUX.
1354.88	1.00	11.00	0.00

ASCRESTS -	AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
	0.00	0.00	0.00	0.00	0.00

AUX.Data - REF.NO. RETARD. Ci TIE STATION INLET LENGTH
0 0.00 0.00 0

AUX.Data - INLET N SIDE SLOPE EXIT N EXIT SLOPE ACTUAL AUX?
0.000 0.00 0.000 0.000 NO

BTM WIDTH - BW1 BW2 BW3 BW4 BW5
0.00 0.00 0.00 0.00 0.00

1********** DETAILED LIST OF BASIC Data **********
WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS		DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S	
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00	

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130

0.0110 0.0090 0.0080 0.0070 0.0060
0.0050 0.0040 0.0030 0.0020 0.0010
0.0000

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000 0.008 0.016 0.025 0.033
0.043 0.052 0.063 0.074 0.086
0.099 0.112 0.126 0.142 0.160
0.180 0.205 0.255 0.345 0.437
0.530 0.603 0.633 0.660 0.684
0.705 0.724 0.742 0.759 0.775
0.790 0.804 0.818 0.831 0.844
0.856 0.868 0.879 0.890 0.900
0.910 0.920 0.930 0.939 0.948
0.957 0.966 0.975 0.983 0.992
1.000

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:21:52 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

INFLOW HYDROGRAPH PROVIDED IN LOCATION 1, PEAK= 2007.30 CFS, AT 861.00 HRS.
TITLE = PSH_Rain_Synth_10D

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1335.43 FT 2270.6 ACFT 0.00 AC 0.0 CFS

NRCS-PSH RAINFALL 1-DAY = 0.00 IN 10-DAY = 0.00 IN DA = 121.15 SM
RUNOFF 1-DAY = 0.00 IN 10-DAY = 0.00 IN

CLIMATIC INDEX = 1.00 CN 10-DAY = 0. CN 1-DAY = 0.

AREAL CORRECTION 1 DAY =0.9321 AREAL CORRECTION 10 DAY =0.9661

PEAK = 2007.3 CFS, AT 861.0 HRS.

ROUTED RESULT - HYD TYPE EMAX VOL-MAX AMAX QMAX
NRCS-PSH 1363.82 FT 7817.6 ACFT 0.00 AC 736.9 CFS

PS STORAGE 5547.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

DRAWDOWN (DDT) TEST 1341.43 FT 3102.6 ACFT 115.77 CFS
CONTROL IS 0.150 DETENTION STORAGE

TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS 229.71 CFS, ELEV = 1354.77
(ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

TIME TO DDT TEST DISCHARGE IS 26.33 DAYS - DRAWDOWN STOPPED.

***** NOTE - CREST OF AUX. RAISED TO HOLD 3315.02 ACFT NOT EVACUATED IN
DRAWDOWN TIME LIMIT. TOTAL STORAGE REQUIRED = 11132.57 ACFT,
NEW ELEVATION OF AUXILIARY SPILLWAY CREST = 1374.78 FT.

****

RATING TABLE DEVELOPED, SITE = 1 :
WITH PS DEVELOPED BY PROGRAM AND NO AUX. DATA GIVEN.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1371.62	784.28	784.28	0.00	10129.47	0.00
12	1385.81	857.22	857.22	0.00	14627.13	0.00
13	1400.00	924.42	924.42	0.00	19125.00	0.00

1SITES ----------
XEQ 10/15/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 12:21:52 SITE = 1 PASS= 1 PART= 3

AUX. CREST 1374.78 FT 11132.6 ACFT 0.00 AC 800.5 CFS

PS STORAGE 8862.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1354.77 FT 5585.6 ACFT 0.00 AC 229.7 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.
AUX. AREAL CORRECTION USED =0.7765

***** MESSAGE - NO INPUT DATA GIVEN FOR AUXILIARY SPILLWAY CREST AND/OR
BOTTOM WIDTH. NO AUXILIARY SPILLWAY ROUTINGS PERFORMED.

Inflow Hyd 1 PSH-Peak = 736.86 CFS at 933.00 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.
---

1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
1 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****
SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/15/2019	12:21:52

>>> SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS <<<
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_10D.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_10D.OUT
DATED 10/15/2019 12:21:52

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_10D.DRG DATED 10/15/2019 12:21:52

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_10D.DHY DATED 10/15/2019 12:21:52

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\PSH_Rain_Synth_10D.DEM DATED 10/15/2019 12:21:52

Gannett Fleming

SITES MODEL OUTPUT

6-hour SDH / FBH

```
********************************************************************************
 SITES XEQ 10/17/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
    VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
    TIME 16:43:28

 ************************* 80-80 LIST OF INPUT Data **************************

 SITES    01/01/20051       Matejcek              121.15    C2
 SAVMOV   0   101
 SAVMOV   101  1                                  1
 *        Hydrologic inputs derived from HEC-HMS model of the Forest
 *        River watershed provided by Houston Engineering (dated
 *        October 4, 2019).
 *        Dam geometry and stage-storage information derived from
 *        survey of Matejcek Dam completed by Houston Engineering
 *        in 2019.
 STRUCTURE 1       Matejcek 2019 Present Day Condition
              1293.00                   0.0
              1309.76                   267.8
              1316.00                   549.4
              1324.00                   1093.6
              1332.00                   1870.6
              1335.43                   2270.6
              1336.00                   2340.3
              1340.00                   2881.6
              1344.00                   3500.1
              1348.00                   4205.1
              1352.00                   4991.2
              1354.88                   5608.4
              1356.00                   5860.1
              1360.00                   6815.1
              1361.79                   7273.5
              1364.00                   7865.9
              1368.00                   9012.1
              1370.00                   9616.3
              1380.00                   12785.7
              1400.00                   19125
 ENDTABLE
 HYD      3            ASH_6H_100Y
 HYD      5            PMP_HMR52_6H
WSDATA    2C 1           121.15
 PDIRECT                    0.00     0.00
 POOLDATA  ELEV     1335.43   1335.43   1309.76         1283.71   TR
 PSINLET   ELEV     0.75     36.33     1354.88   1       11
 PSDATA    1       339.17    4.5       4.58      0.013     1298.72
 ASSURFACE 41       1599.75   .002
        0       574.66    0.035     0.5       3       1
        574.66    602.2     0.013     0       1
```

```
      602.2    1599.75  0.035    0.5      1        1
ENDTABLE
ASDATA   41                  3                   1
BTMWIDTH  FEET     375
ASMATERIAL
      1        2        .002     14       100      0.05
      2        0        0.079    14       92       0.04
      3        13       .004     20       95       .1
      4        0        0.02     20       100      0.05
      5        13       .004     20       95       0.1
      6        0        1.374    0        121      2
ENDTABLE
ASCOORD   1      Topsoil   Y
      0        1336.13  209.2    1339.55  463.14   1348.40
      514.58   1352.02  526.13   1352.42  574.66   1359.73
      602.2    1359.43  613.05   1358.04  661.33   1357.77
      860.77   1361.79  918.06   1361.79  990.05   1358.90
      1114.15  1346.93  1360.32  1321.24  1479.46  1300.00
      1599.75  1283.71
ENDTABLE
ASCOORD   2      Outwash
      0        1333.63  209.2    1337.05  463.14   1345.90
      514.58   1349.52  526.13   1349.92  574.66   1357.23
      602.2    1356.93  613.05   1355.54  661.33   1355.27
      860.77   1359.29  918.06   1359.29  990.05   1356.40
      1114.15  1344.43  1360.32  1318.74  1479.46  1297.50
      1599.75  1281.21
ENDTABLE
ASCOORD   3      Till #1
      0        1326.13  209.2    1329.55  463.14   1338.40
      514.58   1342.02  526.13   1342.48  574.66   1344.38
      602.2    1345.46  613.05   1345.88  661.33   1347.77
      860.77   1351.79  918.06   1351.79  990.05   1348.90
      1114.15  1336.93  1360.32  1311.24  1479.46  1290.00
      1599.75  1273.71
ENDTABLE
ASCOORD   4      Lacustrine
      0        1313.63  209.2    1317.05  463.14   1325.90
      514.58   1329.52  526.13   1329.98  574.66   1331.88
      602.2    1332.96  613.05   1333.38  661.33   1335.27
      860.77   1339.29  918.06   1339.29  990.05   1336.40
      1114.15  1324.43  1360.32  1298.74  1479.46  1277.50
      1599.75  1261.21
ENDTABLE
ASCOORD   5      Till #2
      0        1308.63  209.2    1312.05  463.14   1320.90
      514.58   1324.52  526.13   1324.98  574.66   1326.88
      602.2    1327.96  613.05   1328.38  661.33   1330.27
```

```
      860.77   1334.29   918.06   1334.29   990.05   1331.40
      1114.15   1319.43   1360.32   1293.74   1479.46   1272.50
      1599.75   1256.21
ENDTABLE
ASCOORD   6      Rock
      0      1293.63   209.2    1297.05   463.14    1305.90
      514.58    1309.52   526.13    1309.98   574.66    1311.88
      602.2     1312.96   613.05    1313.38   661.33    1315.27
      860.77    1319.29   918.06    1319.29   990.05    1316.40
      1114.15   1304.43   1360.32   1278.74   1479.46   1257.50
      1599.75   1241.21
ENDTABLE
GRAPHICS  I
GO,DESIGN LCP                              1361.19
SAVMOV    2    101  1              1
ENDJOB

*******************************************************************************

1SITES XEQ 10/17/2019 ---------- COMMENT PAGE ------------------------------
    VER 2005.1.8                Matejcek              WSID = 1

Hydrologic inputs derived from HEC-HMS model of the Forest
River watershed provided by Houston Engineering (dated
October 4, 2019).

Dam geometry and stage-storage information derived from
survey of Matejcek Dam completed by Houston Engineering
in 2019.

***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  1361.79
          FROM THE ASCOORD RECORDS.

***** MESSAGE - VALUES FROM ASSURFACE, REACH  2 IMPLY NO VEGETAL COVER WITH
          "n" OF 0.013.

***** WARNING - DOWNWARD SLOPE FOUND IN INLET CHANNEL OF EXISTING AUX. SPILLWAY
          STARTING AT X =  613., Y = 1358.04; NEXT Y = 1357.77.

1SITES ------------------------------------------------------------------------
XEQ 10/17/2019               Matejcek                  WSID= 1
VER 2005.1.8        Matejcek 2019 Present Day Condition        SUBW= 1
TIME 16:43:28         SITE = 1             PASS=    1     PART=   1
```

********** MATERIAL PROPERTIES **********

MATERIAL	PI	DRY DENSITY lbs/CuFt	Kh	PERCENT CLAY	DETACH. RATE (Ft/H)/(lb/SqFt)	REP. DIAMETER inches
Topsoil	2.	100.	0.05	14.0	--	0.00200
Outwash	0.	92.	0.04	14.0	--	0.07900
Till #1	13.	95.	0.10	20.0	--	0.00400
Lacustrine	0.	100.	0.05	20.0	--	0.02000
Till #2	13.	95.	0.10	20.0	--	0.00400
Rock	0.	121.	2.00	0.0	--	1.37400
TS_FILL	0.	100.	0.05	0.0	--	0.05000
GEN_FILL	2.	100.	0.05	14.0	--	0.00200

********** BASIC Data **********

HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. - Q-PS,1-DAY	Q-PS,10-DAY	Q-SD	Q-FB
0.00	0.00	0.00	0.00

WSDATA - CN	DA-SM	TC/L	-/H	QRF
0.00	121.15	0.00	0.00	0.00

SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
1335.43	1335.43	1309.76	1283.71	NO

BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE
0.00	0.00	0.00	DESIGN

PSDATA - NO. COND	COND L	DIA/W	-/H
1.00	339.17	4.50	4.58

PS N	KE	WEIR L	TW EL
0.013	0.75	36.33	1298.72

2ND STG	ORF H	ORF L	START AUX.
1354.88	1.00	11.00	1361.19

ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
1361.79	0.00	0.00	0.00	0.00

AUX.Data - REF.NO.	RETARD. Ci	TIE STATION	INLET LENGTH
41	0.00	918.06	0

AUX.Data - INLET N	SIDE SLOPE	EXIT N	EXIT SLOPE	ACTUAL AUX?
0.035	3.00	0.035	0.040	YES

BTM WIDTH -	BW1	BW2	BW3	BW4	BW5
ft	375.00	0.00	0.00	0.00	0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

1********** DETAILED LIST OF BASIC Data **********

WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS		SEPARATE STABILITY BERMS DELTA H		WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S		
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00		

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130
0.0110	0.0090	0.0080	0.0070	0.0060
0.0050	0.0040	0.0030	0.0020	0.0010
0.0000				

EXISTING SURFACE OF AUXILIARY SPILLWAY - X,Y COORDINATES:

0.	1336.13
209.	1339.55
463.	1348.40
515.	1352.02
526.	1352.42
575.	1359.73
602.	1359.43
613.	1358.04
661.	1357.77
861.	1361.79
918.	1361.79
990.	1358.90
1114.	1346.93
1360.	1321.24
1479.	1300.00
1600.	1283.71

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000	0.008	0.016	0.025	0.033
0.043	0.052	0.063	0.074	0.086
0.099	0.112	0.126	0.142	0.160
0.180	0.205	0.255	0.345	0.437
0.530	0.603	0.633	0.660	0.684
0.705	0.724	0.742	0.759	0.775
0.790	0.804	0.818	0.831	0.844
0.856	0.868	0.879	0.890	0.900
0.910	0.920	0.930	0.939	0.948
0.957	0.966	0.975	0.983	0.992
1.000				

1SITES ----------
XEQ 10/17/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 16:43:28 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1361.19 FT 7119.8 ACFT 0.00 AC 722.6 CFS
****

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1371.62	784.28	784.28	0.00	10129.47	0.00
12	1385.81	857.22	857.22	0.00	14627.13	0.00
13	1400.00	924.42	924.42	0.00	19125.00	0.00

INFLOW HYDROGRAPH PROVIDED IN LOCATION 3, PEAK= 4646.70 CFS, AT 752.00 HRS.
TITLE = ASH_6H_100Y

INFLOW HYDROGRAPH PROVIDED IN LOCATION 5, PEAK= 24474.60 CFS, AT 740.00 HRS.
TITLE = PMP_HMR52_6H

1SITES ----------
XEQ 10/17/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 16:43:28 SITE = 1 PASS= 1 PART= 3

AUX. CREST 1361.79 FT 7273.5 ACFT 0.00 AC 725.7 CFS

PS STORAGE 5002.9 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1361.19 FT 7119.8 ACFT 0.00 AC 725.1 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.

NRCS-SDH INFLOW HYDROGRAPH INPUT, DA = 121.15 SQUARE MILES

PEAK = 4646.7 CFS, AT 752.0 HRS.

NRCS-FBH INFLOW HYDROGRAPH INPUT, DA = 121.15 SQUARE MILES

PEAK = 24474.6 CFS, AT 740.0 HRS.
AUX. AREAL CORRECTION USED =0.7765

****

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1358.88	712.48	712.48	0.00	6548.28	0.00
12	1360.34	721.03	721.03	0.00	6901.19	0.00
13	1361.79	729.49	729.49	0.00	7273.47	0.00
14	1363.70	2962.24	740.46	2221.78	7785.63	0.00
15	1365.61	7665.03	751.26	6913.77	8327.56	0.00
16	1369.05	20878.74	770.33	20108.40	9329.28	0.00
17	1373.25	43014.96	793.02	42221.94	10647.32	0.00
18	1380.90	100777.76	832.68	99945.08	13069.39	0.00
19	1390.45	194418.77	879.75	193539.02	16097.20	0.00
20	1400.00	313583.88	924.42	312659.47	19125.00	0.00

****

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX@	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	0.	209.	-1.6	0.035	**	**	**	INLET

2	209.	463.	-3.5	0.035	**	**	**	INLET
3	463.	515.	-7.0	0.035	**	**	**	INLET
4	515.	526.	-3.5	0.035	**	**	**	INLET
5	526.	575.	-15.1	0.035	**	**	**	INLET
6	575.	602.	1.1	0.013	**	**	**	INLET
7	602.	613.	12.8	0.035	**	**	**	INLET
8	613.	661.	0.6	0.035	**	**	**	INLET
9	661.	861.	-2.0	0.035	**	**	**	INLET
10	861.	918.	0.0	0.035	**	**	**	CREST
11	918.	990.	4.0	0.035	0.50	1	1.0	EXIT !
12	990.	1114.	9.6	0.035	0.50	1	1.0	EXIT
13	1114.	1360.	10.4	0.035	0.50	1	1.0	EXIT
14	1360.	1479.	17.8	0.035	0.50	1	1.0	EXIT
15	1479.	1600.	13.5	0.035	0.50	1	1.0	EXIT

@ The program interprets retardance curve index entries of less than 1 as
Manning's n values.
+ The minimum maintenance code value of 2 is used in INTEGRITY computations
(the program changes values of 1 to 2 during computation).
* Upper case indicates a reach of constructed spillway channel.
** The program does not use vegetal cover factor, maintenance code, and
rooting depth for inlet and crest reaches in computations.
! Reach 11 used in computing exit channel velocities.
****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	375.0	1364.38	7974.1	0.0	2.59	700.6

PEAK - CFS DISCHARGE =	Q-PS 744.	Q-AUX. 3854.	Q-TOT. 4598.

AUXILIARY SPILLWAY ---	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
	1.48	6.86	0.016	0.021

AUXILIARY SPILLWAY DURATION FLOW = 70.0 HOURS

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 9.1 FT/SEC
EXIT SLOPE = 0.040 FT/FT
FLOW DEPTH = 1.1 FT
****

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)
Aux. Spillway Discharge = 3854. cfs; Bottom Width = 375. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2	
11	918.	990.	4.01	0.035	9.11	2.80	0.278	
12	990.	1114.	9.65	0.035	11.87	5.18	0.514	
13	1114.	1360.	10.44	0.035	12.15	5.47	0.543	
14	1360.	1479.	17.83	0.035	14.28	7.96	0.791	max.
15	1479.	1600.	13.54	0.035	13.14	6.56	0.652	

****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	375.0	1369.74	9538.8	0.0	7.95	2265.3

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	774.	23624.	24398.

AUXILIARY SPILLWAY ---	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
	4.91	12.34	0.011	0.014

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 731.0 hours
and peaked at time = 740.0 hours.)

REACH 11: FROM STATION 918. TO 990. ON 4.0% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 734.0 hours.

REACH 12: FROM STATION 990. TO 1114. ON 9.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 734.0 hours.

REACH 13: FROM STATION 1114. TO 1360. ON 10.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 734.0 hours.

REACH 14: FROM STATION 1360. TO 1479. ON 17.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 733.0 hours.

REACH 15: FROM STATION 1479. TO 1600. ON 13.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 733.0 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The headcut BREACHED the spillway crest at
time equal approximately 736.0 hours.
Computations terminated at that point!

The most upstream headcut began at station 918.
and progressed upstream to station 861.
The final height of the headcut was 12.4 ft.

The headcut having the maximum final overfall height began
at station 1114. and progressed upstream to station 861.
The final height of the headcut was 78.1 ft.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

	DURATION FLOW	ATTACK OE/B	DIST. FROM MOST U/S HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY----	110.0	156.4	>>>BREACH<<<
	Depth = 12.4 ft		

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 18.5 FT/SEC
EXIT SLOPE = 0.040 FT/FT
FLOW DEPTH = 3.3 FT

Inflow Hyd 1 SDH-Peak = 4597.81 CFS at 752.00 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 24397.86 CFS at 739.00 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.
---

1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
2 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
---------- DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/17/2019	16:43:28

>>> SITE SUBWS SUBWS DA CURVE TC TOTAL DA TYPE STRUC <<<

ID	ID	(SQ MI)	NO.	(HRS)	(SQ MI)	DESIGN	CLASS
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	4.5	1361.8	375.0	7.9	1369.7	0.	<BREACH>	18.5	NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_6H.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_6H.OUT
DATED 10/17/2019 16:43:28

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_6H.DRG DATED 10/17/2019 16:43:28

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_6H.DHY DATED 10/17/2019 16:43:28

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_6H.DEM DATED 10/17/2019 16:43:28

AUX.GRAPHICS = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_6H.DG* DATED 10/17/2019 16:43:28

Gannett Fleming

SITES MODEL OUTPUT

24-hour SDH / FBH

```
********************************************************************************
SITES XEQ 10/17/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
   VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
   TIME 16:42:57

************************* 80-80 LIST OF INPUT Data **************************

SITES    01/01/20051       Matejcek              121.15    C2
SAVMOV   0   101
SAVMOV   101  1                                  1
*       Hydrologic inputs derived from HEC-HMS model of the Forest
*       River watershed provided by Houston Engineering (dated
*       October 4, 2019).
*       Dam geometry and stage-storage information derived from
*       survey of Matejcek Dam completed by Houston Engineering
*       in 2019.
STRUCTURE 1       Matejcek 2019 Present Day Condition
            1293.00                  0.0
            1309.76                  267.8
            1316.00                  549.4
            1324.00                  1093.6
            1332.00                  1870.6
            1335.43                  2270.6
            1336.00                  2340.3
            1340.00                  2881.6
            1344.00                  3500.1
            1348.00                  4205.1
            1352.00                  4991.2
            1354.88                  5608.4
            1356.00                  5860.1
            1360.00                  6815.1
            1361.79                  7273.5
            1364.00                  7865.9
            1368.00                  9012.1
            1370.00                  9616.3
            1380.00                  12785.7
            1400.00                  19125
ENDTABLE
HYD      3            ASH_24H_100Y
HYD      5            PMP_HMR52_24H
WSDATA   2C 1           121.15
PDIRECT                    0.00     0.00
POOLDATA  ELEV     1335.43  1335.43  1309.76         1283.71   TR
PSINLET   ELEV     0.75     36.33    1354.88  1       11
PSDATA   1       339.17   4.5      4.58     0.013    1298.72
ASSURFACE 41       1599.75  .002
      0       574.66   0.035    0.5      3       1
      574.66   602.2    0.013    0        1
```

```
      602.2    1599.75  0.035    0.5      1        1
ENDTABLE
ASDATA   41                  3                   1
BTMWIDTH  FEET     375
ASMATERIAL
      1        2        .002     14       100      0.05
      2        0        0.079    14       92       0.04
      3        13       .004     20       95       .1
      4        0        0.02     20       100      0.05
      5        13       .004     20       95       0.1
      6        0        1.374    0        121      2
ENDTABLE
ASCOORD   1      Topsoil   Y
      0        1336.13  209.2    1339.55  463.14   1348.40
      514.58   1352.02  526.13   1352.42  574.66   1359.73
      602.2    1359.43  613.05   1358.04  661.33   1357.77
      860.77   1361.79  918.06   1361.79  990.05   1358.90
      1114.15  1346.93  1360.32  1321.24  1479.46  1300.00
      1599.75  1283.71
ENDTABLE
ASCOORD   2      Outwash
      0        1333.63  209.2    1337.05  463.14   1345.90
      514.58   1349.52  526.13   1349.92  574.66   1357.23
      602.2    1356.93  613.05   1355.54  661.33   1355.27
      860.77   1359.29  918.06   1359.29  990.05   1356.40
      1114.15  1344.43  1360.32  1318.74  1479.46  1297.50
      1599.75  1281.21
ENDTABLE
ASCOORD   3      Till #1
      0        1326.13  209.2    1329.55  463.14   1338.40
      514.58   1342.02  526.13   1342.48  574.66   1344.38
      602.2    1345.46  613.05   1345.88  661.33   1347.77
      860.77   1351.79  918.06   1351.79  990.05   1348.90
      1114.15  1336.93  1360.32  1311.24  1479.46  1290.00
      1599.75  1273.71
ENDTABLE
ASCOORD   4      Lacustrine
      0        1313.63  209.2    1317.05  463.14   1325.90
      514.58   1329.52  526.13   1329.98  574.66   1331.88
      602.2    1332.96  613.05   1333.38  661.33   1335.27
      860.77   1339.29  918.06   1339.29  990.05   1336.40
      1114.15  1324.43  1360.32  1298.74  1479.46  1277.50
      1599.75  1261.21
ENDTABLE
ASCOORD   5      Till #2
      0        1308.63  209.2    1312.05  463.14   1320.90
      514.58   1324.52  526.13   1324.98  574.66   1326.88
      602.2    1327.96  613.05   1328.38  661.33   1330.27
```

```
      860.77   1334.29   918.06   1334.29   990.05   1331.40
      1114.15   1319.43   1360.32   1293.74   1479.46   1272.50
      1599.75   1256.21
ENDTABLE
ASCOORD   6      Rock
      0      1293.63   209.2    1297.05   463.14   1305.90
      514.58   1309.52   526.13   1309.98   574.66   1311.88
      602.2    1312.96   613.05   1313.38   661.33   1315.27
      860.77   1319.29   918.06   1319.29   990.05   1316.40
      1114.15   1304.43   1360.32   1278.74   1479.46   1257.50
      1599.75   1241.21
ENDTABLE
GRAPHICS  I
GO,DESIGN LCP                              1361.19
SAVMOV   2   101  1              1
ENDJOB

*******************************************************************************

1SITES XEQ 10/17/2019 ---------- COMMENT PAGE ------------------------------
    VER 2005.1.8               Matejcek              WSID = 1


Hydrologic inputs derived from HEC-HMS model of the Forest
River watershed provided by Houston Engineering (dated
October 4, 2019).

Dam geometry and stage-storage information derived from
survey of Matejcek Dam completed by Houston Engineering
in 2019.

***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  1361.79
          FROM THE ASCOORD RECORDS.

***** MESSAGE - VALUES FROM ASSURFACE, REACH  2 IMPLY NO VEGETAL COVER WITH
          "n" OF 0.013.

***** WARNING - DOWNWARD SLOPE FOUND IN INLET CHANNEL OF EXISTING AUX. SPILLWAY
          STARTING AT X =  613., Y = 1358.04; NEXT Y = 1357.77.

1SITES ------------------------------------------------------------------------
XEQ 10/17/2019               Matejcek                  WSID= 1
VER 2005.1.8        Matejcek 2019 Present Day Condition        SUBW= 1
TIME 16:42:57         SITE = 1             PASS=    1     PART=   1
```

********** MATERIAL PROPERTIES **********

MATERIAL	PI	DRY DENSITY lbs/CuFt	Kh	PERCENT CLAY	DETACH. RATE (Ft/H)/(lb/SqFt)	REP. DIAMETER inches
Topsoil	2.	100.	0.05	14.0	--	0.00200
Outwash	0.	92.	0.04	14.0	--	0.07900
Till #1	13.	95.	0.10	20.0	--	0.00400
Lacustrine	0.	100.	0.05	20.0	--	0.02000
Till #2	13.	95.	0.10	20.0	--	0.00400
Rock	0.	121.	2.00	0.0	--	1.37400
TS_FILL	0.	100.	0.05	0.0	--	0.05000
GEN_FILL	2.	100.	0.05	14.0	--	0.00200

********** BASIC Data **********

HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. - Q-PS,1-DAY	Q-PS,10-DAY	Q-SD	Q-FB
0.00	0.00	0.00	0.00

WSDATA - CN	DA-SM	TC/L	-/H	QRF
0.00	121.15	0.00	0.00	0.00

SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
1335.43	1335.43	1309.76	1283.71	NO

BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE
0.00	0.00	0.00	DESIGN

PSDATA - NO. COND	COND L	DIA/W	-/H
1.00	339.17	4.50	4.58

PS N	KE	WEIR L	TW EL
0.013	0.75	36.33	1298.72

2ND STG	ORF H	ORF L	START AUX.
1354.88	1.00	11.00	1361.19

ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
1361.79	0.00	0.00	0.00	0.00

AUX.Data - REF.NO.	RETARD. Ci	TIE STATION	INLET LENGTH
41	0.00	918.06	0

AUX.Data - INLET N	SIDE SLOPE	EXIT N	EXIT SLOPE	ACTUAL AUX?
0.035	3.00	0.035	0.040	YES

BTM WIDTH -	BW1	BW2	BW3	BW4	BW5
ft	375.00	0.00	0.00	0.00	0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

1********** DETAILED LIST OF BASIC Data **********

WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS	DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130
0.0110	0.0090	0.0080	0.0070	0.0060
0.0050	0.0040	0.0030	0.0020	0.0010
0.0000				

EXISTING SURFACE OF AUXILIARY SPILLWAY - X,Y COORDINATES:

0.	1336.13
209.	1339.55
463.	1348.40
515.	1352.02
526.	1352.42
575.	1359.73
602.	1359.43
613.	1358.04
661.	1357.77
861.	1361.79
918.	1361.79
990.	1358.90
1114.	1346.93
1360.	1321.24
1479.	1300.00
1600.	1283.71

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000	0.008	0.016	0.025	0.033
0.043	0.052	0.063	0.074	0.086
0.099	0.112	0.126	0.142	0.160
0.180	0.205	0.255	0.345	0.437
0.530	0.603	0.633	0.660	0.684
0.705	0.724	0.742	0.759	0.775
0.790	0.804	0.818	0.831	0.844
0.856	0.868	0.879	0.890	0.900
0.910	0.920	0.930	0.939	0.948
0.957	0.966	0.975	0.983	0.992
1.000				

1SITES ---
XEQ 10/17/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 16:42:57 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1361.19 FT 7119.8 ACFT 0.00 AC 722.6 CFS
****

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1371.62	784.28	784.28	0.00	10129.47	0.00
12	1385.81	857.22	857.22	0.00	14627.13	0.00
13	1400.00	924.42	924.42	0.00	19125.00	0.00

INFLOW HYDROGRAPH PROVIDED IN LOCATION 3, PEAK= 9378.00 CFS, AT 755.00 HRS.
TITLE = ASH_24H_100Y

INFLOW HYDROGRAPH PROVIDED IN LOCATION 5, PEAK= 34252.30 CFS, AT 750.00 HRS.
TITLE = PMP_HMR52_24H

1SITES ----------
XEQ 10/17/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 16:42:57 SITE = 1 PASS= 1 PART= 3

AUX. CREST 1361.79 FT 7273.5 ACFT 0.00 AC 725.7 CFS

PS STORAGE 5002.9 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1361.19 FT 7119.8 ACFT 0.00 AC 725.1 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.

NRCS-SDH INFLOW HYDROGRAPH INPUT, DA = 121.15 SQUARE MILES

PEAK = 9378.0 CFS, AT 755.0 HRS.

NRCS-FBH INFLOW HYDROGRAPH INPUT, DA = 121.15 SQUARE MILES

PEAK = 34252.3 CFS, AT 750.0 HRS.
AUX. AREAL CORRECTION USED =0.7765

****

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
			TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT			
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
			FULL CONDUIT FLOW, ELEV = 1357.43 FT			
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1358.88	712.48	712.48	0.00	6548.28	0.00
12	1360.34	721.03	721.03	0.00	6901.19	0.00
13	1361.79	729.49	729.49	0.00	7273.47	0.00
14	1363.70	2962.24	740.46	2221.78	7785.63	0.00
15	1365.61	7665.03	751.26	6913.77	8327.56	0.00
16	1369.05	20878.74	770.33	20108.40	9329.28	0.00
17	1373.25	43014.96	793.02	42221.94	10647.32	0.00
18	1380.90	100777.76	832.68	99945.08	13069.39	0.00
19	1390.45	194418.77	879.75	193539.02	16097.20	0.00
20	1400.00	313583.88	924.42	312659.47	19125.00	0.00

****

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX@	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	0.	209.	-1.6	0.035	**	**	**	INLET

2	209.	463.	-3.5	0.035	**	**	**	INLET
3	463.	515.	-7.0	0.035	**	**	**	INLET
4	515.	526.	-3.5	0.035	**	**	**	INLET
5	526.	575.	-15.1	0.035	**	**	**	INLET
6	575.	602.	1.1	0.013	**	**	**	INLET
7	602.	613.	12.8	0.035	**	**	**	INLET
8	613.	661.	0.6	0.035	**	**	**	INLET
9	661.	861.	-2.0	0.035	**	**	**	INLET
10	861.	918.	0.0	0.035	**	**	**	CREST
11	918.	990.	4.0	0.035	0.50	1	1.0	EXIT !
12	990.	1114.	9.6	0.035	0.50	1	1.0	EXIT
13	1114.	1360.	10.4	0.035	0.50	1	1.0	EXIT
14	1360.	1479.	17.8	0.035	0.50	1	1.0	EXIT
15	1479.	1600.	13.5	0.035	0.50	1	1.0	EXIT

@ The program interprets retardance curve index entries of less than 1 as
Manning's n values.
+ The minimum maintenance code value of 2 is used in INTEGRITY computations
(the program changes values of 1 to 2 during computation).
* Upper case indicates a reach of constructed spillway channel.
** The program does not use vegetal cover factor, maintenance code, and
rooting depth for inlet and crest reaches in computations.
! Reach 11 used in computing exit channel velocities.
****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	375.0	1366.05	8453.9	0.0	4.26	1180.4

PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.
DISCHARGE =	754.	8577.	9331.

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY	FT	FT/SEC	FT/FT	FT/FT
SPILLWAY ---	2.52	8.91	0.013	0.018

AUXILIARY SPILLWAY DURATION FLOW = 88.0 HOURS

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 12.5 FT/SEC
EXIT SLOPE = 0.040 FT/FT
FLOW DEPTH = 1.8 FT

***** WARNING - SOD STRIPPING WILL PROBABLY OCCUR DUE TO GROSSSTRESS LIMIT IN
STABILITY CONTROL REACH WHICH STARTS AT STATION 1360.32.
****

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL

(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)
Aux. Spillway Discharge = 8577. cfs; Bottom Width = 375. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	TOTAL VELOCITY ft/s	EFFECTIVE STRESS lb/ft^2	STRESS lb/ft^2	
11	918.	990.	4.01	0.035	12.49	4.52	0.449	
12	990.	1114.	9.65	0.035	16.29	8.36	0.830	
13	1114.	1360.	10.44	0.035	16.68	8.84	0.878	
14	1360.	1479.	17.83	0.035	19.61	12.86	1.277	max.
15	1479.	1600.	13.54	0.035	18.05	10.61	1.053	

****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	375.0	1371.59	10119.6	0.0	9.80	2846.1

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	784.	33368.	34152.

AUXILIARY SPILLWAY ---	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
	6.16	13.76	0.010	0.013

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 741.0 hours
and peaked at time = 751.0 hours.)

REACH 11: FROM STATION 918. TO 990. ON 4.0% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 744.0 hours.

REACH 12: FROM STATION 990. TO 1114. ON 9.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 743.0 hours.

REACH 13: FROM STATION 1114. TO 1360. ON 10.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 743.0 hours.

REACH 14: FROM STATION 1360. TO 1479. ON 17.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 743.0 hours.

REACH 15: FROM STATION 1479. TO 1600. ON 13.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 743.0 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The headcut BREACHED the spillway crest at
time equal approximately 746.0 hours.
Computations terminated at that point!

The most upstream headcut began at station 918.
and progressed upstream to station 861.
The final height of the headcut was 14.2 ft.

The headcut having the maximum final overfall height began
at station 1114. and progressed upstream to station 861.
The final height of the headcut was 78.1 ft.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

	DURATION FLOW	ATTACK OE/B	DIST. FROM MOST U/S HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY----	122.0	237.1	>>>BREACH<<<
		Depth = 14.2 ft	

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 21.2 FT/SEC
EXIT SLOPE = 0.040 FT/FT
FLOW DEPTH = 4.1 FT

Inflow Hyd 1 SDH-Peak = 9331.10 CFS at 755.00 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 34152.23 CFS at 750.00 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.
---

1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
2 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
---------- DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/17/2019	16:42:57

>>> SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS <<<
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	4.5	1361.8	375.0	9.8	1371.6	0.	<BREACH>	21.2	NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_24H.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_24H.OUT
DATED 10/17/2019 16:42:57

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_24H.DRG DATED 10/17/2019 16:42:57

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_24H.DHY DATED 10/17/2019 16:42:57

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_24H.DEM DATED 10/17/2019 16:42:57

AUX.GRAPHICS = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_24H.DG* DATED 10/17/2019 16:42:57

Gannett Fleming

SITES MODEL OUTPUT

48-hour SDH / FBH

```
********************************************************************************
SITES XEQ 10/17/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
   VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
   TIME 16:42:27
************************** 80-80 LIST OF INPUT Data ***************************

SITES    01/01/20051       Matejcek              121.15    C2
SAVMOV   0   101
SAVMOV   101  1                                   1
*       Hydrologic inputs derived from HEC-HMS model of the Forest
*       River watershed provided by Houston Engineering (dated
*       October 4, 2019).
*       Dam geometry and stage-storage information derived from
*       survey of Matejcek Dam completed by Houston Engineering
*       in 2019.
STRUCTURE 1       Matejcek 2019 Present Day Condition
            1293.00                   0.0
            1309.76                   267.8
            1316.00                   549.4
            1324.00                   1093.6
            1332.00                   1870.6
            1335.43                   2270.6
            1336.00                   2340.3
            1340.00                   2881.6
            1344.00                   3500.1
            1348.00                   4205.1
            1352.00                   4991.2
            1354.88                   5608.4
            1356.00                   5860.1
            1360.00                   6815.1
            1361.79                   7273.5
            1364.00                   7865.9
            1368.00                   9012.1
            1370.00                   9616.3
            1380.00                   12785.7
            1400.00                   19125
ENDTABLE
HYD      3            ASH_48H_100Y
HYD      5            PMP_HMR52_48H
WSDATA    2C 1           121.15
PDIRECT                    0.00     0.00
POOLDATA  ELEV     1335.43   1335.43   1309.76          1283.71   TR
PSINLET   ELEV     0.75     36.33     1354.88   1       11
PSDATA    1       339.17    4.5       4.58      0.013    1298.72
ASSURFACE 41       1599.75   .002
       0       574.66    0.035     0.5      3       1
       574.66    602.2     0.013     0        1
       602.2     1599.75   0.035     0.5      1       1
```

```
ENDTABLE
ASDATA   41                  3                  1
BTMWIDTH  FEET    375
ASMATERIAL
      1      2      .002    14      100     0.05
      2      0      0.079   14      92      0.04
      3      13     .004    20      95      .1
      4      0      0.02    20      100     0.05
      5      13     .004    20      95      0.1
      6      0      1.374   0       121     2
ENDTABLE
ASCOORD   1      Topsoil   Y
      0      1336.13   209.2    1339.55   463.14    1348.40
      514.58    1352.02   526.13    1352.42   574.66    1359.73
      602.2     1359.43   613.05    1358.04   661.33    1357.77
      860.77    1361.79   918.06    1361.79   990.05    1358.90
      1114.15   1346.93   1360.32   1321.24   1479.46   1300.00
      1599.75   1283.71
ENDTABLE
ASCOORD   2      Outwash
      0      1333.63   209.2    1337.05   463.14    1345.90
      514.58    1349.52   526.13    1349.92   574.66    1357.23
      602.2     1356.93   613.05    1355.54   661.33    1355.27
      860.77    1359.29   918.06    1359.29   990.05    1356.40
      1114.15   1344.43   1360.32   1318.74   1479.46   1297.50
      1599.75   1281.21
ENDTABLE
ASCOORD   3      Till #1
      0      1326.13   209.2    1329.55   463.14    1338.40
      514.58    1342.02   526.13    1342.48   574.66    1344.38
      602.2     1345.46   613.05    1345.88   661.33    1347.77
      860.77    1351.79   918.06    1351.79   990.05    1348.90
      1114.15   1336.93   1360.32   1311.24   1479.46   1290.00
      1599.75   1273.71
ENDTABLE
ASCOORD   4      Lacustrine
      0      1313.63   209.2    1317.05   463.14    1325.90
      514.58    1329.52   526.13    1329.98   574.66    1331.88
      602.2     1332.96   613.05    1333.38   661.33    1335.27
      860.77    1339.29   918.06    1339.29   990.05    1336.40
      1114.15   1324.43   1360.32   1298.74   1479.46   1277.50
      1599.75   1261.21
ENDTABLE
ASCOORD   5      Till #2
      0      1308.63   209.2    1312.05   463.14    1320.90
      514.58    1324.52   526.13    1324.98   574.66    1326.88
      602.2     1327.96   613.05    1328.38   661.33    1330.27
      860.77    1334.29   918.06    1334.29   990.05    1331.40
```

```
      1114.15   1319.43   1360.32   1293.74   1479.46   1272.50
      1599.75   1256.21
ENDTABLE
ASCOORD    6       Rock
      0       1293.63   209.2     1297.05   463.14    1305.90
      514.58    1309.52   526.13    1309.98   574.66    1311.88
      602.2     1312.96   613.05    1313.38   661.33    1315.27
      860.77    1319.29   918.06    1319.29   990.05    1316.40
      1114.15   1304.43   1360.32   1278.74   1479.46   1257.50
      1599.75   1241.21
ENDTABLE
GRAPHICS  I
GO,DESIGN LCP                              1361.19
SAVMOV    2    101  1              1
ENDJOB

*******************************************************************************

1SITES XEQ 10/17/2019 ---------- COMMENT PAGE ------------------------------
    VER 2005.1.8                Matejcek              WSID = 1

 Hydrologic inputs derived from HEC-HMS model of the Forest
 River watershed provided by Houston Engineering (dated
 October 4, 2019).

 Dam geometry and stage-storage information derived from
 survey of Matejcek Dam completed by Houston Engineering
 in 2019.

 ***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

 ***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  1361.79
           FROM THE ASCOORD RECORDS.

 ***** MESSAGE - VALUES FROM ASSURFACE, REACH  2 IMPLY NO VEGETAL COVER WITH
           "n" OF 0.013.

 ***** WARNING - DOWNWARD SLOPE FOUND IN INLET CHANNEL OF EXISTING AUX. SPILLWAY
           STARTING AT X =  613., Y = 1358.04; NEXT Y = 1357.77.

1SITES ------------------------------------------------------------------------
XEQ 10/17/2019                Matejcek                  WSID= 1
VER 2005.1.8         Matejcek 2019 Present Day Condition         SUBW= 1
TIME 16:42:27          SITE = 1              PASS=    1     PART=   1
```

********** MATERIAL PROPERTIES **********

MATERIAL	PI	DRY DENSITY lbs/CuFt	Kh	PERCENT CLAY	DETACH. RATE (Ft/H)/(lb/SqFt)	REP. DIAMETER inches
Topsoil	2.	100.	0.05	14.0	--	0.00200
Outwash	0.	92.	0.04	14.0	--	0.07900
Till #1	13.	95.	0.10	20.0	--	0.00400
Lacustrine	0.	100.	0.05	20.0	--	0.02000
Till #2	13.	95.	0.10	20.0	--	0.00400
Rock	0.	121.	2.00	0.0	--	1.37400
TS_FILL	0.	100.	0.05	0.0	--	0.05000
GEN_FILL	2.	100.	0.05	14.0	--	0.00200

********** BASIC Data **********

HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. - Q-PS,1-DAY	Q-PS,10-DAY	Q-SD	Q-FB
0.00	0.00	0.00	0.00

WSDATA - CN	DA-SM	TC/L	-/H	QRF
0.00	121.15	0.00	0.00	0.00

SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
1335.43	1335.43	1309.76	1283.71	NO

BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE
0.00	0.00	0.00	DESIGN

PSDATA - NO. COND	COND L	DIA/W	-/H
1.00	339.17	4.50	4.58

PS N	KE	WEIR L	TW EL
0.013	0.75	36.33	1298.72

2ND STG	ORF H	ORF L	START AUX.
1354.88	1.00	11.00	1361.19

ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
1361.79	0.00	0.00	0.00	0.00

AUX.Data - REF.NO.	RETARD. Ci	TIE STATION	INLET LENGTH
41	0.00	918.06	0

AUX.Data - INLET N	SIDE SLOPE	EXIT N	EXIT SLOPE	ACTUAL AUX?
0.035	3.00	0.035	0.040	YES

BTM WIDTH -	BW1	BW2	BW3	BW4	BW5
ft	375.00	0.00	0.00	0.00	0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

1********** DETAILED LIST OF BASIC Data **********

WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS		DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S	
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00	

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130
0.0110	0.0090	0.0080	0.0070	0.0060
0.0050	0.0040	0.0030	0.0020	0.0010
0.0000				

EXISTING SURFACE OF AUXILIARY SPILLWAY - X,Y COORDINATES:

0.	1336.13
209.	1339.55
463.	1348.40
515.	1352.02
526.	1352.42
575.	1359.73
602.	1359.43
613.	1358.04
661.	1357.77
861.	1361.79
918.	1361.79
990.	1358.90
1114.	1346.93
1360.	1321.24
1479.	1300.00
1600.	1283.71

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000	0.008	0.016	0.025	0.033
0.043	0.052	0.063	0.074	0.086
0.099	0.112	0.126	0.142	0.160
0.180	0.205	0.255	0.345	0.437
0.530	0.603	0.633	0.660	0.684
0.705	0.724	0.742	0.759	0.775
0.790	0.804	0.818	0.831	0.844
0.856	0.868	0.879	0.890	0.900
0.910	0.920	0.930	0.939	0.948
0.957	0.966	0.975	0.983	0.992
1.000				

1SITES ----------
XEQ 10/17/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 16:42:27 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1361.19 FT 7119.8 ACFT 0.00 AC 722.6 CFS

****

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1371.62	784.28	784.28	0.00	10129.47	0.00
12	1385.81	857.22	857.22	0.00	14627.13	0.00
13	1400.00	924.42	924.42	0.00	19125.00	0.00

INFLOW HYDROGRAPH PROVIDED IN LOCATION 3, PEAK= 9617.60 CFS, AT 768.00 HRS.
TITLE = ASH_48H_100Y

INFLOW HYDROGRAPH PROVIDED IN LOCATION 5, PEAK= 35865.60 CFS, AT 762.00 HRS.
TITLE = PMP_HMR52_48H

1SITES ----------
XEQ 10/17/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 16:42:27 SITE = 1 PASS= 1 PART= 3

AUX. CREST 1361.79 FT 7273.5 ACFT 0.00 AC 725.7 CFS

PS STORAGE 5002.9 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1361.19 FT 7119.8 ACFT 0.00 AC 725.1 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.

NRCS-SDH INFLOW HYDROGRAPH INPUT, DA = 121.15 SQUARE MILES

PEAK = 9617.6 CFS, AT 768.0 HRS.

NRCS-FBH INFLOW HYDROGRAPH INPUT, DA = 121.15 SQUARE MILES

PEAK = 35865.6 CFS, AT 762.0 HRS.
AUX. AREAL CORRECTION USED =0.7765

****

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
			TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT			
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
			FULL CONDUIT FLOW, ELEV = 1357.43 FT			
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1358.88	712.48	712.48	0.00	6548.28	0.00
12	1360.34	721.03	721.03	0.00	6901.19	0.00
13	1361.79	729.49	729.49	0.00	7273.47	0.00
14	1363.70	2962.24	740.46	2221.78	7785.63	0.00
15	1365.61	7665.03	751.26	6913.77	8327.56	0.00
16	1369.05	20878.74	770.33	20108.40	9329.28	0.00
17	1373.25	43014.96	793.02	42221.94	10647.32	0.00
18	1380.90	100777.76	832.68	99945.08	13069.39	0.00
19	1390.45	194418.77	879.75	193539.02	16097.20	0.00
20	1400.00	313583.88	924.42	312659.47	19125.00	0.00

****

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX@	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
-----	----	----	----	------ ----------	-------	-----	-------	--------

1	0.	209.	-1.6	0.035	**	**	**	INLET
2	209.	463.	-3.5	0.035	**	**	**	INLET
3	463.	515.	-7.0	0.035	**	**	**	INLET
4	515.	526.	-3.5	0.035	**	**	**	INLET
5	526.	575.	-15.1	0.035	**	**	**	INLET
6	575.	602.	1.1	0.013	**	**	**	INLET
7	602.	613.	12.8	0.035	**	**	**	INLET
8	613.	661.	0.6	0.035	**	**	**	INLET
9	661.	861.	-2.0	0.035	**	**	**	INLET
10	861.	918.	0.0	0.035	**	**	**	CREST
11	918.	990.	4.0	0.035	0.50	1	1.0	EXIT !
12	990.	1114.	9.6	0.035	0.50	1	1.0	EXIT
13	1114.	1360.	10.4	0.035	0.50	1	1.0	EXIT
14	1360.	1479.	17.8	0.035	0.50	1	1.0	EXIT
15	1479.	1600.	13.5	0.035	0.50	1	1.0	EXIT

@ The program interprets retardance curve index entries of less than 1 as
Manning's n values.
+ The minimum maintenance code value of 2 is used in INTEGRITY computations
(the program changes values of 1 to 2 during computation).
* Upper case indicates a reach of constructed spillway channel.
** The program does not use vegetal cover factor, maintenance code, and
rooting depth for inlet and crest reaches in computations.
! Reach 11 used in computing exit channel velocities.
****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	375.0	1366.12	8474.1	0.0	4.33	1200.7

PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.
DISCHARGE =	754.	8844.	9598.

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT 2.57	FT/SEC 9.00	FT/FT 0.013	FT/FT 0.018

AUXILIARY SPILLWAY DURATION FLOW = 97.0 HOURS

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 12.6 FT/SEC
EXIT SLOPE = 0.040 FT/FT
FLOW DEPTH = 1.8 FT

***** WARNING - SOD STRIPPING WILL PROBABLY OCCUR DUE TO GROSSSTRESS LIMIT IN
STABILITY CONTROL REACH WHICH STARTS AT STATION 1360.32.
****

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)
Aux. Spillway Discharge = 8844. cfs; Bottom Width = 375. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2
11	918.	990.	4.01	0.035	12.64	4.61	0.458
12	990.	1114.	9.65	0.035	16.48	8.52	0.846
13	1114.	1360.	10.44	0.035	16.88	9.00	0.894
14	1360.	1479.	17.83	0.035	19.85	13.10	1.301 max.
15	1479.	1600.	13.54	0.035	18.27	10.80	1.073

****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	375.0	1371.90	10217.4	0.0	10.11	2943.9

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	786.	35009.	35795.

AUXILIARY SPILLWAY ---	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
	6.36	13.97	0.010	0.013

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 752.0 hours
and peaked at time = 763.0 hours.)

REACH 11: FROM STATION 918. TO 990. ON 4.0% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 755.0 hours.

REACH 12: FROM STATION 990. TO 1114. ON 9.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 755.0 hours.

REACH 13: FROM STATION 1114. TO 1360. ON 10.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 755.0 hours.

REACH 14: FROM STATION 1360. TO 1479. ON 17.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 755.0 hours.

REACH 15: FROM STATION 1479. TO 1600. ON 13.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 755.0 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The headcut BREACHED the spillway crest at
time equal approximately 757.0 hours.
Computations terminated at that point!

The most upstream headcut began at station 918.
and progressed upstream to station 861.
The final height of the headcut was 13.6 ft.

The headcut having the maximum final overfall height began
at station 1114. and progressed upstream to station 861.
The final height of the headcut was 78.1 ft.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

	DURATION FLOW	ATTACK OE/B	DIST. FROM MOST U/S HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY----	127.0	266.0	>>>BREACH<<<
	Depth = 13.6 ft		

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 21.6 FT/SEC
EXIT SLOPE = 0.040 FT/FT
FLOW DEPTH = 4.2 FT

Inflow Hyd 1 SDH-Peak = 9598.46 CFS at 768.00 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 35794.80 CFS at 762.00 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.
---

1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
2 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
---------- DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/17/2019	16:42:27

>>> SITE SUBWS SUBWS DA CURVE TC TOTAL DA TYPE STRUC <<<

ID	ID	(SQ MI)	NO.	(HRS)	(SQ MI)	DESIGN	CLASS
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	4.5	1361.8	375.0	10.1	1371.9	0.<BREACH>		21.6	NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_48H.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_48H.OUT
DATED 10/17/2019 16:42:27

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_48H.DRG DATED 10/17/2019 16:42:27

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_48H.DHY DATED 10/17/2019 16:42:27

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_48H.DEM DATED 10/17/2019 16:42:27

AUX.GRAPHICS = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_48H.DG* DATED 10/17/2019 16:42:27

Gannett Fleming

SITES MODEL OUTPUT

48-hour SDH / 72-hour FBH

```
********************************************************************************
SITES XEQ 10/17/2019   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
   VER 2005.1.8            (USER MANUAL - DATED DECEMBER 2005)
   TIME 16:41:53
************************** 80-80 LIST OF INPUT Data **************************

SITES    01/01/20051       Matejcek              121.15    C2
SAVMOV   0   101
SAVMOV   101  1                                  1
*       Hydrologic inputs derived from HEC-HMS model of the Forest
*       River watershed provided by Houston Engineering (dated
*       October 4, 2019).
*       Dam geometry and stage-storage information derived from
*       survey of Matejcek Dam completed by Houston Engineering
*       in 2019.
STRUCTURE 1       Matejcek 2019 Present Day Condition
            1293.00                  0.0
            1309.76                  267.8
            1316.00                  549.4
            1324.00                  1093.6
            1332.00                  1870.6
            1335.43                  2270.6
            1336.00                  2340.3
            1340.00                  2881.6
            1344.00                  3500.1
            1348.00                  4205.1
            1352.00                  4991.2
            1354.88                  5608.4
            1356.00                  5860.1
            1360.00                  6815.1
            1361.79                  7273.5
            1364.00                  7865.9
            1368.00                  9012.1
            1370.00                  9616.3
            1380.00                  12785.7
            1400.00                  19125
ENDTABLE
HYD      3            ASH_48H_100Y
HYD      5            PMP_HMR52
WSDATA   2C 1           121.15
PDIRECT                    0.00     0.00
POOLDATA  ELEV     1335.43   1335.43   1309.76         1283.71   TR
PSINLET   ELEV     0.75     36.33     1354.88   1       11
PSDATA   1       339.17   4.5      4.58     0.013     1298.72
ASSURFACE 41       1599.75   .002
      0       574.66   0.035    0.5      3       1
      574.66   602.2    0.013    0       1
      602.2    1599.75  0.035    0.5      1       1
```

```
ENDTABLE
ASDATA   41                  3                  1
BTMWIDTH  FEET    375
ASMATERIAL
      1      2      .002    14      100     0.05
      2      0      0.079   14      92      0.04
      3      13     .004    20      95      .1
      4      0      0.02    20      100     0.05
      5      13     .004    20      95      0.1
      6      0      1.374   0       121     2
ENDTABLE
ASCOORD   1      Topsoil   Y
      0      1336.13   209.2    1339.55   463.14    1348.40
      514.58    1352.02   526.13    1352.42   574.66    1359.73
      602.2     1359.43   613.05    1358.04   661.33    1357.77
      860.77    1361.79   918.06    1361.79   990.05    1358.90
      1114.15   1346.93   1360.32   1321.24   1479.46   1300.00
      1599.75   1283.71
ENDTABLE
ASCOORD   2      Outwash
      0      1333.63   209.2    1337.05   463.14    1345.90
      514.58    1349.52   526.13    1349.92   574.66    1357.23
      602.2     1356.93   613.05    1355.54   661.33    1355.27
      860.77    1359.29   918.06    1359.29   990.05    1356.40
      1114.15   1344.43   1360.32   1318.74   1479.46   1297.50
      1599.75   1281.21
ENDTABLE
ASCOORD   3      Till #1
      0      1326.13   209.2    1329.55   463.14    1338.40
      514.58    1342.02   526.13    1342.48   574.66    1344.38
      602.2     1345.46   613.05    1345.88   661.33    1347.77
      860.77    1351.79   918.06    1351.79   990.05    1348.90
      1114.15   1336.93   1360.32   1311.24   1479.46   1290.00
      1599.75   1273.71
ENDTABLE
ASCOORD   4      Lacustrine
      0      1313.63   209.2    1317.05   463.14    1325.90
      514.58    1329.52   526.13    1329.98   574.66    1331.88
      602.2     1332.96   613.05    1333.38   661.33    1335.27
      860.77    1339.29   918.06    1339.29   990.05    1336.40
      1114.15   1324.43   1360.32   1298.74   1479.46   1277.50
      1599.75   1261.21
ENDTABLE
ASCOORD   5      Till #2
      0      1308.63   209.2    1312.05   463.14    1320.90
      514.58    1324.52   526.13    1324.98   574.66    1326.88
      602.2     1327.96   613.05    1328.38   661.33    1330.27
      860.77    1334.29   918.06    1334.29   990.05    1331.40
```

```
      1114.15   1319.43   1360.32   1293.74   1479.46   1272.50
      1599.75   1256.21
ENDTABLE
ASCOORD    6       Rock
      0       1293.63   209.2     1297.05   463.14    1305.90
      514.58    1309.52   526.13    1309.98   574.66    1311.88
      602.2     1312.96   613.05    1313.38   661.33    1315.27
      860.77    1319.29   918.06    1319.29   990.05    1316.40
      1114.15   1304.43   1360.32   1278.74   1479.46   1257.50
      1599.75   1241.21
ENDTABLE
GRAPHICS  I
GO,DESIGN LCP                              1361.19
SAVMOV    2    101  1              1
ENDJOB

*******************************************************************************

1SITES XEQ 10/17/2019 ---------- COMMENT PAGE ------------------------------
    VER 2005.1.8                Matejcek              WSID = 1

 Hydrologic inputs derived from HEC-HMS model of the Forest
 River watershed provided by Houston Engineering (dated
 October 4, 2019).

 Dam geometry and stage-storage information derived from
 survey of Matejcek Dam completed by Houston Engineering
 in 2019.

 ***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

 ***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  1361.79
           FROM THE ASCOORD RECORDS.

 ***** MESSAGE - VALUES FROM ASSURFACE, REACH  2 IMPLY NO VEGETAL COVER WITH
           "n" OF 0.013.

 ***** WARNING - DOWNWARD SLOPE FOUND IN INLET CHANNEL OF EXISTING AUX. SPILLWAY
           STARTING AT X =  613., Y = 1358.04; NEXT Y = 1357.77.

1SITES ------------------------------------------------------------------------
 XEQ 10/17/2019                Matejcek                  WSID= 1
 VER 2005.1.8         Matejcek 2019 Present Day Condition         SUBW= 1
 TIME 16:41:53          SITE = 1              PASS=    1     PART=   1
```

********** MATERIAL PROPERTIES **********

MATERIAL	PI	DRY DENSITY lbs/CuFt	Kh	PERCENT CLAY	DETACH. RATE (Ft/H)/(lb/SqFt)	REP. DIAMETER inches
Topsoil	2.	100.	0.05	14.0	--	0.00200
Outwash	0.	92.	0.04	14.0	--	0.07900
Till #1	13.	95.	0.10	20.0	--	0.00400
Lacustrine	0.	100.	0.05	20.0	--	0.02000
Till #2	13.	95.	0.10	20.0	--	0.00400
Rock	0.	121.	2.00	0.0	--	1.37400
TS_FILL	0.	100.	0.05	0.0	--	0.05000
GEN_FILL	2.	100.	0.05	14.0	--	0.00200

********** BASIC Data **********

HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

INFLOW HYDROGRAPH(S) ENTERED

PRECIP. - Q-PS,1-DAY	Q-PS,10-DAY	Q-SD	Q-FB
0.00	0.00	0.00	0.00

WSDATA - CN	DA-SM	TC/L	-/H	QRF
0.00	121.15	0.00	0.00	0.00

SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
1335.43	1335.43	1309.76	1283.71	NO

BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE
0.00	0.00	0.00	DESIGN

PSDATA - NO. COND	COND L	DIA/W	-/H
1.00	339.17	4.50	4.58

PS N	KE	WEIR L	TW EL
0.013	0.75	36.33	1298.72

2ND STG	ORF H	ORF L	START AUX.
1354.88	1.00	11.00	1361.19

ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
1361.79	0.00	0.00	0.00	0.00

AUX.Data - REF.NO.	RETARD. Ci	TIE STATION	INLET LENGTH
41	0.00	918.06	0

AUX.Data - INLET N	SIDE SLOPE	EXIT N	EXIT SLOPE	ACTUAL AUX?
0.035	3.00	0.035	0.040	YES

BTM WIDTH -	BW1	BW2	BW3	BW4	BW5
ft	375.00	0.00	0.00	0.00	0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

1********** DETAILED LIST OF BASIC Data **********

WEIR COEF. FOR ORIFICES..... 3.10 RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10 TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60 NO. POINTS FOR DESIGN HYD. ... 5000

HOOD, WEIR INLET COEF. ..... 0.60 DRAWDOWN TIME LIMIT - DAYS.... 10.0
HOOD, PIPE ENTRANCE COEF. ..... 0.60 DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. ..... 0.00 OTHER DRAWDOWN RATIOS APPLY ?. NO

PS ACCURACY OF FULL FLOW CALC.,FT 0.01 WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00 WSP FSS CALC. PRECISION, FT.. 0.005

GRAVITATIONAL CONSTANT..... 32.16 AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545 AUX. SPILLWAY MIN. CAP. EXP. 0.493

MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00 MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00 PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00 OLD TR60 CRITERIA USED ..... NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00 OLD NHCP378 CRITERIA USED .... NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS		DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S	
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00	

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130
0.0110	0.0090	0.0080	0.0070	0.0060
0.0050	0.0040	0.0030	0.0020	0.0010
0.0000				

EXISTING SURFACE OF AUXILIARY SPILLWAY - X,Y COORDINATES:

0.	1336.13
209.	1339.55
463.	1348.40
515.	1352.02
526.	1352.42
575.	1359.73
602.	1359.43
613.	1358.04
661.	1357.77
861.	1361.79
918.	1361.79
990.	1358.90
1114.	1346.93
1360.	1321.24
1479.	1300.00
1600.	1283.71

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000	0.008	0.016	0.025	0.033
0.043	0.052	0.063	0.074	0.086
0.099	0.112	0.126	0.142	0.160
0.180	0.205	0.255	0.345	0.437
0.530	0.603	0.633	0.660	0.684
0.705	0.724	0.742	0.759	0.775
0.790	0.804	0.818	0.831	0.844
0.856	0.868	0.879	0.890	0.900
0.910	0.920	0.930	0.939	0.948
0.957	0.966	0.975	0.983	0.992
1.000				

1SITES ---
XEQ 10/17/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 16:41:53 SITE = 1 PASS= 1 PART= 2

***** MESSAGE - AREAL CORRECTIONS BASED ON DRAINAGE AREA OF 100.0 SQ. MILES.

DESIGN 0.77650 PS-1 DAY 0.93213 PS-10 DAY 0.96607.
MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

CREST PS 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

SED ACCUM 1335.43 FT 2270.6 ACFT 0.00 AC 188.3 CFS

2ND STAGE 1354.88 FT 5608.4 ACFT 0.00 AC 857.2 CFS

START ELEV 1361.19 FT 7119.8 ACFT 0.00 AC 722.6 CFS

****

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
		TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT				
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
		FULL CONDUIT FLOW, ELEV = 1357.43 FT				
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1371.62	784.28	784.28	0.00	10129.47	0.00
12	1385.81	857.22	857.22	0.00	14627.13	0.00
13	1400.00	924.42	924.42	0.00	19125.00	0.00

INFLOW HYDROGRAPH PROVIDED IN LOCATION 3, PEAK= 9617.60 CFS, AT 768.00 HRS.
TITLE = ASH_48H_100Y

INFLOW HYDROGRAPH PROVIDED IN LOCATION 5, PEAK= 36917.90 CFS, AT 54.00 HRS.
TITLE = PMP_HMR52

1SITES ----------
XEQ 10/17/2019 Matejcek WSID= 1
VER 2005.1.8 Matejcek 2019 Present Day Condition SUBW= 1
TIME 16:41:53 SITE = 1 PASS= 1 PART= 3

AUX. CREST 1361.79 FT 7273.5 ACFT 0.00 AC 725.7 CFS

PS STORAGE 5002.9 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 1361.19 FT 7119.8 ACFT 0.00 AC 725.1 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.

NRCS-SDH INFLOW HYDROGRAPH INPUT, DA = 121.15 SQUARE MILES

PEAK = 9617.6 CFS, AT 768.0 HRS.

NRCS-FBH INFLOW HYDROGRAPH INPUT, DA = 121.15 SQUARE MILES

PEAK = 36917.9 CFS, AT 54.0 HRS.
AUX. AREAL CORRECTION USED =0.7765

****

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1335.43	0.00	0.00	0.00	2270.60	0.00
2	1335.62	2.91	2.91	0.00	2294.32	0.00
3	1335.82	8.24	8.24	0.00	2318.04	0.00
			TRANSITION TO ORIFICE FLOW, ELEV = 1336.01 FT			
4	1336.01	15.14	15.14	0.00	2341.92	0.00
5	1342.30	133.61	133.61	0.00	3237.45	0.00
6	1348.59	188.34	188.34	0.00	4321.19	0.00
7	1354.88	230.42	230.42	0.00	5608.40	0.00
8	1355.73	323.73	323.73	0.00	5799.34	0.00
9	1356.58	489.99	489.99	0.00	5998.39	0.00
			FULL CONDUIT FLOW, ELEV = 1357.43 FT			
10	1357.43	703.72	703.72	0.00	6201.23	0.00
11	1358.88	712.48	712.48	0.00	6548.28	0.00
12	1360.34	721.03	721.03	0.00	6901.19	0.00
13	1361.79	729.49	729.49	0.00	7273.47	0.00
14	1363.70	2962.24	740.46	2221.78	7785.63	0.00
15	1365.61	7665.03	751.26	6913.77	8327.56	0.00
16	1369.05	20878.74	770.33	20108.40	9329.28	0.00
17	1373.25	43014.96	793.02	42221.94	10647.32	0.00
18	1380.90	100777.76	832.68	99945.08	13069.39	0.00
19	1390.45	194418.77	879.75	193539.02	16097.20	0.00
20	1400.00	313583.88	924.42	312659.47	19125.00	0.00

****

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX@	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	0.	209.	-1.6	0.035	**	**	**	INLET

2	209.	463.	-3.5	0.035	**	**	**	INLET
3	463.	515.	-7.0	0.035	**	**	**	INLET
4	515.	526.	-3.5	0.035	**	**	**	INLET
5	526.	575.	-15.1	0.035	**	**	**	INLET
6	575.	602.	1.1	0.013	**	**	**	INLET
7	602.	613.	12.8	0.035	**	**	**	INLET
8	613.	661.	0.6	0.035	**	**	**	INLET
9	661.	861.	-2.0	0.035	**	**	**	INLET
10	861.	918.	0.0	0.035	**	**	**	CREST
11	918.	990.	4.0	0.035	0.50	1	1.0	EXIT !
12	990.	1114.	9.6	0.035	0.50	1	1.0	EXIT
13	1114.	1360.	10.4	0.035	0.50	1	1.0	EXIT
14	1360.	1479.	17.8	0.035	0.50	1	1.0	EXIT
15	1479.	1600.	13.5	0.035	0.50	1	1.0	EXIT

@ The program interprets retardance curve index entries of less than 1 as
Manning's n values.
+ The minimum maintenance code value of 2 is used in INTEGRITY computations
(the program changes values of 1 to 2 during computation).
* Upper case indicates a reach of constructed spillway channel.
** The program does not use vegetal cover factor, maintenance code, and
rooting depth for inlet and crest reaches in computations.
! Reach 11 used in computing exit channel velocities.
****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	375.0	1366.12	8474.1	0.0	4.33	1200.7

	PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.
DISCHARGE =		754.	8844.	9598.

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT 2.57	FT/SEC 9.00	FT/FT 0.013	FT/FT 0.018

AUXILIARY SPILLWAY DURATION FLOW = 97.0 HOURS

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 12.6 FT/SEC
EXIT SLOPE = 0.040 FT/FT
FLOW DEPTH = 1.8 FT

***** WARNING - SOD STRIPPING WILL PROBABLY OCCUR DUE TO GROSSSTRESS LIMIT IN
STABILITY CONTROL REACH WHICH STARTS AT STATION 1360.32.
****

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL

(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)
Aux. Spillway Discharge = 8844. cfs; Bottom Width = 375. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	TOTAL VELOCITY ft/s	EFFECTIVE STRESS lb/ft^2	STRESS lb/ft^2	
11	918.	990.	4.01	0.035	12.64	4.61	0.458	
12	990.	1114.	9.65	0.035	16.48	8.52	0.846	
13	1114.	1360.	10.44	0.035	16.88	9.00	0.894	
14	1360.	1479.	17.83	0.035	19.85	13.10	1.301	max.
15	1479.	1600.	13.54	0.035	18.27	10.80	1.073	

****

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	375.0	1372.09	10279.0	0.0	10.30	3005.6

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	787.	36043.	36829.

AUXILIARY SPILLWAY ---	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
	6.48	14.10	0.010	0.013

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 41.0 hours
and peaked at time = 55.0 hours.)

REACH 11: FROM STATION 918. TO 990. ON 4.0% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 45.0 hours.

REACH 12: FROM STATION 990. TO 1114. ON 9.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 44.0 hours.

REACH 13: FROM STATION 1114. TO 1360. ON 10.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 44.0 hours.

REACH 14: FROM STATION 1360. TO 1479. ON 17.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 44.0 hours.

REACH 15: FROM STATION 1479. TO 1600. ON 13.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 44.0 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The headcut BREACHED the spillway crest at
time equal approximately 47.0 hours.
Computations terminated at that point!

The most upstream headcut began at station 918.
and progressed upstream to station 861.
The final height of the headcut was 12.2 ft.

The headcut having the maximum final overfall height began
at station 1114. and progressed upstream to station 861.
The final height of the headcut was 78.1 ft.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

	DURATION FLOW	ATTACK OE/B	DIST. FROM MOST U/S HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY----	132.0	288.5	>>>BREACH<<<
	Depth = 12.2 ft		

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 21.8 FT/SEC
EXIT SLOPE = 0.040 FT/FT
FLOW DEPTH = 4.3 FT

Inflow Hyd 1 SDH-Peak = 9598.46 CFS at 768.00 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 36829.40 CFS at 54.00 hrs., Location Point

HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.

---

1 Matejcek

0 SUBWATERSHED(S) ANALYZED.
1 STRUCTURE(S) ANALYZED.
2 HYDROGRAPHS ROUTED AT LOWEST SITE.
0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

****

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8
---------- DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
1	10/17/2019	16:41:53

>>> SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS <<<
1	1	121.15	0.	0.00	121.15	TR60	C

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	4.5	1361.8	375.0	10.3	1372.1	0.<BREACH>	21.8		NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_72H.D2C
OUTPUT = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_72H.OUT
DATED 10/17/2019 16:41:53

GRAPHICS FILES GENERATED

OPTION "L" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_72H.DRG DATED 10/17/2019 16:41:53

OPTION "P" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_72H.DHY DATED 10/17/2019 16:41:53

OPTION "E" = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_72H.DEM DATED 10/17/2019 16:41:53

AUX.GRAPHICS = C:\Users\grichards\Desktop\Matejcek SITES\Matejcek\SDH_FBH_72H.DG* DATED 10/17/2019 16:41:53

APPENDIX E

Geotechnical Analysis Report

DRAFT

GEOTECHNICAL ENGINEERING REPORT

Forest River Dam No. 1 (Matejcek Dam)
Walsh County, North Dakota

National Inventory of Dams ID: ND00043

Prepared For
HOUSTON ENGINEERING, INC.
Fargo, North Dakota

Houston Project No. R007135-0033

Owner
WALSH COUNTY WATER RESOURCE DISTRICT
Grafton, North Dakota

Prepared By

Gannett Fleming

Excellence Delivered As Promised

GF Project No. 064799

Greenwood Village, Colorado
October 16, 2019

GEOTECHNICAL ENGINEERING REPORT
FOREST RIVER DAM NO. 1 (Matejcek Dam)
WALSH COUNTY, NORTH DAKOTA

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Gannett Fleming

GEOTECHNICAL ENGINEERING REPORT
FOREST RIVER DAM NO. 1 (Matejcek Dam)
WALSH COUNTY, NORTH DAKOTA

1 INTRODUCTION

This geotechnical engineering report (GER) summarizes data collected as part of the preliminary geologic investigation for Forest River Dam No. 1, hereinafter referred to as Matejcek Dam. The investigation was performed by Gannett Fleming, Inc (GF) as part of a subconsultant services agreement with Houston Engineering, Inc. and conducted pursuant to the Natural Resource and Conservation Service (NRCS) Statement of Work for its Cooperative Agreement 67-63633-18-XXX with the Walsh County Water Resource District (WCWRD). The purpose of the Statement of Work is to develop a Supplemental Watershed Plan-Environmental Assessment (EA) of the Environmental Impact Statement (EIS) for Matejcek Dam. The purpose of the preliminary geologic investigation was to develop profiles and geotechnical data for evaluation of the spillway integrity and for characterization of the embankment and foundation soils.

2 PROJECT DESCRIPTION AND LOCATION

Matejcek Dam is located in Sections 23 and 24 of Township 155N, Range 57W (Exhibit 1). County Road 14 runs approximately north-south on the crest of the dam and provides access to the project. Matejcek Dam is an earth embankment approximately 86.6 feet high[1] and 1,175 feet long. The embankment was constructed from August 7, 1964 to August 19, 1966 to provide flood control and recreation. The Matejcek Dam watershed is approximately 155 square miles. The storage capacity of the reservoir at various pool levels is indicated in Table 1.

Table 1. Reservoir Storage Capacity

Pool Level	Elevation (ft)	Volume (acre-ft)	Surface Area (acres)
Normal Pool	1334.8	2746	135
Spillway Crest	1360.8	7725	253
Maximum Pool	1366.0	9000	282

Below Matejcek Dam, the Middle South Branch of the Forest River flows eastward and joins the Forest River just west of Fordville. The Forest River flows generally eastward and northward to its confluence with the Red River, which forms the border between North Dakota and Minnesota. The Red River flows northward into Canada and Lake Winnipeg, which is drained by the Nelson River into Hudson Bay.

3 GENERAL CONDITIONS

This section of the GER discusses physiography, soils, bedrock, seismicity, and general geological conditions based on published reports and mapping.

[1] The height of the dam is based on the original As-Built Drawings (using El. 1366.0 for dam top and El. 1279.45 feet for downstream channel bottom) and the associated definition provided for dam height in the Seismic Failure Index sheet, line G (Gannett Fleming, 2010, p. 14).

3.1 Physiography

The project is situated within the Glaciated Plains section of the Central Lowland physiographic province (Anderson, 2018). The Glaciated Plains are described as a "rolling, glaciated landscape; more than 80 percent of the area is gently sloping with local relief generally less than 100 feet in most places, but ranging up to 300 feet in some places" (Waldkirch, 1999).

Just east of the project lies the eastward-facing Pembina escarpment, which separates the Glaciated Plains from the topographically lower and flatter Red River Valley section of the Central Lowland province. The Red River Valley section is described as a "flat plain resulting from sedimentation on the floor of glacial Lake Agassiz; more than 95 percent of the area is gently sloping with local relief less than 25 feet in most places" (Waldkirch, 1999).

Approximately 1 mile southeast of the dam lies the northern terminus of the Dahlen esker, a spectacular ridge of glacial origin, which is considered to be one of the best examples of its kind in North America (Manz, 2016; Kume, 1967). The Dahlen esker is about 4 miles long, 400 feet wide, and as high as 50 to 80 feet (Bluemle, 2007).

3.2 Soils

Published soils mapping by the NRCS and surficial materials mapping by the North Dakota Geological Survey (NDGS) are summarized in this section.

3.2.1 NRCS Soils Mapping

Soils information was obtained from the USDA online Web Soil Survey (2018). A soil map is provided on page 9 of the NRCS custom soil resource report, which is provided in Appendix A of this report. Four soil map units are mapped in the vicinity of the dam and spillway area (USDA, 2018):

F641F	Udarents loamy, earthen dam, 1 to 75 percent slopes
F592F	Kloten-Walsh-Edgeley loams, 6 to 35 percent slopes
F315A	Vang-Brantford loams, 0 to 2 percent slopes
F563A	Fluvaquents, channeled-Fairdale complex, 0 to 2 percent slopes, frequently flooded

The dam embankment is mapped as F641F soils, which have a typical profile including loam, sandy clay loam, clay loam, and gravelly loam to a depth of 60 inches. Under USCS, they are classified as clay (CL) and clayey sand (SC).

Downstream of the dam, the channel of the Middle South Branch of the Fork River is mapped as F563A soils, which are hydric soils. These alluvial soils have a typical profile consisting of fine sandy loam and stratified loamy sand to silt loam to a depth of 79 inches. Under USCS, they are classified as silty sand (SM) and clayey sand (SC).

F592F soils are mapped on both sides of the stream channel downstream of the dam and both sides of the reservoir upstream of the dam. These soils are derived from residuum weathered from shale and have a typical profile consisting of loam and parachannery clay loam to 14 inches overlying bedrock. Under USCS, they are classified as silt (ML) and clay (CL).

The curved portion of the auxiliary spillway (ASW) west of the dam is mapped as F315A soils. These soils are derived from shaly glaciofluvial deposits and have a typical profile consisting of loam, clay loam, and gravelly loamy coarse sand to a depth of 60 inches. Under USCS, the loams are classified as clay, and the sand is classified as well graded (SW) and poorly graded (SP), sometimes with silt and gravel (SW-SM and SP-SM).

3.2.2 NDGS Surficial Deposits Mapping

In the inch per two mile scale geologic map of Walsh County (Bluemle, 1973), two types of natural surface materials are mapped in the dam and reservoir area: 1) Quaternary glacial sediment, designated the till facies of the Pleistocene Coleharbor Formation, and 2) alluvium, designated the sand and silt facies of the Holocene Walsh Formation. The till typically consists of "a non-sorted, non-stratified mixture of angular, subangular and rounded blocks of rock, gravel and sand in a stiff matrix of silt and clay," while the younger alluvial sand and silt facies consists of oxidized "dark brown, gray or black silty clay, clayey silt, or sandy silt" having "vague horizontal bedding" and containing shells, wood, and bones (Bluemle, 1973).

More recent 1:24,000 scale mapping of the Dahlen quadrangle (Manz and Harris, 2017) is presented in Exhibit 2. The Holocene alluvium is mapped as alluvium and overbank sediment (map unit Hor) of the Oahe Formation and described as follows:

> *"Sand, silt, clay and disseminated organic debris; obscurely bedded; dark colored; in many places associated with sand and gravel of older river-channel sediment; commonly more than three feet (1 meter) thick."*

The upper part of the auxiliary spillway is mapped shaley sand and gravel sediment (map unit Qgrf) of the Goose River Formation of the Coleharbor Group and described as follows:

> *"Moderately well-sorted, light to dark grayish brown, low-angle flat-bedded to high-angle cross-bedded silt, sand, and gravel deposited as outwash by the ancestral Park River and other meltwater streams flowing off the Pembina Escarpment onto the Elk Valley delta; flat to gently undulating surface commonly with braided channel scars, oxbows, and other relict markings; up to 70 feet (21 meters) thick."*

3.3 Bedrock

Bedrock in the vicinity the dam and spillway is mapped as the Cretaceous age Pierre Formation of the Zuni sequence Bluemle (1973). According to Bluemle (2016), the Pierre Formation is 70 to 84 million years old and consists of gray marine shale. Pederson and Reid (1969) describe the Pierre Formation as follows:

> *"In eastern North Dakota, the Pierre [Formation] consists of about 200 feet of light to dark gray to brownish-black shale, marlstone, and claystone. Common yellowish to whitish bentonite (clay) beds occur in the lower part of the formation, a product of the alteration of volcanic ash. Manganiferous ironstone and clayey limestone concretions are also common in parts of the formation."*

The lower two members of the Pierre Formation (in ascending order, the Pembina Member and the Gregory Member) contain bentonitic clays (Bluemle, 1973). The Pierre Formation locally contains flattened, clayey limestone concretions and abundant fossil remains and internal molds of the clam *Inoceramus* and other smaller bivalves (Pederson and Reid, 1969; Laird, 1951).

Bluemle (2016) reports that the Pierre shale is soft, easily erodible, and produces landscapes of low relief mantled by soils of low fertility:

> *"As it is quite soft and erodes easily, the landforms on the Pierre shale surface tend to have low relief and gentle slopes. In places where the Pierre shale covers extensive areas, the land is rolling and may have a scrubby, sometimes desolate character. The soils that develop on the Pierre surface tend to be poor, resulting in marginal farmland."*

The Pierre Formation unconformably underlies glacial drift and conformably overlies the Niobrara Formation, the upper portion of which consists of light gray to medium light gray, calcareous shale containing abundant white specks (Carlson, 1964).

More recent 1:24,000 scale mapping of the Dahlen quadrangle (Manz and Harris, 2017) is presented in Exhibit 2. In this mapping the valley walls at the dam site are mapped as Upper Cretaceous undifferentiated Pierre and Niobrara Formation and described as "shale; commonly obscured by a thin veneer of till; offshore marine deposits."

Bluemle (1973) describes the regional bedrock structure as follows: Walsh County is

> *"situated on the eastern edge of the Williston basin, an intracratonic, structural basin consisting of a thick sequence of sedimentary rocks. All the formations below the Coleharbor have a westerly regional dip and become thicker westward."*

3.4 Seismicity

According to published mapping of earthquakes in North Dakota (Anderson, 2010), the closest earthquake to Matejcek Dam occurred on November 5, 2008 near Goodrich, which is about 110 miles southwest of the dam. The 2008 Goodrich earthquake had a reported Modified Mercalli Earthquake Intensity value of II, which means the earthquake would have been felt only by a few persons at rest, especially on the upper floors of buildings.[2] The Precambrian basement of eastern North Dakota is part of the Superior Craton, which is an extremely old and deformed but

[2] https://earthquake.usgs.gov/learn/topics/mercalli.php

geologically stable region (Bluemle, 2018). The North Dakota Geological Survey (Bluemle, 2018) considers the state to be in an area of low earthquake probability:

> *"North Dakota is located in an area of low earthquake probability. Infrequent, small earthquakes may occur near or within the state, but it is unlikely they will cause any serious damage."*

4 PREVIOUS STUDIES AND CONSTRUCTION RECORDS

This section of the GER discusses project conditions based on the previous field investigation, laboratory testing, the As-Built Drawings, the USACE Phase I inspection reports, and Gannett Fleming's 2010 Dam Assessment Report.

4.1 Previous Subsurface Exploration

The As-Built Drawings (Appendix B) provide graphic logs of soils borings completed during the previous field investigation. The logs are arranged in three boxes labeled North Abutment (10 test holes), Foundation (5 test holes), and Borrow North Abutment (40 test holes). The sheet also provides a profile along the centerline of the dam with graphic logs of ten test pits and two test holes projected from distances ranging from 100 feet upstream to 95 feet downstream of the centerline. The As-Built Drawings provide no written logs of the test pits and test holes, but the Topographic Map of Dam Site (Sheet 4) appears to show many of the test pit and test hole locations.

The client-furnished USACE Phase I Inspection Report provides a summary of foundation, embankment, and structural engineering data and the logs of nine test pits and two test holes, which are thought to be some of the ones shown in the centerline profile in the As-Built Drawings. A backhoe was used to excavate "Hole" Nos. 1, 3, 4, 5, 6, 7, 8, 9, and 10, while a Concore A-5 rig with flight augers was used to excavate Hole Nos. 2 and 11. The eleven test excavations were performed between centerline Stations 13+00 and 24+00 and at varying distances from the centerline: 100 feet upstream (Holes 5, 7, and 9), 90 feet upstream (Hole 6), 15 feet upstream (Holes 3, 8, 9, and 10), 20 feet downstream (Hole 1), 70 feet downstream (Hole 4), and 95 feet downstream (Hole 2). Pertinent information from the Phase I report and the As-Built Drawings are summarized below.

4.1.1 Embankment Foundation

The Phase I report describes the embankment foundation as follows:

> *"The valley material consisted of shaley alluvium of low density clay and silt which contained shale fragments and organic material. It classified as CL, MH and ML and was up to 7 feet thick. This overlies weathered or very hard Pierre shale bedrock or stiff glacial drift. Glacial drift and colluvium of silt, sand and clay mantles the left abutment from 10 to 25 feet. Weathered and jointed Pierre shale was encountered at shallow depths in the right abutment. Groundwater was encountered at shallow depths in the valley and in sand lenses in the abutments."*

4.1.2 Borrow and Spillway Area

The Phase I report describes the borrow and spillway areas as follows:

> *"The material encountered was glacial drift of intermixed silt, sand and clay, shaley gravel with cobbles, and some Pierre shale. The most predominant material was the drift."*

4.2 Previous Laboratory Testing

4.2.1 Foundation Materials

The Phase I report indicates two samples of alluvium were subjected to undisturbed testing including consolidated-undrained triaxial "R", consolidation, and permeability tests. The stiff glacial drift and shale bedrock were considered non-yielding and strength tests were not run on those materials. Sampling and testing were presumably conducted per NRCS guidelines for the time period of the investigation. Results of the testing of the alluvial samples are summarized in Table 2.

Table 2. Lab Test Results for Two Samples of Alluvium

Sample	USCS	LL	PI	Undisturbed Dry Density (lbs/ft^3)	Depth (ft)	"R" Shear Strength		Consoli-dation[1] (%)	Permea-bility[2] (ft/day)
						ϕ (°)	Cohesion (tons/ft^2)		
64W2281	MH	65	24	62.4	5 – 6.5	22	250	16	-
64W2283	ML	43	25	78.0	6.5 – 8	25	0.0	-	0.002

Notes:
1. Under 76-foot embankment
2. After consolidation due to embankment load.

4.2.2 Embankment Materials

The Phase I report indicates the embankment materials ranged from sands and gravels to high plasticity silts (MH) and the embankment was constructed of mostly glacial drift and shaley gravel in three zones as listed in Table 3.

Table 3. Embankment Construction Materials

Zone	Location	Material
I	Central impervious core	Mostly glacial drift (ML, SC, and CL material)
II	Upstream section	Impervious, pervious, and shaley gravel
III	Downstream section	Shaley gravel (GC)

Notes in the Maximum Cross Section of Dam (Station 17+50) in the As-Built Drawings indicate Zone II is "generally excavation from spillway" and Zone III is "excavation from spillway."

The Phase I report indicates triaxial "R" shear strength tests were performed on representative samples and provides the results listed in Table 4.

Table 4. Lab Test Results for Embankment Materials

Sample	Classification	LL	PI	Maximum Dry Density[1] (lbs/ft³)	"R" Shear Strength			
					Φ (°)		Cohesion (tons/ft²)	
					95%[2]	100%[2]	95%[2]	100%[2]
66W1843	Shaley Gravel (GC)	46	21	100 to 103	32.5	-	1000	-
66W2287	Drift (SC)	38	14	103.5	18.0	19.0	425	1000
66W2288	Drift (ML)	43	3	81.0	25	-	575	-
Notes: 1) Standard Proctor Method; 2) Percent of maximum dry density								

According to the Phase I report, construction compaction specifications stated that all embankment materials shall be compacted to 100 percent of Standard Proctor maximum density with moistures at optimum to 4 percent above. The Phase I report indicates 263 field density tests were performed during construction, and results varied from 99.7 to 109 percent of maximum standard proctor, with a predominant range of 100 to 103 percent. As-Built Drawings indicate an allowance for settlement of 2.5 feet within the area of maximum embankment height.

4.3 Foundation Treatment

The Phase I report describes the foundation treatment as follows:

> *"The entire foundation below the embankment was stripped 1 foot. Within the valley the low density shaley alluvium was excavated to either drift or bedrock below the Zone I embankment. Below the outer slopes all alluvium of less than 80 pcf density was removed. A core trench cutoff, 20 feet wide, was excavated to stiff drift or firm bedrock below the entire length of the embankment. This is shown* [in the As-Built Drawings]. *The excavated material was incorporated into the embankment or dumped downstream. The excavated area was backfilled with embankment material."*

In cut areas of the ASW, the As-Built Drawings indicate the Contractor was required to over-excavate 0.5 feet where glacial drift is exposed and 1.0 feet where shale is exposed and then backfill with select material. The As-Built Drawings indicate no foundation treatment in the fill area of the ASW. As shown in the topographic map in the As-Built Drawings, most of the ASW is in cut except from approximately Station 15+50 to 19+90 (ASW centerline) where some of the left side and most of the right side of the ASW is in fill. The fill is retained by a 4-foot-high dike having a top width of 10 feet and 3:1 side slopes.

4.4 Drains

The project features four constructed drains—a foundation drain, a south outlet drain, an auxiliary drain, and an upstream ASW sod drain. The Phase I report describes the foundation drain as "a filter drain … set on shale beneath the downstream slope and abutment sections." According to

the As-Built Drawings, the foundation drain was constructed of 53 cubic yards of pit-run sand-gravel, 50 linear feet of six-inch-diameter asbestos cement perforated pipe, and 25 linear feet of 6-inch-diameter asbestos cement non-perforated pipe. The perforated pipe extends through the valley section of the drain, and the non-perforated pipes transfer the seepage to outlets on both sides of the stilling basin.

During construction, apparently due to seepage noted in the south abutment downstream of the dam, the As-Built Drawings suggest the south outlet drain was added to the project drainage system. The south outlet drain is located on the right (south) side of the primary outlet just downstream of the foundation drain and appears to be constructed of 30 feet of 6" diameter perforated pipe running parallel to the primary outlet. A-20-foot-long section of 6-inch diameter non-perforated pipe connects the south outlet drain to the Principal Spillway (PSW) outlet channel.

The Phase I Inspection Report indicates the added south outlet drain was inadequate and some sliding occurred in the right abutment and embankment post-construction:

> *"After construction, seepage developed near the intersection of the toe and the south abutment. The area was very wet and boggy with some sliding of the abutment and embankment. The original and modified drainage system had not been extensive enough to intercept the entire seep area. The SCS installed 13 cased test wells to monitor the water levels.*[3] *An investigation revealed that the area south of the dam is sandy which contributed water to the area. It was also determined that water was coming out at or near a bentonite seam in the bedrock shale. William Clairmont, Incorporated* [the construction contractor] *was given a notice to proceed on the installation of an auxiliary drain on 23 September 1969."*

The As-Built Drawings provide a plan and profile of the auxiliary drain. The auxiliary drain was constructed of 498 linear feet of 8-inch perforated asbestos cement pipe. Note 3 of the plan drawing states, "the drain material shall be a poorly graded gravel with all the material being retained on the #4 sieve and maximum size not to exceed 3"." Note 4 requires the drain material to extend at least 3 feet below the bentonite layer and indicates the exact depths will be determined by the Engineer in the field. The profile drawing indicates the bottom of the drain descends from approximately Elevation 1298 feet at its upstream end to 1287 feet at its downstream end.

The As-Built Drawings shows a fourth drain, labeled the "sod drain," was constructed within the spillway upstream of County Road 14. The drain is located 25 feet from the base of the spillway cut slope. The sod drain's upper end is located at the western end of a concrete masonry pipe beneath County Road 14. The sod drain was supposed to outlet to a metal flume at its downstream end; however, a handwritten note on the flume outlet detail indicates the flume outlet for the sod drain was deleted from the contract.

[3] Gannett Fleming's 2010 Dam Assessment Report indicates the wells existed in 1979 but were not found during the 2010 inspection. If the wells can be located and access is practicable, Gannett Fleming will obtain water levels from these wells during the proposed investigation.

4.5 Previous Repairs and Inspection Observations

The Phase I Report indicates other repairs completed in addition to the installation of the auxiliary drain, include:

"1) Replacement of the ruptured polyvinyl (PVC) water stops in the conduit with copper water stops. This problem occurred during construction;
2) Repair of the channel erosion downstream of the stilling basin;
3) Repair of the erosion along the spillway and embankment slopes and waterways."

Periodic dam inspections provide additional observations on the condition of the dam and its appurtenances. Gannett Fleming's 2010 Dam Assessment Report identified several potential dam safety deficiencies. Pertinent findings of previous inspections and the 2010 assessment are summarized below.

4.5.1 Embankment Deformation and Right Abutment Sliding

Sliding of the downstream embankment and right abutment is mentioned in the Phase I report: "The area was very wet and boggy with some sliding of the abutment and embankment."

The September 1987 inspection report noted "a very minor dip on the crest of the embankment at about the location where the conduit crosses the embankment" and "a minor rise in the crest of the embankment" just to the north of the minor dip. The report notes that the crest of the embankment was resurfaced with a coat of asphalt pavement.

The August 1991 inspection report suggests the auxiliary drain had stabilized the right abutment slide areas:

> *"The two or three previously mentioned slide areas are located about half ways up on the right bank of the Middle branch of Forest River and about 200 to 300 feet downstream from the main embankment. An auxiliary drain was installed on the right abutment to pick up the excess moisture from this area and a good flow was released at the end of the drain. These appear to be stabilized now."*

The May 27, 2008 inspection report states, "a shallow slip was identified on the downstream slope," and notes, "the slip only involved the topsoil layer as there was no evidence of tension cracks on the surface." The location of the shallow surface slip is indicated in an aerial photograph attached to the inspection report, which is provided here in Exhibit 3.

Gannett Fleming's 2010 Dam Assessment Report states that "the downstream slope appears to be irregular."

4.5.2 Seepage

The September 1987 inspection report noted "several small patches of coarse grass growing on the south downstream groin area from the berm and on the groin a ways." The moist area was above the normal reservoir elevation, so not thought to be pool-related, and the report states, "it is believed that the south abutment drain picks the excess water up a little further downstream."

The September 1987 inspection report also noted "on the west edge of the entrance to the emergency spillway, water was flowing toward the reservoir in a ditch along the west or outer edge." The report states, "this was definitely above the normal pool elevation and was not pool related but the seepage apparently follows along a soil seam from the land to the west and empties into the ditch." The August 1991 also commented on the ASW seepage area:

> *"A line of cattails was growing along the left outer edge of the emergency spillway (along the west and north edge) and on the upstream side of the crest. The seepage appears to be coming from the higher ground to the west. It is believed that the moisture infiltrates the soil, goes down to a layer of more impermeable type soil and exits at the outer edge of the emergency spillway. This seepage is definitely not pool related since it exits above the normal pool elevation."*

The reported seepage location appears to coincide with the location of the upstream ASW sod drain outlet, so the seepage may include water collected by the sod drain.

Gannett Fleming's 2010 Dam Assessment Report states, "Seepage observed within downstream toe area."

4.5.3 Drains

The October 1983 inspection report observed that "the concrete liner on the inside of the right foundation drain is cracked and broken at least near the outlet end" and that "the left foundation drain was almost buried under riprap and it appears to be bent downward." Regarding the auxiliary drain, the 1983 inspection report states:

"No asbestos cement pipe was observed at the outlet end. It is possible that a short section of a metal conduit with an animal screen was added to the end of the conduit which disturbed the flow and changed the end slope of the flowing water. The metal conduit appeared to have about a ten-inch diameter. The rate of flow could not be calculated with any certainty."

Flows from the drain system observed during dam inspections are summarized in Table 5.

Table 5. Drain Flows Per USACE Dam Inspection Reports

Date	Foundation Drain Flow (gpm)		South Auxiliary Drain (gpm)
	Left	Right	
07-19-1978	2	3 to 5	10 to 15
10-19-1983	1.5 to 2.5 (est.)	1 to 1.5 (est.)	1" to 1.25" (flow not calculated)
09-29-1987	Flowing (not measured)	1.28	14.06
08-20-1991	Unreported	Unreported	Unreported
07-08-1995	2.25 (est.)	1.5	8.6

Gannett Fleming's 2010 Dam Assessment Report noted that single broadly graded coarse aggregate was used in the drains, and the large maximum particle size (3 inches) will encourage segregation of the material.

4.5.4 Erosion

According to the Phase I Report, repairs were made due to channel erosion downstream of the stilling basin and erosion along the spillway and embankment slopes and waterways.

4.5.5 Principal Spillway (PSW)

Ruptured polyvinyl chloride (PVC) waterstops in the PSW conduit were replaced with copper waterstops from February 1 to February 27, 1967 per the As-Built Drawings. No filter diaphragm was constructed, although "concrete anti-seep collars" are shown in the As-Built Drawings.

4.5.6 Low-Level Outlet of PSW

The Phase I report (p. 4) indicates the gate hoist to the low-level pipe is inoperative and the gate can only be operated manually by jacks. The September 1987 inspection report notes that the slide gate of the low-level outlet might be "hard to operate" due to minor bends in the thrust pipe and screw. The low-level drawdown gate is reported to be inoperable (Gannett Fleming, 2010).

4.5.7 Hydrologic Capability

The Phase I Report (PDF p. 6) states, "the embankment at the design crest elevation can contain an event equal to between 50 and 55 percent of the Probable Maximum Flood without overtopping," which is less than desirable for a high hazard structure. The Phase I report (PDF p. 6) states, "the hydrologic capacity could be improved by raising the embankment height, increasing the spillway capacity or a combination of these measures." Gannett Fleming's 2010 Dam Assessment Report (p. 15) states, "based upon the results of the ASW integrity analyses, it appears likely that the ASW crest would breach during passage of a FBH" (freeboard design hydrograph).

4.5.8 Hydraulic Capacity

Gannett Fleming's 2010 Dam Assessment Report (p 16) states, "assuming the dam must satisfy high-hazard design criteria, current deficiencies include overtopping of the dam during passage of

the FBH and flow passing through the ASW during flood events more frequent than permitted by the design criteria."

5 2019 PRELIMINARY GEOLOGIC INVESTIGATION

5.1 General

GF drilled six borings in February 12-16, 2019 to develop profiles and geotechnical data for evaluation of the spillway integrity and for characterization of the embankment and foundation soils. The locations of the six test borings are shown in Exhibit 4, and boring logs and core box photos are provided in Appendix C.

Borings 1, 2, and 3 were drilled in the ASW to develop a geologic profile for use in evaluating the spillway integrity. Borings 4 and 5 were drilled within the dam embankment footprint to characterize embankment and foundation soils. Boring 4 is located on the downstream side of the dam crest, between the edge of the northbound roadway and the cable guide rail, and Borings 5 and 6 on the downstream slope bench. Boring 5 was located directly downstream of Boring 4 in order to provide an embankment section. Boring 6 was drilled near the embankment's junction with the right (south) abutment and upstream of the upstream end of the auxiliary drain in to obtain samples of right abutment materials and to monitor the water level upstream of the auxiliary drain.

Interstate Drilling Services LLP (IDS) of Grand Forks, ND drilled the test borings. IDS is certified as a Monitoring Well Contractor (#427) and a Water Well Contractor (#201) in North Dakota.

5.2 Standard Penetration Testing

Hollow stem augers (3.25-inch ID) were used for drilling, and continuous SPT soil samples were collected using s 2.5-foot-long sampler (2-inch OD). Blow counts from the Standard Penetration Testing (SPT) performed during drilling provide an indication of the relative density of granular soils and the relatively consistency of fine-grained cohesive soils. SPT results are typically expressed as an "N-value," which represents the number of blows required to advance the 2-inch-OD sampler two consecutive 6-inch increments using a 140-pound hammer falling 30 inches or an equivalent autohammer. Table 6 lists the range and average N values based on the SPT results. The N values do not factor in cases where refusal occurred. Refusal occurs when the application of 50 hammer blows does not advance the sampler 6 inches, which indicates dense or hard material impenetrable by the SPT method. The number of refusals and percentage of tests refusing are also listed in Table 6.

The lowest average N-values occur in the foundation soils in Boring GF-5 where the average N-value was 13 in the till and 14 in the clay/shale of the Pierre Formation. The embankment material is very stiff to hard with average N-values ranging from 22 to 31. Higher average N-values were recorded in the spillway borings than in the dam borings in both the till (56 to 59 versus 12 to 16) and in the clay/shale (71 versus 14 to 46).

Table 6. SPT Refusals and N-Value Ranges and Averages

Layer	Boring	Number of Tests	Test Refusals		N-Values			
			Number	%	*n*	Range	Mean	Median
Embankment	GF-4	37	0	0	37	12 - 72	31	29
	GF-5	14	0	0	14	14 - 32	22	21
	GF-6	2	0	0	2	22 - 25	24	24
Outwash	GF-2	3	0	0	3	26 - 68	41	29
	GF-3	3	0	0	3	14 - 30	22	21
Till	GF-2	13	3	23	10	40 - 89	59	56
	GF-3	13	2	15	11	21 - 94	56	57
	GF-4	4	0	0	4	13 - 24	17	16
	GF-5	6	0	0	6	11 - 17	13	12
Colluvium/ Residuum	GF-6	9	0	0	9	12 - 34	20	19
Clay/Shale	GF-2	2	2	100	0	-	-	-
	GF-3	4	2	50	2	69 -73	71	71
	GF-4	8	0	0	8	19 - 45	33	33
	GF-5	5	0	0	5	10 -20	14	15
	GF-6	6	0	0	6	28 - 63	46	44

5.3 Undisturbed Soil Sampling

The borings encountered no materials suitable for collection of undisturbed soil samples, so none were collected.

5.4 Rock Coring

NQ3 rock coring was performed in Boring GF-2 from a depth of 47.5 to 59.5 feet. The average core recovery was 96 percent and average Rock Quality Designation (RQD) was 69 percent, indicating good quality rock. The rock was generally very soft as core specimens could be broken by hand and gouged with a fingernail. The core developed hairline fractures parallel to bedding over time. The rock was soft enough to be generally penetrable by Standard Penetration Testing (SPT) in the other borings, especially the dam borings (GF-4, GF-5, and GF-6) where SPT refusal was not encountered.

5.5 Piezometer Installation

Borings 4, 5, and 6 were equipped with vibrating wire pressure transducers, which were grouted in place in the borehole. The two pressure transducers were connected to a datalogger housed in a fiberglass or steel lockable enclosure affixed to a raised casing. Piezometer construction logs are provided in Appendix D. Piezometric data obtained from the vibrating wire pressure transducers through September 20, 2019 is also presented in Appendix D.

5.5 Field Crumb Dispersion Testing

Field crumb dispersion tests were performed on 25 soil samples. Test results for soils from the dam borings are summarized in Table 7. The results suggest the embankment, till, and foundation soils are generally non-dispersive, and the foundation rock is generally dispersive to highly dispersive. Photos of the field crumb dispersion tests are provided in Appendix E.

Table 7. Field Crumb Dispersion Test Results – Dam Borings

Layer	Boring	Sample Depth (ft)		Grade	Average
		Top	Bottom		
Embankment	GF-4	40	42.5	1 - Non-dispersive	1
		82.5	85	1 - Non-dispersive	
	GF-5	5	7.5	1 - Non-dispersive	
		30	32.5	1 - Non-dispersive	
	GF-6	2.5	5	1 - Non-dispersive	
Till	GF-4	97.5	100	2 - Intermediate	1.5
	GF-5	42.5	45	1 - Non-dispersive	
Colluvium/Residuum	GF-6	15	17.5	1 - Non-dispersive	1
Clay/Shale	GF-4	112.5	115	4 - Highly Dispersive	3
	GF-5	57.5	60	4 - Highly Dispersive	
	GF-6	40	42.5	1 - Non-dispersive	
		45	47.5	3 - Dispersive	

Test results for soils from the spillway borings are summarized in Table 8. The results suggest the outwash material is variable from non-dispersive to dispersive, the till material is dispersive, and the foundation rock is highly dispersive.

Table 8. Field Crumb Dispersion Test Results – Spillway Borings

Layer	Boring	Sample Depth (ft)		Grade	Average
		Top	Bottom		
Outwash	GF-2	7.5	10	3 - Dispersive	1.8
		7.5	10	1 - Non-dispersive	
		7.5	10	2 - Intermediate	
	GF-3	2.5	5	1 - Non-dispersive	
Brown Oxidized Till	GF-2	15	16.5	2 - Intermediate	3
	GF-3	12.5	15	3 - Dispersive	
Upper Gray Reduced Till	GF-2	*22.5*	*25*	3 - Dispersive	
	GF-2	30	32	4 - Highly Dispersive	
	GF-3	22.5	24	1 - Non-dispersive	
Lower Gray Reduced Till	GF-2	37.5	40	4 - Highly Dispersive	
	GF-3	40	41.5	4 - Highly Dispersive	
Clay/Shale	GF-2	45	47.5	4 - Highly Dispersive	4
	GF-3	44.5	45.8	4 - Highly Dispersive	

5.6 Lab Testing

Laboratory testing of soil and rock samples collected during the 2019 subsurface exploration program was performed for use in geotechnical analysis. Soil gradation data was used for drainfill compatibility analysis, auxiliary spillway integrity parameter selection and to estimate parameters for embankment seepage and stability models. All testing was performed in accordance with ASTM test standards.

The 2019 laboratory testing program was conducted by Terracon Consulting Engineers located in Grand Forks, ND. Soil and rock testing included the following:

- 25 moisture content tests (ASTM D2216)
- 9 USCS Classifications: sieve (ASTM D422), hydrometer (ASTM D7928), and Atterberg Limits ASTM D4318)
- 9 Specific gravity tests (ASTM D854)
- 6 Unit weight of soil tests (direct measure)
- 4 Flexible wall permeability tests (ASTM D5084)
- 4 Consolidated, undrained triaxial shear strength tests with pore pressures monitored (ASTM D4767)
- 2 Slake durability tests (ASTM D4644)
- 15 Crumb dispersion tests (ASTM D6572)

The triaxial permeability and CU_{bar} shear strength tests were performed on reconstituted specimens based on results from the natural moisture content and unit weight testing. Laboratory test results are included in Appendix F.

5.7 Subsurface Exploration Findings

The available data from all previous and current subsurface exploration programs were evaluated and considered in the current analyses. The following discussion is focused on the results of the 2019 exploration. The reader should take note that lower case USCS symbols indicate field classifications whereas upper case USCS symbols indicate laboratory classifications.

5.7.1 Embankment

The typical embankment section as shown on As-Built Drawing Sheet 6, and replicated in Figure 1, indicates the embankment is comprised of three zones with the following descriptions:

- Zone I: Impervious material
- Zone II: Impervious or pervious material including shaley, gravelly excavation from spillway.
- Zone III: Shaley, gravelly excavation from spillway.

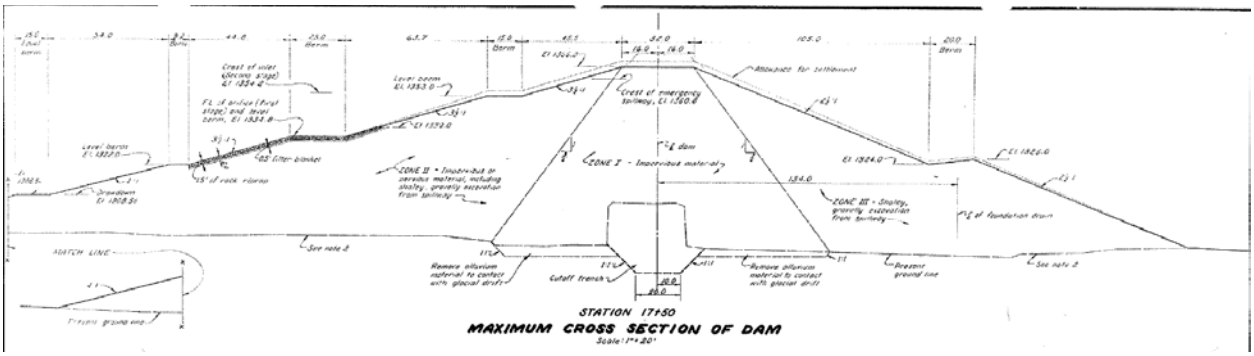


Figure 1. Typical Embankment Section from As-Built Drawings

Zone I

Zone I is located along the dam centerline and acts as the impervious core. Material from Zone I was sampled in boring GF-4 and was laboratory classified as a grayish-brown sandy-silt (ML). This compares somewhat reasonably with the Phase I report that indicates Zone I material consists of silt (ml), clayey sand (sc) and lean clay (cl). The geologist's 2019 field log indicates a relatively consistent material with N values ranging between 12 and 48 blows per foot (bpf) and averaging 29 bpf with pocket penetrometer readings ranging from 2 tons per square foot (tsf) to greater than 4.5 tsf. Laboratory testing confirms a relatively impermeable material with a measured hydraulic conductivity of 3.9×10^{-8} cm/sec. Crumb dispersion testing indicates Zone I soils are non-dispersive. Shear strength testing indicated a drained friction angle of 34°.

Zone II

Zone II is located upstream of the Zone I impervious core. Zone II materials were not sampled or tested during the 2019 subsurface exploration, but are believed to be similar to Zone I material with the exception of slightly more gravel material.

Zone III

Zone III is located downstream of the Zone I impervious core and was sampled in borings GF-5 and GF-6. The soils that comprise Zone III were field classified as grayish-brown clayey sand (sc) and laboratory classified sandy elastic silt (MH). These material descriptions do not agree with the Phase I report which indicates Zone III material is comprised of shaley gravel (gc). It is possible that the Zone III material was initially placed was a clayey gravel but then was broken down during the placement/compaction effort of original construction to the current sc or MH classification. The 2019 geologist's field logs indicate N values ranging between 14 and 31 bpf and averaging 22 bpf while pocket penetrometer readings range from 2.2 tsf to greater than 4.5 tsf. Crumb testing indicates Zone III soils are non-dispersive. No strength testing was completed on the Zone III material.

5.7.2 Foundation Soil

The foundation soils were encountered in borings GF-4, -5 and -6. Glacial till material was identified in GF-4 and GF-5 while colluvial/residual soils were identified in GF-6, located near the right downstream embankment groin. The glacial till was classified as grayish brown silty, clayey sand (sc) and a sandy silt (ML). These classifications are in somewhat agreement with the Phase I report that indicate MH and ML foundation materials. Per the geologist's field logs, N values in the till ranged from 11 to 45 bpf and average 23 bpf while the colluvial/residual soils ranged from 12 to 34 bpf and averaged 20 bpf. Pocket penetrometer readings were generally greater than 4.5 tsf in the colluvial/residual whereas the glacial till readings averaged 2.8 tsf. Dispersion testing of foundation soils beneath the embankment are non-dispersive. Permeability testing of the till and colluvial/residual yielded hydraulic conductivities of 2.8×10^{-6} cm/sec and 6.8×10^{-6} cm/sec, respectively. Shear strength testing of till and colluvial/residual indicated drained friction angles of 36° and 32°, respectively.

5.7.3 Auxiliary Spillway Soils

Auxiliary spillway soils were encountered in borings GF-2 and GF-3 and typically indicated glacial outwash, classified as silty sand (SM), silty sand with gravel (sm), and silty clay (sc), underlain by glacial till, classified as sandy silt (ML), silty sand with gravel (sm), clayey sand with gravel (sc), and silty, sandy clay (cl). A stratum of glaciolacustrine silt (ml) was encountered in boring GF-2 between layers of till. Per the 2019 geologist's logs, the N-values ranged from 14 to 94 bpf with an average of 52 bpf, while several instances of refusal blows (50 blows per 6-inches) were noted. Pocket penetrometer readings were generally greater than 4.5 tsf for all spillway soil types. Dispersion testing on spillway soils indicates a concern as several till specimens yield a Grade 3 or 4 (see Table 8) indicating dispersive and highly dispersive characteristics. It is recommended that additional dispersion testing on the till strata be completed if alternative dam rehabilitations concepts expose or utilize this stratum in the rehabilitation concept. No shear strength testing was completed on spillway soils.

5.7.4 Foundation Rock

The rock underlying the foundation soil was identified as the Pierre Shale and was encountered in all five borings. However, rock was only cored in GF-2 as it was soft enough to be sampled using the split-spoon sampler elsewhere. The foundation rock was field described as a very dark gray clayey shale, but was broken down and classified in the laboratory as an elastic silt (MH) in a composite sample from GF-2 and GF-3 and as a fat clay (CH) from a sample in GF-4. The rock was noted to be very soft, and thinly bedded with occasional white bentonite clay interbeds. The rock encountered below elevation 1314 in GF-2 was the highest quality observed on site as core recovery was 96% and RQD was 69%. Dispersion testing of the foundation rock indicate a concern as several Grade 3's and 4's are noted, see Tables 7 and 8, indicating dispersive and highly dispersive characteristics. It is recommended that additional dispersion testing on the bedrock be completed if alternative dam rehabilitations concepts expose or tie into the rock strata.

A sample of the clayey shale foundation rock was reconstituted for permeability and shear strength testing, which yielded a hydraulic conductivity of 5.9×10^{-6} cm/sec and drained shear strength of

13°. Two slake durability tests on rock samples yielded slake durability index values of 40.7% and 19.5%, i.e. Type 2 and 3 degradation after two cycles, indicating that site bedrock has low durability with respect to weathering and is anticipated to revert to soil upon exposure to the elements.

6. GEOTECHNICAL ANALYSES

6.1 Auxiliary Spillway SITES Analysis

The following geotechnical engineering parameters were developed for use in the auxiliary spillway integrity analysis (SITES). The SITES evaluation will be completed under the Hydraulics task and results will be included in that report. Headcut erodibility index was determined following guidelines given in National Engineering Handbook, Chapter 52, *Field Procedures for Headcut Erodibility Index*. Other parameters were developed from laboratory test data and correlation with published values. Appendix G contains the calculations for the recommendations.

Two test borings were completed at the control section of the existing auxiliary spillway. GF-2 and GF-3 were drilled on the inside and outside edge of the existing spillway, respectively as shown on Figure 4. GF-1 was not completed due to depth at which bedrock was encountered in GF-2 and GF-3. Two profile recommendations are provided in Table 9 for upstream to downstream reach of the auxiliary spillway to determine if presence of Lacustrine stratum effects spillway integrity. This five-foot thick stratum was encountered in GF-2, but not in GF-3.

A sensitivity analysis in the SITES model for the D_{75} value for 'Rock' is recommended to determine influence of this parameter on spillway integrity. Field data D_{75} values listed in Table 9 are the maximum anticipated. Lower D_{75} for rock could be similar to soil values since samples were obtained by split-spoon indicating a very soft "rock like" structure, not strongly cemented material. Therefore, 'Rock' strata D_{75} should be varied from 34.9 to 2 to determine effect of this parameter on results.

Table 9. Engineering Soil and Rock Parameters and Stratigraphy for use in SITES Analysis

Stata	Unit Weight (pcf)	% Clay	Kh	D75 (mm)	PI	GF-2 Depth (ft)		Thickness(ft)	GF-3 Depth (ft)		Thickness(ft)
Outwash	92	14	0.042	2	0	2.5	10	7.5	2.5	10	7.5
Till	95	20	0.102	0.1	13	10	22.5	12.5	10	43.5	33.5
Lacustrine	100	20	0.049	0.5	0	22.5	27.5	5	-	-	-
Till	95	20	0.102	0.1	13	27.5	42.5	15	-	-	-
Rock	121	NA	2	34.9	NA	42.5	and below	> 50	43.5	and below	> 50

Notes:

1. Lacustrine soils were not encountered in GF-3 and therefore there is no divide between upper and lower till layers.
2. Inputs for percent clay and plasticity are not required to model rock in SITES.
3. Borings GF-2 and GF-3 were terminated in rock and thus a material underlying the Pierre Shale was not identified.

6.2 Drain fill Compatibility Analysis

Modern embankment dams are designed to control seepage and reduce the risks of seepage problems related to soil migration. A series of calculations were completed to evaluate compatibility of existing materials and to design drain aggregates to filter site soils. The calculations were performed using the procedures in Chapter 26 of the National Engineering Handbook Part 633 (NRCS, 2017) and are included in Appendix G. Results are summarized below.

Embankment soils at Matecjek Dam typically consist of sandy silt (ML) and sandy elastic silt (MH) materials. Based on the results of the gradational analyses of the embankment soils which indicate similar particle size, compatibility between the embankment zones was not conducted. By inspection, Zone I is compatible with Zone III. Gradation analysis on Zone II was not conducted, therefore compatibility of this Zone with Zone I (given its similar description as Zone III on the As-Built drawings) is anticipated, but cannot be confirmed.

Per the record drawings, the existing foundation drain and auxiliary drain built during original construction that parallels the principal spillway conduit are comprised of "pit run sand and gravel" with no specified gradation. Pit run sand and gravel is typically used to classify coarse grained material directly excavated from a borrow source without any processing to remove oversize or fine-grained materials. The south auxiliary drain, located on the right abutment and downstream of the embankment, is comprised of a single coarse aggregate material noted as a "poorly-graded gravel with a maximum particle size of 3-inches and a minimum particle size equivalent to the No. 4 sieve (4.75 mm)". The south abutment auxiliary drain also extends beneath the bentonite layer, so it is assumed that this drain fill is in contact with the clayey shale (confirm to be dispersive per crumb testing).

By inspection, neither existing drain fill meets the state-of-the-practice drain fill gradation criteria for seepage control/conveyance as the existing materials are too coarse, too broadly graded, or potentially too dirty (i.e., too high of a fines content). Additionally, the Grade 3 and 4 dispersion ratings if existing foundation soils indicates further material incompatibility.

Gradational analyses of the existing site soils indicate that a mortar sand meeting the gradational requirements of ASTM C144 would be adequate to protect the embankment from dispersive soils while maintaining effective seepage conveyance.

6.3 Seepage Analyses

Gannett Fleming performed seepage analyses to estimate the phreatic surface in the embankment during normal pool and flood surcharge pool levels for the purpose of evaluating slope stability. Seepage conditions were analyzed at the maximum-height embankment cross section using stratigraphy interpreted from the historic As-Built drawings and supplemented with existing topography and subsurface data from borings GF-4 and GF-5. Seepage modeling was performed using the SEEP/W module of GeoStudio 2016, Version 8.16 by GEO-SLOPE International.

Permeabilities of site soil and rock strata were estimated based on laboratory testing and assumptions regarding relative material permeabilities based on material descriptions. A detailed summary of the inputs and assumptions used to generate the seepage model are included in Appendix G.

A seepage model was created to calibrate soil and rock layer permeabilities using observed piezometer data from February 2019 through September 2019 to improve understanding of the phreatic surface and pore pressures in the dam and foundation. In the calibration process, permeabilities of subsurface strata were adjusted until the seepage model results matched reasonably well with the observed piezometer data. Table 10 compares the actual head observed in the piezometers to the predicted head modeled in SEEP/W for steady-state seepage at Normal Pool (Appendix G for the model output).

Table 10. Comparison of Observed Piezometric Heads with Modeled Heads for Normal Pool Conditions.

Piezometer	Strata	Measured Head (ft)	Modeled Head (ft)
GF-4U	Glacial Till	1334	1304
GF-4D	Foundation Rock	1336	1305
GF-5U	Glacial Till	1292	1290
GF-5D	Foundation Rock	1294	1293

In general, the measured heads within GF-5U/5D correlate with the calibration model. However, data from GF-4U, located in the glacial till, and GF-4D, located in the foundation rock, show pore pressures nearly equal to the pool elevation despite being located downstream of the Zone I impervious core. Pore pressures of this magnitude are unusual for a zoned earth embankment dam and would indicate an open flow path between the reservoir to the piezometer. However, such a flow path is not likely due to the lower heads recorded in GF-5U/5D located in the same strata immediately downstream of GF-4U/4D. It is hypothesized that GF-4U/4D is being influenced by an unknown, non-reservoir source, and is therefore not considered appropriate to calibrate the seepage model. Additional piezometers installed in the upstream Zone II strata, Zone I impervious core, and/or on the right abutment should be considered during a future phase of design to investigate the usual heads in GF-4U/4D.

Historical As-Built drawings indicate that Matejcek Dam was constructed with an internal foundation drainage system. The seepage models showed good correlation with observed piezometer measurements when the drain shown on the As-built drawings was included as a region and boundary condition in the model. Embankment seepage models were created to estimate the steady state phreatic surface at normal pool and at a flood surcharge pool for evaluation of slope stability, as discussed in Section 6.4.

6.4 Slope Stability Analyses

Gannett Fleming performed slope stability analyses of the upstream and downstream embankment slopes based on the requirements of TR-60 (2019). Analyses were performed at the cross section representing the maximum height of the dam and utilizing pore water pressures computed by the

seepage modeling. Slope stability modeling was performed using the SLOPE/W program, module of GeoStudio 2016, Version 8.16 by GEO-SLOPE International. Existing embankment slope angles were based on the site topography data. The existing upstream slope is approximately 3.5H:1V and contains three distinct benches at El. 1356, El. 1337, and El. 1322. A fourth bench at El. 1310 is noted on the record drawings but is not well discerned from the recent topography. The existing downstream slope is approximately 2.5H:1V and contains one bench at El. 1326.

Recommended shear strength parameters were determined based on the results of the subsurface exploration and laboratory testing programs. Table 11 summarizes the recommended shear strengths and unit weights for site soils.

As discussed in the Inputs and Assumptions for Seepage and Slope Stability Modeling (Appendix G), all three embankment fill sections are grouped together and treated as one material for discussion and analysis, based on the similarities in grain-size and blow counts. The shear strength parameters of embankment fill (Zone I, II, and III) were determined based on results of consolidated, undrained (CU_{bar}) triaxial shear strength with pore pressures monitored testing of samples from Zone I with pore pressures monitored. The triaxial test results were evaluated with respect to shear strength guidance provided in the U.S. Corps of Engineers (COE) EM 1110-2-1902 (2003). A linear Mohr-Coulomb failure envelope was constructed for the Mohr circles at failure such that two thirds of the Mohr circle points of tangency are above the line and one-third below, in accordance with EM 1110-2-1902, Appendix D, Section D-6.b.1. The Mohr circles and the recommended design failure envelope are plotted together for both effective stress and total stress conditions in Appendix G.

Consideration was given to applying an impenetrable material model to the Foundation Rock (Pierre Shale). This feature is applied when rock is known to be intact or unlikely to develop a failure surface through the material matrix. However, the Pierre Shale is known to contain bentonite interbedding, which would enable such a failure surface. The orientation of the bentonite interbedding is not discernable based on the 2019 subsurface exploration documentation and therefore shear strength parameters obtained from reconstituted test specimens are utilized to represent the shear strength along the bentonite interbedding.

Table 11. Recommended Parameters for Slope Stability Analyses.

Material	Unit Weight (pcf)	Shear Strength Parameters				
		Effective Stress		Total Stress		Bilinear Stress
		Cohesion, c' (psf)	Friction Angle, ϕ' (degrees)	Cohesion, c (psf)	Friction Angle, ϕ (degrees)	Normal Stress[1], σ_N (psf)
Zone I	115	0	34	430	25	2065
Zone II	115	0	34	430	25	2065
Zone III	115	0	34	430	25	2065
Drain Fill	115	0	34	0	34	-
Glacial Till	120	0	36	185	24	658
Foundation Rock	125	0	13	865	7	8003

Note: 1) The normal stress, σ_N, is the normal stress coordinate of the intersection of the effective stress and total stress failure envelope (TR-60 Figure 5-2 is replicated as Figure 2) and is calculated with the equation: $\sigma_N = \frac{c - c'}{\tan\phi - \tan\phi}$

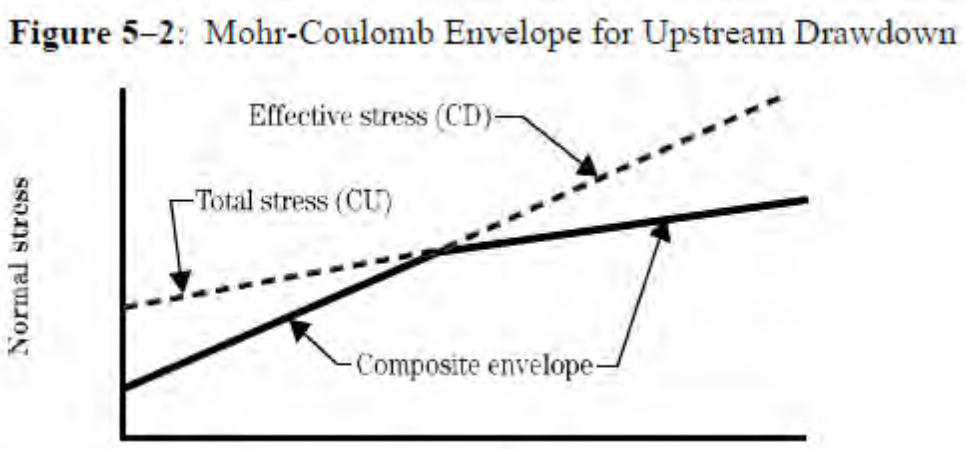


Figure 2. Composite Shear Strength Envelope from Figure 5-2 in TR-60

Slope stability analysis results are included in Appendix G and summarized in Table 12.

Minimum factors of safety from TR-60, Table 5-3 are utilized to assess downstream embankment stability for normal pool and flood surcharge pool, and upstream slope stability during a rapid drawdown condition.

The SLOPE/W model utilizes effective strength parameters for the normal pool, steady-state seepage condition. Two evaluations were performed, one where the impenetrable material model

is applied to the Foundation Rock and one where the Foundation Rock utilizes effective stress parameters shown in Table 11.

To analyze the flood surcharge condition, the SLOPE/W model utilizes a composite envelope (bilinear strength), i.e., the lowest of the effective or consolidated total stress failure envelope as required by TR-60. SLOPE/W requires the input of both effective and total stress parameters as well as the normal stress of the intersection of the two failure envelopes to perform a bilinear strength analysis. These parameters are presented in Table11.

Rapid drawdown stability of the existing upstream slope was evaluated in accordance with TR-60 using the composite failure envelope. It was assumed that rapid drawdown was instantaneous from normal pool to the elevation of the lowest lake drain invert, El. 1309.76 as indicated on the historic As-Built drawings and adjusted to NAVD88. The phreatic surface after drawdown was assumed to be equal to the El. 1309.76 through Zone II and then linearly decrease to El. 1290 (approximate invert of internal drainage system conveyance pipe) through Zone I and Zone III.

Evaluation of the SLOPE/W model results indicate that the controlling stratum is the underlying Pierre Shale foundation rock. When the Pierre Shale is assumed to be impenetrable, the model indicates TR-60 requirements are met for both normal pool and flood surcharge pool conditions. However, when considering the bentonite interbedding, the model indicates deep failure circles through the Pierre Shale and a safety factor less than the required 1.5 is predicted. A summary of the SLOPE/W results is presented in Table 12.

Table 12. Embankment Slope Stability Analysis Results

Analysis	Required Minimum Factor of Safety	Calculated Minimum Factor of Safety
Rapid Drawdown (Composite Strength Failure Envelope)	1.2	1.6 (OK)
Downstream Slope (Existing), Normal Pool Steady State, Considers Bentonite Interbedding in Foundation Rock	1.5	1.2 (Not Met)
Downstream Slope (Existing), Normal Pool Steady State, Assumes Impenetrable Foundation Rock	1.5	1.7 (OK)
Downstream Slope (Existing), Flood Surcharge Pool Steady State, Considers Bentonite Interbedding in Foundation Rock	1.4	1.0 (Not Met)
Downstream Slope (Existing), Flood Surcharge Pool Steady State, Assumes Impenetrable Foundation Rock	1.4	1.7 (OK)

6.4.1 Slope Stability Conclusions

1. The steady-state seepage load condition for normal pool and flood surcharge pool conditions did not meet the required minimum factor of safety in TR-60 when bentonite interbedding within the Pierre Shale is considered. Additional investigation regarding the presence of bentonite interbedding or mitigation of the effects of the bentonite interbedding should be considered in a future phase of design.
2. The factor of safety for rapid drawdown loading of the upstream slope is greater than the required minimum factor of safety in TR-60, however the modeled slip surface is very deep relative to typical rapid drawdown failures. Additional investigation into determining the shear strength of the Zone II material should be considered in a future design phase.

7 CONSIDERATIONS FOR FUTURE WORK

The geotechnical analyses performed herein are intended to be used to develop a conceptual rehabilitation design for Matecjek Dam. Depending on the concepts considered, additional investigation into the following areas may be warranted in a future phase of design:

- The unusually high pore pressures recorded by the transducers in GF-4U (located in the glacial till) and GF-4D (located in the Pierre Shale), that appear to be influenced by a source other than the reservoir pool.
    - Additional piezometers located in Zone I, Zone II, or the glacial till upstream of the cutoff trench could be beneficial to better understand the seepage regime.
- Additional dispersion testing on the till strata within the auxiliary spillway if alternative dam rehabilitations concepts expose or utilize this stratum in the rehabilitation concept.
- Additional dispersion testing of the foundation rock if this stratum is to be exposed or excavated.
- The shear strength of Zone II and Zone III embankment strata.
- Compatibility of between Zone II and Zone I embankment strata.
- The presence of the bentonite interbedding within the foundation rock and effect on shear strength.
- Stability of the left abutment above the south auxiliary drain.
- Functionality of the south auxiliary drain.
- Removal and replacement of existing drain fill with a seepage collection and filtration drain fill compatible with adjacent soil.
- Flow monitoring of the existing foundation drain outlets and south auxiliary drain outlet.
- Site seismicity and liquefaction susceptibility as required by TR-60.
    - It is believed that the peak horizontal ground acceleration at Matecjek Dam is below the minimum threshold indicated by TR-60 and thus dynamic stability may not be required, however this should be confirmed.
    - The subsurface data obtained from the 2019 do not indicate the presence of soils typically susceptible to liquefaction, such as loose sands. However, if additional explorations indicate the presence of loose, saturated sands, liquefaction analyses should be performed.

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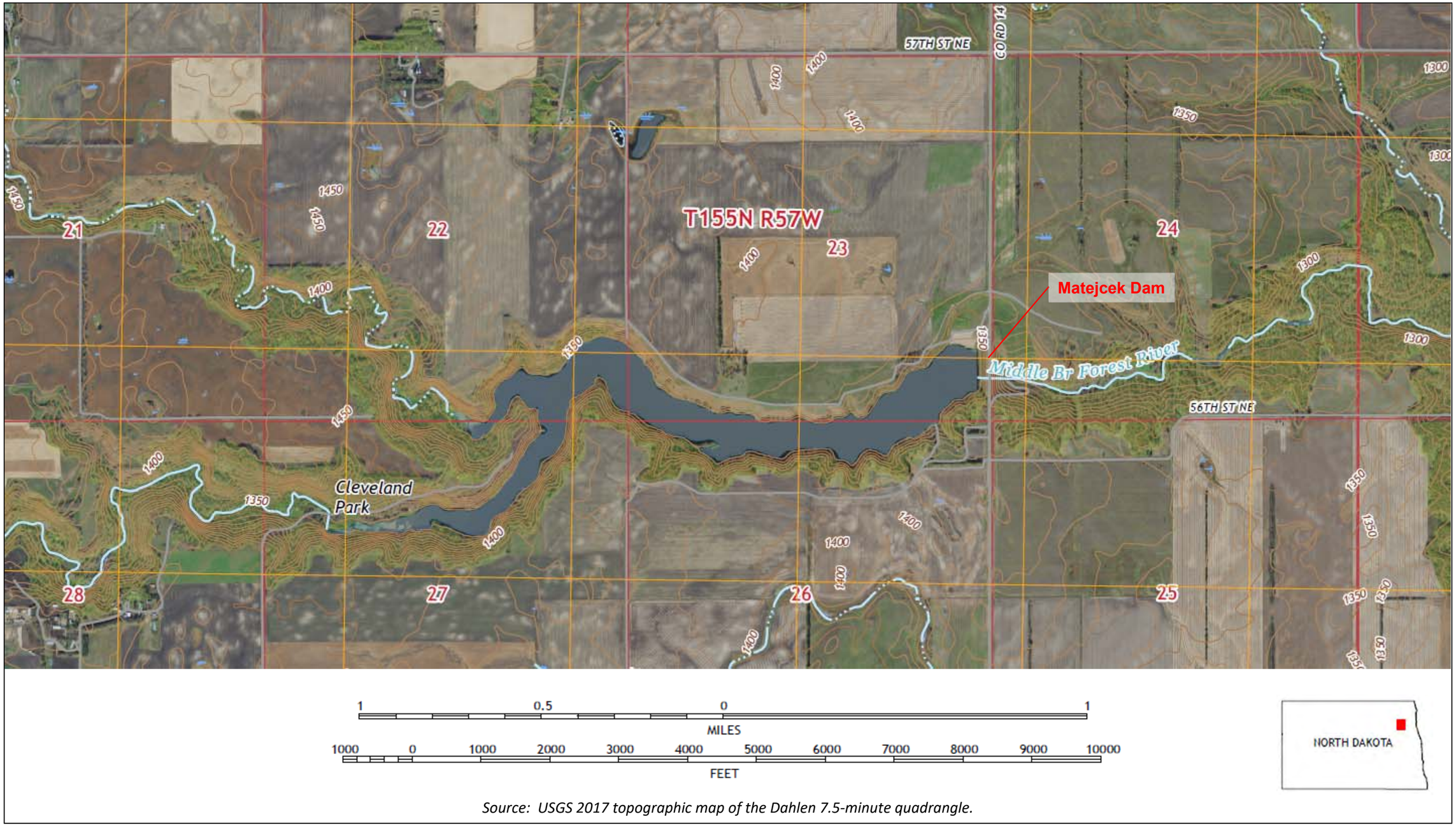
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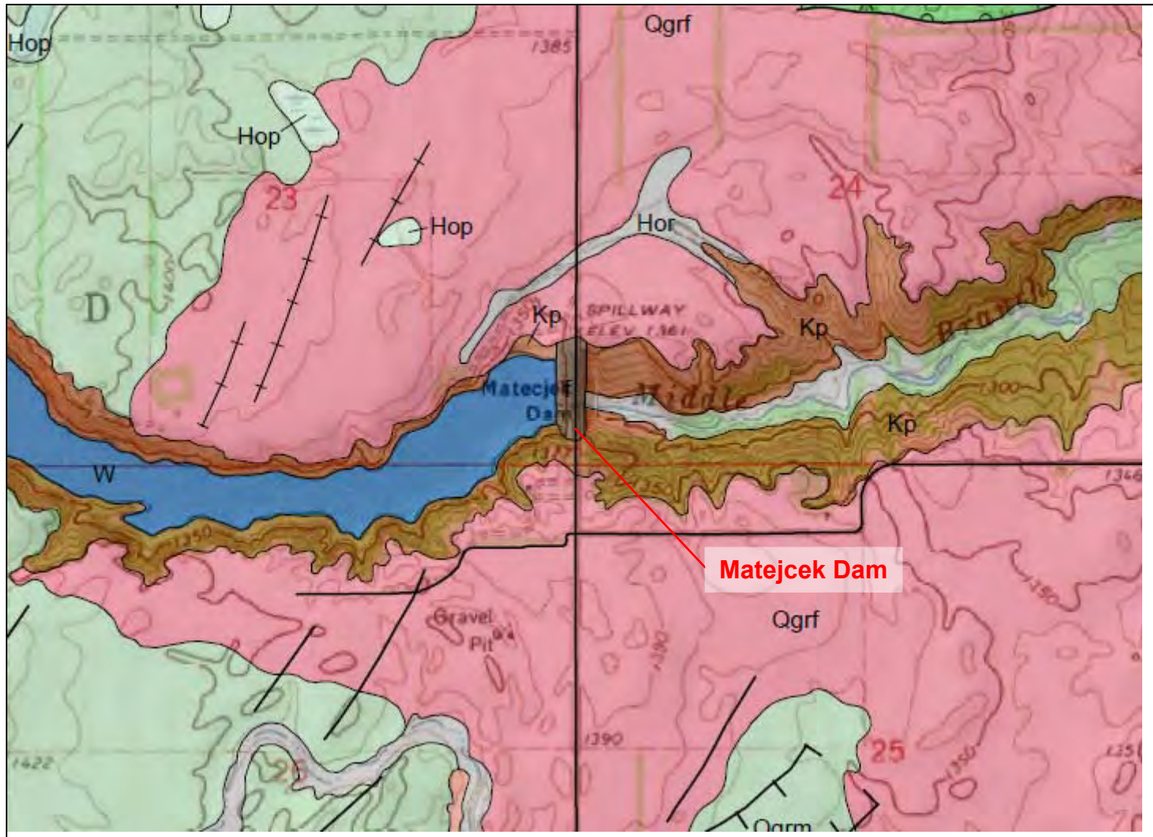
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EXHIBITS



Source: USGS 2017 topographic map of the Dahlen 7.5-minute quadrangle.

Exhibit 1. Location Map



EXPLANATION

W — **Water**

f — **Fill**

Quaternary System

Holocene

Oahe Formation – Sand, silt, clay, gravel, and organic debris; all postglacial sediment deposited on the landscape; includes river sediment, windblown sediment, lake sediment, and slopewash.

Hor — **Alluvium and overbank sediment** – Sand, silt, clay, and disseminated organic debris; obscurely bedded; dark colored; in many places associated with sand and gravel of older river-channel sediment; commonly more than three feet (1 m) thick.

Hop — **Pond and slough sediment** – Organic debris, clay, and silt; obscurely bedded; dark colored; generally more than three feet (1 m) thick; deposited in poorly drained depressions in the landscape.

Holocene and Older

Qs — **Sediment eroded by slope processes** – Sand, silt, and clay; unsorted; unbedded; often pebbly; steeply sloping and eroded by mass movement and slope wash; lithology reflects the upslope material; colluvium commonly present at the base of steep slopes.

Pleistocene

Coleharbor Group – Includes all sediments in North Dakota associated with deposition by Pleistocene glaciers.

Goose River Formation (undifferentiated) – Sediment deposited by a glacier as a result of a readvance from the northwest (Riding Mountain provenance) of the generally retreating Late Wisconsinan ice sheet into the Red River lowland.

Qgrm — **Clay-loam, pebbly** – Unsorted; unbedded; contains cobbles and boulders; shale pebbles abundant; as much as 80 feet (24 meters) thick; deposited by glacial ice on an ice-cored glaciated landscape; collapsed glacial sediment with less than 30 feet (10 meters) of relief.

Qgrp — **Clay-loam, pebbly** – Unsorted; unbedded; contains cobbles and boulders; shale pebbles abundant; glacial sediment covering, but not obscuring, pre-existing topography; buried meltwater channels are the most common feature present; may include exposures of sand and gravel; draped (palimpsest) features are visible on aerial photographs "through" the collapsed glacial sediment; deposited on an ice-cored glaciated landscape.

Qgrf — **Sand and gravel, shaly** – Moderately well-sorted, light to dark grayish brown, low-angle flat-bedded to high-angle cross-bedded silt, sand, and gravel deposited as outwash by the ancestral Park River and other meltwater streams flowing off the Pembina Escarpment onto the Elk Valley delta; flat to gently undulating surface commonly with braided channel scars, oxbows, and other relict markings; up to 70 feet (21 meters) thick.

Cretaceous System

Kp — **Pierre and Niobrara Formation, undifferentiated (Upper Cretaceous)** – Shale; commonly obscured by a thin veneer of till; offshore marine deposits.

Geologic Symbols

Other lineations – Established from aerial photographs; line marks the dimension of the feature; located in glacial sediment and thinly veneered glacial sediment; interpreted as disintegration trenches, streamlined bedforms associated with the movement of glacial ice, or lineations of unknown origin; generally difficult to discern on topographic maps and on the ground.

Palimpsest channel – Established from aerial photographs and LiDAR; lines indicate the crests of the scarps; half-circles indicate the downslope direction; interpreted as a buried meltwater channel; generally apparent on topographic maps, may not be apparent on the ground.

Beach ridges, spits and offshore bars – Established from aerial photographs; line indicates the crest of the ridge; interpreted as beach ridges or offshore bars deposited along the margin of Lake Agassiz; discernible on topographic maps and on the ground.

Sharp scarp – Established from aerial photographs and LiDAR; line indicates the crest of the scarp and the hachures point downslope; easily discernible on topographic maps and on the ground.

Source: Surface Geology, Dahlen Quadrangle (Manz and Harris, 2017)

0 0.5 1
Miles



Exhibit 2. Surface Geology Map



Exhibit 3. Shallow Surface Slip Location

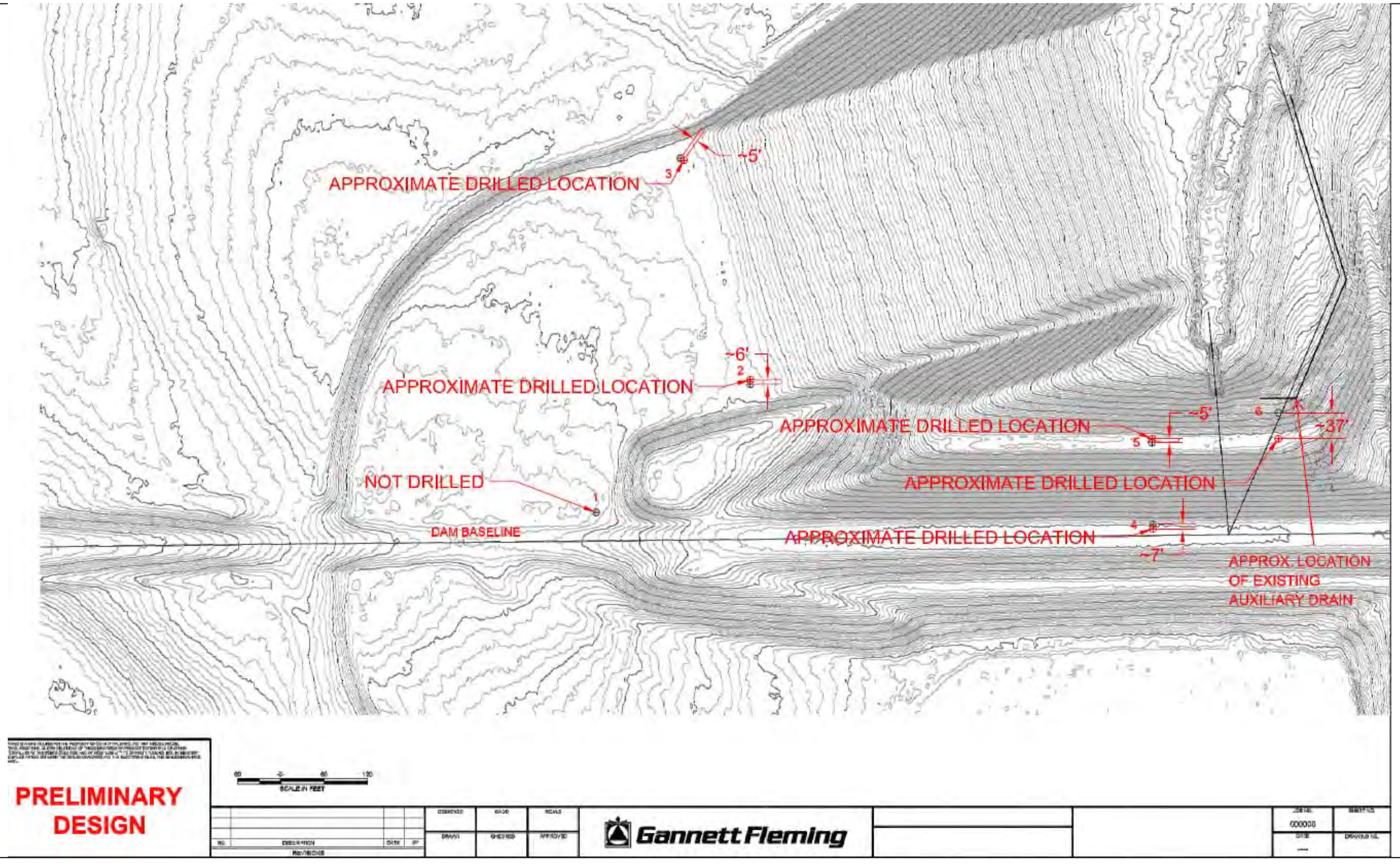


Exhibit 4. Boring Location Plan

APPENDICES

APPENDIX A

NRCS Custom Soil Resource Report

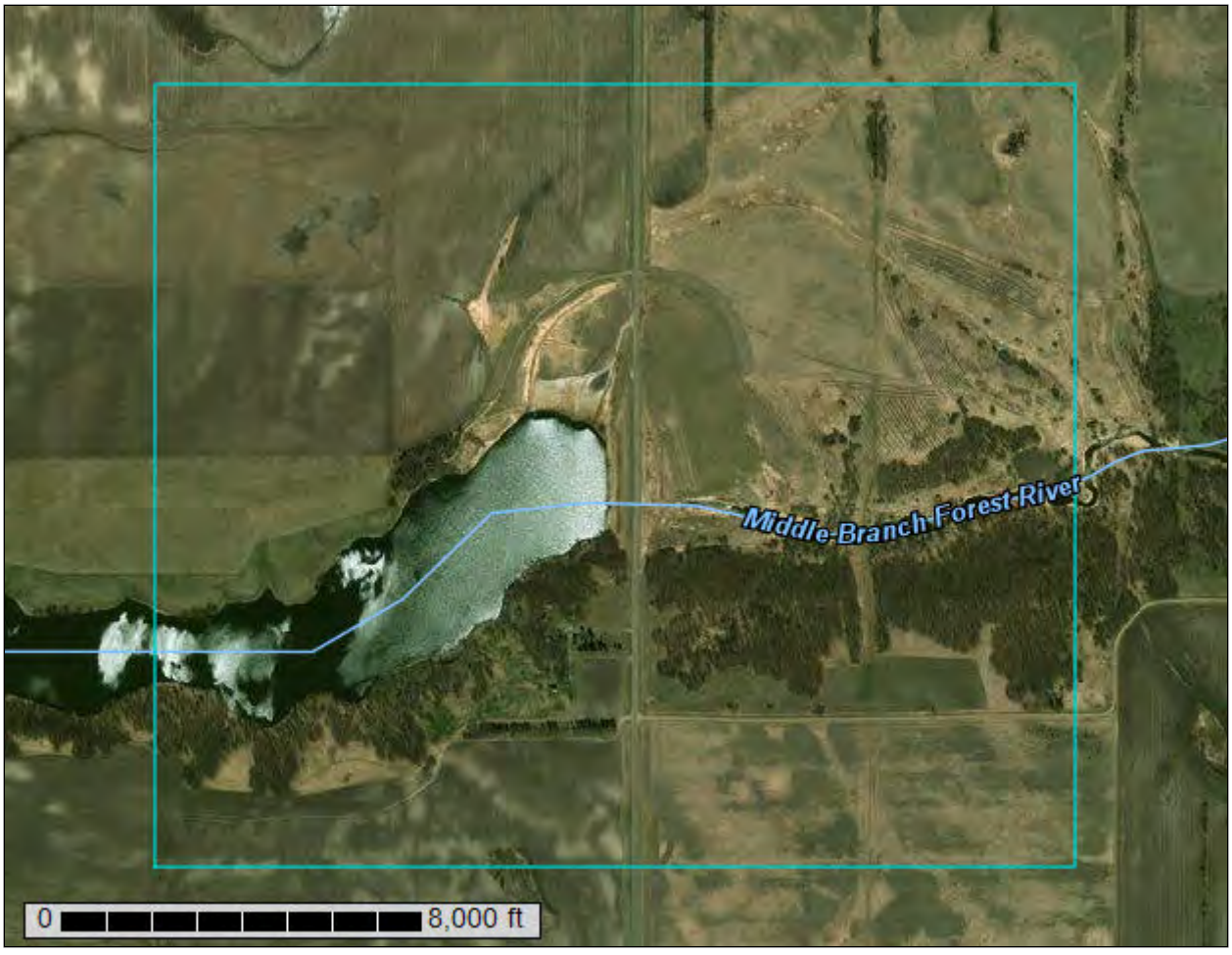
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Walsh County, North Dakota



December 5, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

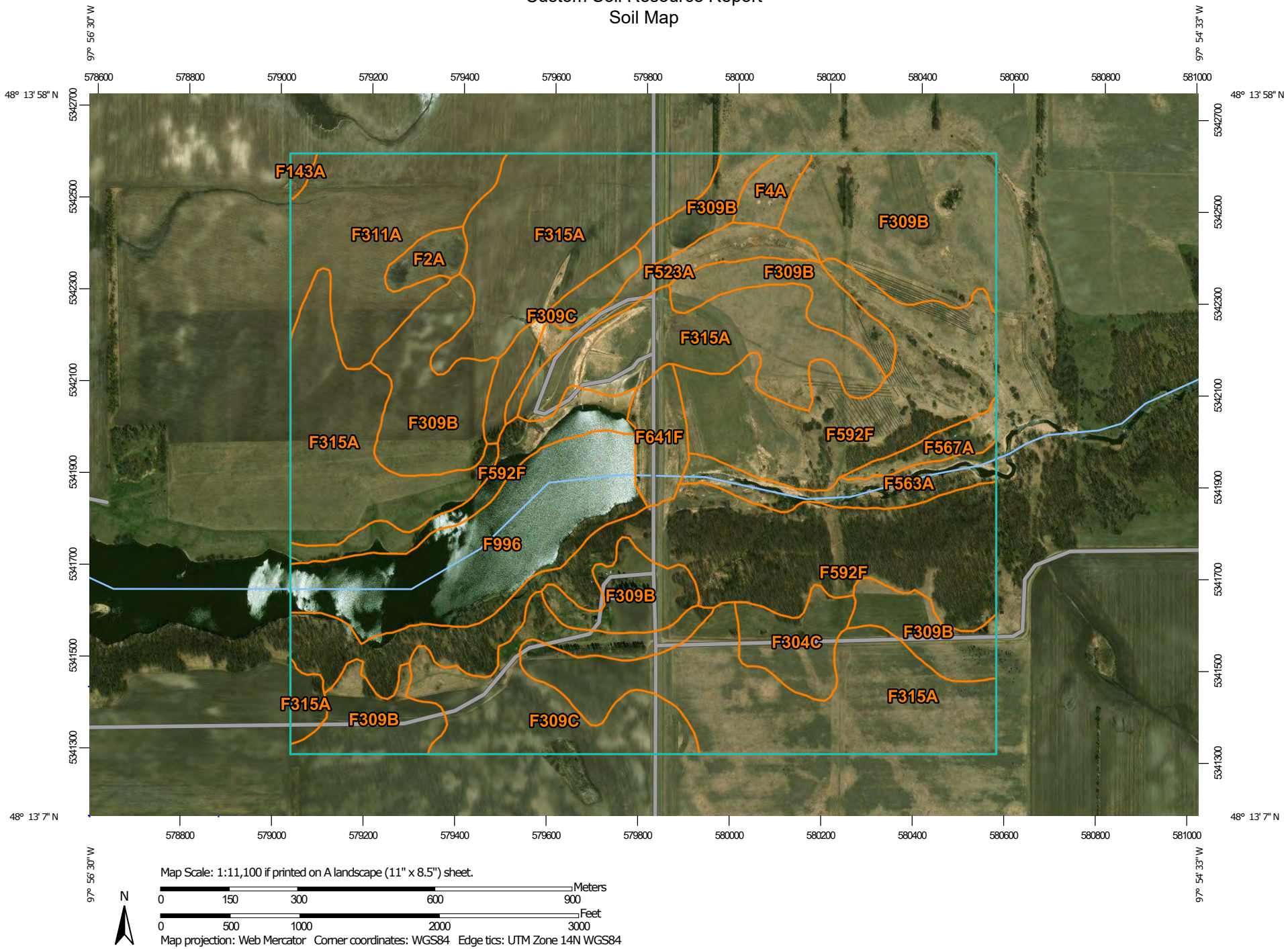
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:11,100 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 150 300 600 900

Feet
0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Walsh County, North Dakota
Survey Area Data: Version 19, Sep 14, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 7, 2012—May 16, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
F2A	Tonka silt loam, 0 to 1 percent slopes	3.8	0.8%
F4A	Southam silty clay loam, 0 to 1 percent slopes	4.0	0.8%
F143A	Barnes-Svea loams, 0 to 3 percent slopes	0.9	0.2%
F304C	Coe-Binford complex, 6 to 9 percent slopes	9.7	1.9%
F309B	Brantford-Vang loams, 2 to 6 percent slopes	94.8	18.9%
F309C	Brantford-Vang loams, 6 to 9 percent slopes	34.9	7.0%
F311A	Walsh-Vang loams, 0 to 2 percent slopes	30.9	6.2%
F315A	Vang-Brantford loams, 0 to 2 percent slopes	140.3	28.0%
F523A	Lowe-Fluvaquents, channeled complex, 0 to 2 percent slopes, frequently flooded	9.5	1.9%
F563A	Fluvaquents, channeled-Fairdale complex, 0 to 2 percent slopes, frequently flooded	10.6	2.1%
F567A	Fairdale loam, 0 to 2 percent slopes, occasionally flooded	4.3	0.9%
F592F	Kloten-Walsh-Edgeley loams, 6 to 35 percent slopes	111.6	22.3%
F641F	Udarents loamy, earthen dam, 1 to 75 percent slopes	7.3	1.5%
F996	Water	38.2	7.6%
Totals for Area of Interest		**500.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some

observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The

pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Walsh County, North Dakota

F2A—Tonka silt loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2q3tm
Elevation: 950 to 2,530 feet
Mean annual precipitation: 16 to 23 inches
Mean annual air temperature: 36 to 43 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Tonka and similar soils: 73 percent
Minor components: 27 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tonka

Setting

Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Local alluvium over till

Typical profile

Ap - 0 to 7 inches: silt loam
A - 7 to 13 inches: silt loam
E - 13 to 19 inches: loam
Bt - 19 to 34 inches: silty clay loam
2BC - 34 to 50 inches: clay loam
2Cg - 50 to 79 inches: loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 10 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 3.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Ecological site: Wet Meadow (R055AY055ND)

Forage suitability group: Wet (G055AY900ND)
Hydric soil rating: Yes

Minor Components

Parnell
Percent of map unit: 9 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Shallow Marsh (R055AY054ND)
Hydric soil rating: Yes

Wyard
Percent of map unit: 6 percent
Landform: Swales on ground moraines
Landform position (three-dimensional): Dip
Microfeatures of landform position: Closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Subirrigated (R055AY048ND)
Hydric soil rating: No

Vallers
Percent of map unit: 4 percent
Landform: Ground moraines
Landform position (three-dimensional): Dip
Microfeatures of landform position: Closed depressions
Down-slope shape: Concave
Across-slope shape: Linear, concave
Ecological site: Wet Meadow (R055AY055ND)
Hydric soil rating: Yes

Manfred
Percent of map unit: 3 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Saline Lowland (R055AY042ND)
Hydric soil rating: Yes

Hamerly
Percent of map unit: 3 percent
Landform: Ground moraines
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Limy Subirrigated (R055AY040ND)
Hydric soil rating: No

Cavour
Percent of map unit: 2 percent
Landform: Ground moraines
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Claypan (R055AY039ND)

Hydric soil rating: No

F4A—Southam silty clay loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2q3w8
Elevation: 950 to 2,530 feet
Mean annual precipitation: 16 to 23 inches
Mean annual air temperature: 36 to 43 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Southam and similar soils: 68 percent
Minor components: 32 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Southam

Setting

Landform: Marshes
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Local alluvium

Typical profile

A - 0 to 4 inches: silty clay loam
Ag1 - 4 to 18 inches: silty clay loam
Ag2 - 18 to 42 inches: silty clay
Cg - 42 to 79 inches: silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 3 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: C/D
Ecological site: Non-Site (R055AY999ND)
Forage suitability group: Not suited (G055AY000ND)
Hydric soil rating: Yes

Minor Components

Vallers, moderately saline
Percent of map unit: 9 percent
Landform: Ground moraines
Landform position (three-dimensional): Dip
Microfeatures of landform position: Closed depressions
Down-slope shape: Concave
Across-slope shape: Linear, concave
Ecological site: Saline Lowland (R055AY042ND)
Hydric soil rating: Yes

Arveson
Percent of map unit: 8 percent
Landform: Flats on lake plains
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Wet Meadow (R055AY055ND)
Hydric soil rating: Yes

Water, intermittent
Percent of map unit: 5 percent
Landform: Marshes
Ecological site: Non-Site (R055AY999ND)

Parnell
Percent of map unit: 4 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Shallow Marsh (R055AY054ND)
Hydric soil rating: Yes

Manfred
Percent of map unit: 3 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Saline Lowland (R055AY042ND)
Hydric soil rating: Yes

Mauvais
Percent of map unit: 3 percent
Landform: Beaches on marshes
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Subirrigated (R055AY048ND)
Hydric soil rating: No

F143A—Barnes-Svea loams, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2q4gq
Elevation: 950 to 2,530 feet
Mean annual precipitation: 16 to 23 inches
Mean annual air temperature: 36 to 43 degrees F
Frost-free period: 110 to 150 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Barnes and similar soils: 39 percent
Svea and similar soils: 38 percent
Minor components: 23 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Barnes

Setting

Landform: Ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Fine-loamy till

Typical profile

Ap - 0 to 7 inches: loam
Bw - 7 to 16 inches: loam
Bk - 16 to 37 inches: loam
C - 37 to 79 inches: loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 48 to 79 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Gypsum, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (1.0 to 3.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2c
Hydrologic Soil Group: B
Ecological site: Loamy (R055AY047ND)
Forage suitability group: Loam (G055AY100ND)
Hydric soil rating: No

Description of Svea

Setting

Landform: Ground moraines
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Fine-loamy till

Typical profile

Ap - 0 to 8 inches: loam
A - 8 to 11 inches: loam
Bw - 11 to 22 inches: loam
Bk - 22 to 37 inches: loam
C - 37 to 79 inches: loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to slightly saline (1.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2c
Hydrologic Soil Group: B
Ecological site: Loamy Overflow (R055AY041ND)
Forage suitability group: Overflow (G055AY500ND)
Hydric soil rating: No

Minor Components

Hamerly

Percent of map unit: 9 percent
Landform: Ground moraines
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear

Ecological site: Limy Subirrigated (R055AY040ND)
Hydric soil rating: No

Cresbard

Percent of map unit: 3 percent
Landform: Ground moraines
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Clayey (R055AY038ND)
Hydric soil rating: No

Parnell

Percent of map unit: 3 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Shallow Marsh (R055AY054ND)
Hydric soil rating: Yes

Tonka

Percent of map unit: 3 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Wet Meadow (R055AY055ND)
Hydric soil rating: Yes

Renshaw

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Shallow Gravel (R055AY046ND)
Hydric soil rating: No

Buse

Percent of map unit: 2 percent
Landform: Ground moraines
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Thin Loamy (R055AY052ND)
Hydric soil rating: No

F304C—Coe-Binford complex, 6 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2q4vk

Elevation: 1,200 to 2,490 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 37 to 39 degrees F
Frost-free period: 110 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Coe and similar soils: 43 percent
Binford and similar soils: 25 percent
Minor components: 32 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coe

Setting

Landform: Knolls
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Shaly glaciofluvial deposits

Typical profile

A - 0 to 10 inches: gravelly sandy loam
C - 10 to 60 inches: very gravelly coarse sand

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Very low (about 2.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Very Shallow (R055AY053ND)
Forage suitability group: Not suited (G055AY000ND)
Hydric soil rating: No

Description of Binford

Setting

Landform: Knolls
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Shaly glaciofluvial deposits

Typical profile

Ap - 0 to 8 inches: sandy loam

Bw - 8 to 17 inches: sandy loam
2C - 17 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: Shallow Gravel (R055AY046ND)
Forage suitability group: Very Droughty Loam (G055AY130ND)
Hydric soil rating: No

Minor Components

Coe

Percent of map unit: 10 percent
Landform: Knolls
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Very Shallow (R055AY053ND)
Hydric soil rating: No

Walum

Percent of map unit: 6 percent
Landform: Rises
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Subirrigated Sands (R055AY049ND)
Hydric soil rating: No

Brantford

Percent of map unit: 5 percent
Landform: Rises
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Shallow Gravel (R055AY046ND)
Hydric soil rating: No

Vang

Percent of map unit: 4 percent
Landform: Rises
Down-slope shape: Concave
Across-slope shape: Linear

Ecological site: Loamy (R055AY047ND)
Hydric soil rating: No

Lohnes

Percent of map unit: 4 percent
Landform: Knolls
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sands (R055AY043ND)
Hydric soil rating: No

Wyrene, shaly

Percent of map unit: 3 percent
Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Limy Subirrigated (R055AY040ND)
Hydric soil rating: No

F309B—Brantford-Vang loams, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2q4vn
Elevation: 1,200 to 2,490 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 37 to 39 degrees F
Frost-free period: 110 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Brantford and similar soils: 50 percent
Vang, well drained, and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Brantford

Setting

Landform: Rises
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Shaly glaciofluvial deposits

Typical profile

Ap - 0 to 9 inches: loam
Bw - 9 to 15 inches: loam
2Bk - 15 to 40 inches: gravelly loamy coarse sand
2C - 40 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Shallow Gravel (R055AY046ND)
Forage suitability group: Very Droughty Loam (G055AY130ND)
Hydric soil rating: No

Description of Vang, Well Drained

Setting

Landform: Rises
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Shaly glaciofluvial deposits

Typical profile

Ap - 0 to 7 inches: loam
A - 7 to 11 inches: loam
Bw - 11 to 27 inches: clay loam
2C - 27 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy (R055AY047ND)

Forage suitability group: Droughty Loam (G055AY120ND)
Hydric soil rating: No

Minor Components

Binford
Percent of map unit: 4 percent
Landform: Rises
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Shallow Gravel (R055AY046ND)
Hydric soil rating: No

Kensal
Percent of map unit: 3 percent
Landform: Flats, rises
Down-slope shape: Linear, convex
Across-slope shape: Linear
Ecological site: Loamy (R055AY047ND)
Hydric soil rating: No

Walsh
Percent of map unit: 3 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Loamy Overflow (R055AY041ND)
Hydric soil rating: No

Walum
Percent of map unit: 3 percent
Landform: Rises
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Subirrigated Sands (R055AY049ND)
Hydric soil rating: No

Coe
Percent of map unit: 2 percent
Landform: Rises
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Very Shallow (R055AY053ND)
Hydric soil rating: No

F309C—Brantford-Vang loams, 6 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2q4vp
Elevation: 1,200 to 2,490 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 37 to 39 degrees F
Frost-free period: 110 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Brantford and similar soils: 65 percent
Vang, well drained, and similar soils: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Brantford

Setting

Landform: Knolls
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Shaly glaciofluvial deposits

Typical profile

Ap - 0 to 9 inches: loam
Bw - 9 to 15 inches: loam
2Bk - 15 to 40 inches: gravelly loamy coarse sand
2C - 40 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Shallow Gravel (R055AY046ND)

Forage suitability group: Very Droughty Loam (G055AY130ND)
Hydric soil rating: No

Description of Vang, Well Drained

Setting

Landform: Knolls
Landform position (two-dimensional): Backslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Shaly glaciofluvial deposits

Typical profile

Ap - 0 to 7 inches: loam
A - 7 to 11 inches: loam
Bw - 11 to 27 inches: clay loam
2C - 27 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Loamy (R055AY047ND)
Forage suitability group: Droughty Loam (G055AY120ND)
Hydric soil rating: No

Minor Components

Binford

Percent of map unit: 4 percent
Landform: Knolls
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Shallow Gravel (R055AY046ND)
Hydric soil rating: No

Coe

Percent of map unit: 3 percent
Landform: Knolls
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex

Across-slope shape: Convex
Ecological site: Very Shallow (R055AY053ND)
Hydric soil rating: No

Tonka

Percent of map unit: 2 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Wet Meadow (R055AY055ND)
Hydric soil rating: Yes

Kensal

Percent of map unit: 2 percent
Landform: Flats, rises
Down-slope shape: Linear, convex
Across-slope shape: Linear
Ecological site: Loamy (R055AY047ND)
Hydric soil rating: No

Walsh

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Loamy Overflow (R055AY041ND)
Hydric soil rating: No

Walum

Percent of map unit: 2 percent
Landform: Rises
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Subirrigated Sands (R055AY049ND)
Hydric soil rating: No

F311A—Walsh-Vang loams, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2q4vr
Elevation: 1,200 to 2,490 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 37 to 39 degrees F
Frost-free period: 110 to 120 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Walsh and similar soils: 63 percent
Vang, well drained, and similar soils: 23 percent

Minor components: 14 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Walsh

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fine-loamy colluvium

Typical profile

Ap - 0 to 6 inches: loam
A - 6 to 12 inches: loam
Bw - 12 to 26 inches: loam
C - 26 to 60 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2c
Hydrologic Soil Group: B
Ecological site: Loamy Overflow (R055AY041ND)
Forage suitability group: Overflow (G055AY500ND)
Hydric soil rating: No

Description of Vang, Well Drained

Setting

Landform: Rises
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Shaly glaciofluvial deposits

Typical profile

Ap - 0 to 7 inches: loam
A - 7 to 11 inches: loam
Bw - 11 to 27 inches: clay loam
2C - 27 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: Loamy (R055AY047ND)
Forage suitability group: Droughty Loam (G055AY120ND)
Hydric soil rating: No

Minor Components

Inkster

Percent of map unit: 6 percent
Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: Sandy (R055AY044ND)
Hydric soil rating: No

Hamerly

Percent of map unit: 4 percent
Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Limy Subirrigated (R055AY040ND)
Hydric soil rating: No

Edgeley

Percent of map unit: 2 percent
Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy (R055AY047ND)
Hydric soil rating: No

Brantford

Percent of map unit: 2 percent
Landform: Rises
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Shallow Gravel (R055AY046ND)
Hydric soil rating: No

F315A—Vang-Brantford loams, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2q4vv
Elevation: 1,200 to 2,490 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 37 to 39 degrees F
Frost-free period: 110 to 120 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Vang, well drained, and similar soils: 50 percent
Brantford and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vang, Well Drained

Setting

Landform: Rises
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Shaly glaciofluvial deposits

Typical profile

Ap - 0 to 7 inches: loam
A - 7 to 11 inches: loam
Bw - 11 to 27 inches: clay loam
2C - 27 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B

Ecological site: Loamy (R055AY047ND)
Forage suitability group: Droughty Loam (G055AY120ND)
Hydric soil rating: No

Description of Brantford

Setting

Landform: Rises
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Shaly glaciofluvial deposits

Typical profile

Ap - 0 to 9 inches: loam
Bw - 9 to 15 inches: loam
2Bk - 15 to 40 inches: gravelly loamy coarse sand
2C - 40 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Shallow Gravel (R055AY046ND)
Forage suitability group: Very Droughty Loam (G055AY130ND)
Hydric soil rating: No

Minor Components

Binford

Percent of map unit: 3 percent
Landform: Rises
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Shallow Gravel (R055AY046ND)
Hydric soil rating: No

Coe

Percent of map unit: 3 percent
Landform: Rises
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Very Shallow (R055AY053ND)
Hydric soil rating: No

Tonka

Percent of map unit: 2 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Wet Meadow (R055AY055ND)
Hydric soil rating: Yes

Walsh

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy Overflow (R055AY041ND)
Hydric soil rating: No

F523A—Lowe-Fluvaquents, channeled complex, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2q56j
Elevation: 950 to 2,530 feet
Mean annual precipitation: 16 to 23 inches
Mean annual air temperature: 36 to 43 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Fluvaquents, channeled, frequently flooded, and similar soils: 40 percent
Lowe, frequently flooded, and similar soils: 28 percent
Lowe, moderately saline, frequently flooded, and similar soils: 20 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fluvaquents, Channeled, Frequently Flooded

Setting

Landform: Drainageways
Microfeatures of landform position: Channels
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 5 inches: fine sandy loam
Cg - 5 to 79 inches: stratified loamy sand to silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Frequent
Frequency of ponding: Rare
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: A/D
Ecological site: Non-Site (R055AY999ND)
Forage suitability group: Not suited (G055AY000ND)
Hydric soil rating: Yes

Description of Lowe, Frequently Flooded

Setting

Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fine-loamy alluvium

Typical profile

Ak - 0 to 8 inches: loam
Bkg - 8 to 32 inches: loam
Akgb - 32 to 38 inches: loam
Cg - 38 to 79 inches: stratified loam to sandy loam to sandy clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: Rare
Calcium carbonate, maximum in profile: 45 percent
Gypsum, maximum in profile: 3 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: B/D
Ecological site: Wet Meadow (R055AY055ND)
Forage suitability group: Wet (G055AY900ND)
Hydric soil rating: Yes

Description of Lowe, Moderately Saline, Frequently Flooded

Setting

Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fine-loamy alluvium

Typical profile

Akz - 0 to 8 inches: loam
Bkzg - 8 to 32 inches: loam
Akzgb - 32 to 38 inches: loam
Cg - 38 to 79 inches: stratified loam to sandy loam to sandy clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: Rare
Calcium carbonate, maximum in profile: 45 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: B/D
Ecological site: Saline Lowland (R055AY042ND)
Forage suitability group: Saline (G055AY895ND)
Hydric soil rating: Yes

Minor Components

Lowe, very poorly drained, frequently flooded

Percent of map unit: 5 percent
Landform: Drainageways
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Shallow Marsh (R055AY054ND)
Hydric soil rating: Yes

Moritz, frequently flooded

Percent of map unit: 5 percent

Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Limy Subirrigated (R055AY040ND)
Hydric soil rating: No

La prairie, frequently flooded

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy Overflow (R055AY041ND)
Hydric soil rating: No

F563A—Fluvaquents, channeled-Fairdale complex, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2q56w
Elevation: 950 to 2,530 feet
Mean annual precipitation: 16 to 23 inches
Mean annual air temperature: 36 to 43 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Fluvaquents, channeled, frequently flooded, and similar soils: 40 percent
Fairdale, frequently flooded, and similar soils: 27 percent
Minor components: 33 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fluvaquents, Channeled, Frequently Flooded

Setting

Landform: Drainageways
Microfeatures of landform position: Channels
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 5 inches: fine sandy loam
Cg - 5 to 79 inches: stratified loamy sand to silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches

Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Frequent
Frequency of ponding: Rare
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: A/D
Ecological site: Non-Site (R055AY999ND)
Forage suitability group: Not suited (G055AY000ND)
Hydric soil rating: Yes

Description of Fairdale, Frequently Flooded

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Fine-loamy alluvium

Typical profile

A - 0 to 7 inches: loam
BC - 7 to 40 inches: loam
Ab - 40 to 64 inches: silt loam
C' - 64 to 79 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: B
Ecological site: Loamy Overflow (R055AY041ND)
Forage suitability group: Overflow (G055AY500ND)

Hydric soil rating: No

Minor Components

La prairie, frequently flooded
Percent of map unit: 11 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy Overflow (R055AY041ND)
Hydric soil rating: No

Velva, moist, frequently flooded
Percent of map unit: 10 percent
Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Loamy Overflow (R055AY041ND)
Hydric soil rating: No

Cashel, frequently flooded
Percent of map unit: 6 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Subirrigated (R055AY048ND)
Hydric soil rating: No

Rauville, frequently flooded
Percent of map unit: 3 percent
Landform: Drainageways
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Shallow Marsh (R055AY054ND)
Hydric soil rating: Yes

Lowe, frequently flooded
Percent of map unit: 3 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Wet Meadow (R055AY055ND)
Hydric soil rating: Yes

F567A—Fairdale loam, 0 to 2 percent slopes, occasionally flooded

Map Unit Setting
National map unit symbol: 2q56z

Elevation: 950 to 2,530 feet
Mean annual precipitation: 16 to 23 inches
Mean annual air temperature: 36 to 43 degrees F
Frost-free period: 110 to 150 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Fairdale, occasionally flooded, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fairdale, Occasionally Flooded

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Fine-loamy alluvium

Typical profile

Ap - 0 to 7 inches: loam
BC - 7 to 40 inches: loam
Ab - 40 to 64 inches: silt loam
C' - 64 to 79 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2c
Hydrologic Soil Group: B
Ecological site: Loamy (R055AY047ND)
Forage suitability group: Loam (G055AY100ND)
Hydric soil rating: No

Minor Components

Cashel, occasionally flooded

Percent of map unit: 6 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Concave

Ecological site: Subirrigated (R055AY048ND)
Hydric soil rating: No

La prairie, occasionally flooded
Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy (R055AY047ND)
Hydric soil rating: No

Fluvaquents, channeled, frequently flooded
Percent of map unit: 5 percent
Landform: Drainageways
Microfeatures of landform position: Channels
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Non-Site (R055AY999ND)
Hydric soil rating: Yes

Lowe, frequently flooded
Percent of map unit: 4 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Wet Meadow (R055AY055ND)
Hydric soil rating: Yes

F592F—Kloten-Walsh-Edgeley loams, 6 to 35 percent slopes

Map Unit Setting
National map unit symbol: 2q5d8
Elevation: 950 to 2,530 feet
Mean annual precipitation: 16 to 23 inches
Mean annual air temperature: 36 to 43 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition
Kloten and similar soils: 61 percent
Walsh and similar soils: 19 percent
Edgeley and similar soils: 17 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kloten

Setting
Landform: Escarpments
Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from shale

Typical profile

A - 0 to 6 inches: loam
AC - 6 to 14 inches: parachannery clay loam
Cr - 14 to 79 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 7 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: Shallow Loamy (R055AY057ND)
Forage suitability group: Not suited (G055AY000ND)
Hydric soil rating: No

Description of Walsh

Setting

Landform: Escarpments
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Shaly fine-loamy colluvium

Typical profile

A - 0 to 12 inches: loam
Bw - 12 to 26 inches: loam
C - 26 to 79 inches: loam

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy (R055AY047ND)
Forage suitability group: Loam (G055AY100ND)
Hydric soil rating: No

Description of Edgeley

Setting

Landform: Escarpments
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium over residuum weathered from shale

Typical profile

A - 0 to 7 inches: loam
BA - 7 to 15 inches: loam
Bw1 - 15 to 23 inches: clay loam
Bw2 - 23 to 32 inches: parachannery silty clay loam
2Cr - 32 to 79 inches: bedrock

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: Loamy (R055AY047ND)
Forage suitability group: Not suited (G055AY000ND)
Hydric soil rating: No

Minor Components

Buse

Percent of map unit: 3 percent
Landform: Moraines
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Thin Loamy (R055AY052ND)
Hydric soil rating: No

F641F—Udarents loamy, earthen dam, 1 to 75 percent slopes

Map Unit Setting

National map unit symbol: 2q5dv
Elevation: 1,200 to 2,490 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 37 to 39 degrees F
Frost-free period: 110 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Udarents, loamy, earthen dam, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udarents, Loamy, Earthen Dam

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Till

Typical profile

A - 0 to 6 inches: loam
AC - 6 to 12 inches: sandy clay loam
C1 - 12 to 25 inches: clay loam
C2 - 25 to 35 inches: clay loam
C3 - 35 to 42 inches: gravelly loam
C4 - 42 to 60 inches: clay loam

Properties and qualities

Slope: 1 to 75 percent
Percent of area covered with surface fragments: 0.5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Gypsum, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: Non-Site (R055AY999ND)
Forage suitability group: Not suited (G055AY000ND)
Hydric soil rating: No

F996—Water

Map Unit Setting

National map unit symbol: 2q5mr
Elevation: 1,200 to 2,490 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 37 to 39 degrees F
Frost-free period: 110 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Interpretive groups

Land capability classification (irrigated): None specified
Ecological site: Non-Site (R055AY999ND)

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APPENDIX B

As-Built Drawings

FLOOD RETARDING
FISH & WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

GRAND FORKS, NELSON, & WALSH COUNTIES, NORTH DAKOTA

SPONSORS

NELSON COUNTY SOIL CONSERVATION DISTRICT
THREE RIVERS SOIL CONSERVATION DISTRICT
WALSH COUNTY SOIL CONSERVATION DISTRICT
WESTERN GRAND FORKS COUNTY SOIL CONSERVATION DISTRICT
EASTERN GRAND FORKS COUNTY SOIL CONSERVATION DISTRICT
WALSH COUNTY WATER MANAGEMENT DISTRICT

CONSTRUCTION DATA:

CONSTRUCTION STARTED: AUGUST 7, 1964
COMPLETED: AUGUST 19, 1966
CONTRACTOR: Wm CLAIRMONT INC., BISMARCK, NO. DAKOTA
PROJECT ENGINEER: WILLIS J. DEMKE
ENGINEER: RICHARD BERGANTINE
PROJECT INSPECTORS: MEL ASKEW
GENE ANDREWS
ELMER BITTNER

BENCH MARK DATA:

BM	ELEVATION	LOCATION
T-13	1365.00	BRASS CAP IN CONCRETE - 75 FEET EAST OF E SOUTH END OF DAM
B-12	1295.00	BRASS CAP IN CONCRETE - 10 FEET SOUTH OF ABUTMENT TOE DRAIN IN SOUTH WALL OF OUTLET CHUTE OF PRINCIPAL SPILLWAY

ELEVATION DATA OF STRUCTURAL ITEMS:

FOUNDATION DRAIN OUTLETS	ELEVATION INSTALLED
NORTH OUTLET	1287.00
SOUTH OUTLET	1296.17
* RISER	
TOP	1354.20
FLOOR	1306.00

* See report and data on conduit settlement recordings on file at Bismarck State office SCS, BISMARCK, NO. DAKOTA

INDEX

SHEET	
1, 2, 3	TABLE OF QUANTITIES, LOCATION MAP, TOPOGRAPHIC MAP OF RESERVOIR AREA
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4A	DELETED FROM CONTRACT
4B	INSTALLATION OF GATE
5.	PROFILE ALONG E DAM LOG OF SOIL BORINGS
6.	MAXIMUM SECTION. PROFILE ALONG E OF DAM
7.	CROSS SECTION OF DAM ALONG E PRINCIPAL SPILLWAY PRINCIPAL SPILLWAY DETAILS
8, 9, 9A, 9B	DETAILS - TRANSVERSE DRAINS
10, 11	DRAWDOWN STRUCTURE
12	DETAILS OF INLET
13-18	DETAILS OF STEEL INLET STRUCTURE
19-21	DETAILS OF TRASH RACKS
22-35	STEEL PLACING PRIN. SPWY. & SA.F. BASIN
1-A	FLOOD ROUTING

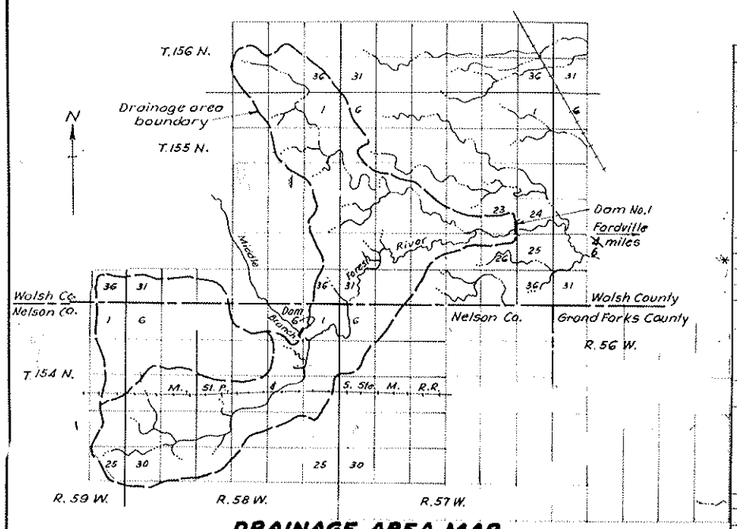
"AS BUILTS"

FLOOD RETARDING-FISH AND WILDLIFE DAM No.1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed J.M.M. D.E.M. 5-64	Date	Approved by
Drawn		Title
Traced		Date
Checked RWB WRE		Sheet No. of Sheets; Drawing No. SE-20,230

SCS-313 (9-64)



DRAINAGE AREA MAP

Scale: 1" = 1 Mile
D.A. = 45.9 sq. mi.

TABLE OF QUANTITIES

"AS BUILT"

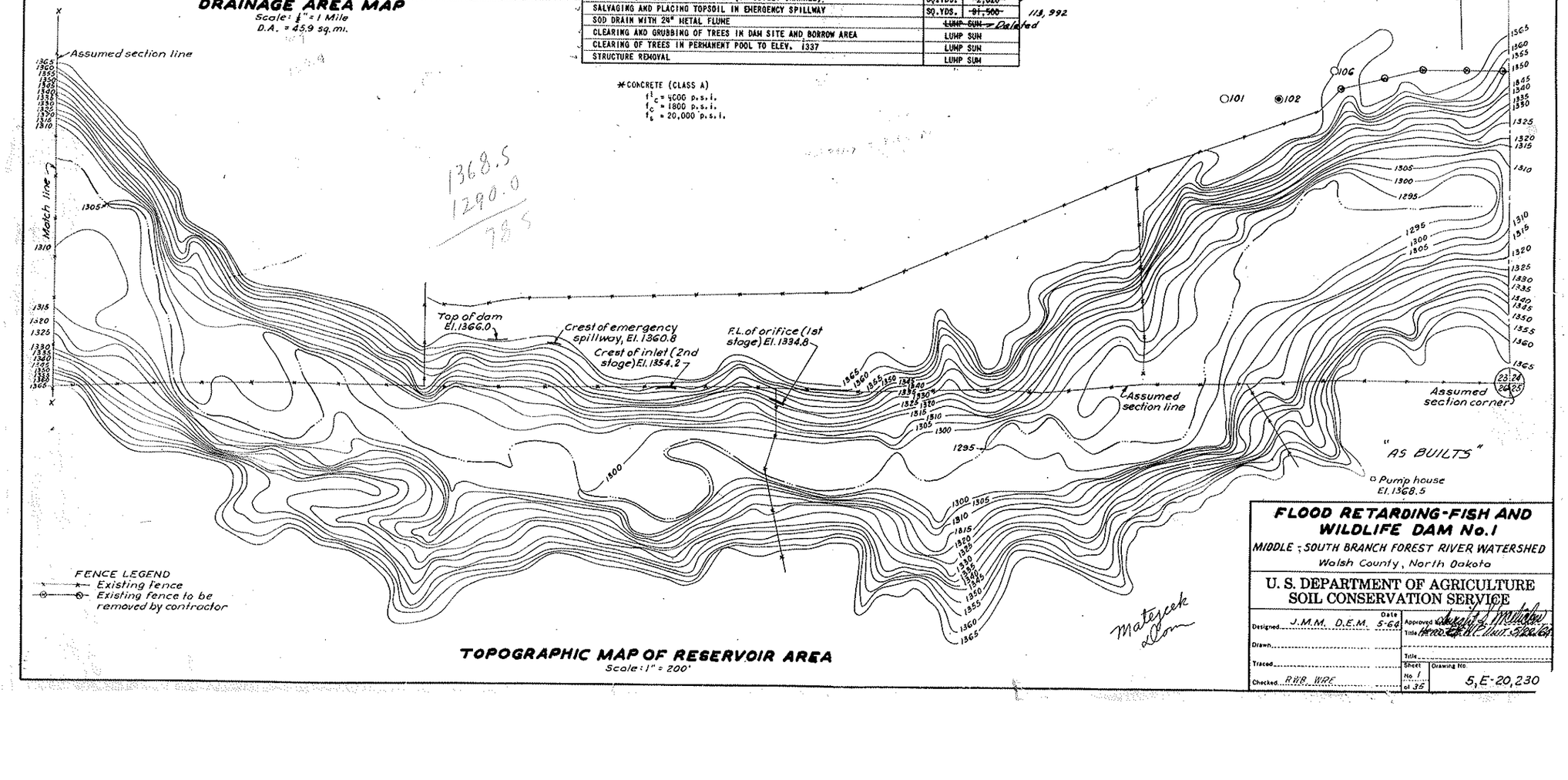
ITEM	UNIT	QUANTITY	
COMPACTED EARTH FILL, CLASS B-1, IN ZONE I OF DAM, CUTOFF TRENCH AND CONDUIT TRENCH	CU.YDS.	~~127,090~~	
COMPACTED EARTH FILL, CLASS B-1, IN ZONE II OF DAM	CU.YDS.	~~179,070~~	
COMPACTED EARTH FILL, CLASS B-1, IN ZONE III OF DAM	CU.YDS.	~~110,880~~	520,803
COMPACTED EARTH FILL, CLASS B-1, IN OUTLET CHANNEL AND DIKE, EMERGENCY SPILLWAY AND SPILLWAY DIKE	CU.YDS.	~~55,600~~	
EXCAVATION: A. EMERGENCY SPILLWAY	CU.YDS.	350,600	
B. OUTLET CHANNEL	CU.YDS.	1,630	
C. CONDUIT TRENCH	CU.YDS.	3,040	
D. CUTOFF TRENCH	CU.YDS.	14,080	44,851
E. FOUNDATION REMOVAL	CU.YDS.	16,470	
F. FOUNDATION DRAINS	CU.YDS.	760	
G. STRUCTURAL	CU.YDS.	40	
CONDUIT TRENCH BACKFILL	CU.YDS.	325	
CONCRETE (CLASS A) AIR ENTRAINED	CU.YDS.	~~717.1~~	723.5
STEEL BAR REINFORCEMENT	LBS.	~~120,666~~	125,937
TRASH RACK (PER DETAILS) 4 REQUIRED	LUMP SUM		
24" DIA. METAL SLIDE GATE WITH SPIGOT BACK AND 39 3/4" HIGH GATE FRAME (ARMCO MODEL 50-10C OR EQUAL) ONE REQUIRED PER DETAILS	LUMP SUM		
GATE LIFTING MECHANISM, CONSISTING OF GATE STEM, OIL RETAINERS, PIPE HOUSING WITH UNION, STEM SLEEVES, STEM COUPLINGS, OIL FILL PIPE, BASE ANGLE, FASTENING STRAPS AND A 30" DIA. HANDWHEEL LIFT (ARMCO MODEL HB-30 OR EQUAL) WITH BRONZE LIFT NUT	LUMP SUM		
24" DIA., CLASS V (6,000 LBS. PER LIN.FT.) R.C. PIPE WITH R-4 JOINTS AND RUBBER GASKETS	LIN.FT.	111	
FOUNDATION DRAINS: A. PIT-RUN SAND-GRAVEL	CU.YDS.	~~690~~	751
B. 6" DIA. ASBESTOS CEMENT NONPERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150, OR EQUAL)	LIN.FT.	~~216~~	241
C. 6" DIA. ASBESTOS CEMENT PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE, CLASS 150, OR EQUAL)	LIN.FT.	~~201~~	251
ROCK RIPRAP AND FILTER BLANKET (ON FACE OF DAM)	SQ.YDS.	~~5,000~~	6830
ROCK RIPRAP AND FILTER BLANKET (IN OUTLET CHANNEL)	SQ.YDS.	~~2,080~~	
SALVAGING AND PLACING TOPSOIL IN EMERGENCY SPILLWAY	SQ.YDS.	~~81,500~~	113,992
SOD DRAIN WITH 24" METAL FLUME	~~LUMP SUM~~ = Deleted		
CLEARING AND GRUBBING OF TREES IN DAM SITE AND BORROW AREA	LUMP SUM		
CLEARING OF TREES IN PERMANENT POOL TO ELEV. 1337	LUMP SUM		
STRUCTURE REMOVAL	LUMP SUM		

*CONCRETE (CLASS A)
f'_c = 4000 p.s.i.
f_c = 1800 p.s.i.
f_s = 20,000 p.s.i.

RESERVOIR CAPACITY TABLE

ELEV.	AREA-ACRES	STORAGE ACRE FEET	ACCUM. STORAGE ACRE FEET
1290.0	0	0	0
1295.0	11.20	28.00	28.00
1300.0	22.60	84.50	112.50
1305.0	34.61	143.03	255.53
1308.56	45.82	143.17	398.70
1310.0	50.36	69.25	467.95
1315.0	66.62	292.45	760.40
1320.0	82.63	373.13	1133.53
1325.0	100.54	457.92	1591.45
1330.0	118.06	546.50	2137.95
1334.8	134.81	606.89	2744.84 ✓
1335.0	135.51	27.03	2771.87
1340.0	154.69	725.53	3497.40
1345.0	177.66	830.88	4328.28
1350.0	200.79	946.12	5274.40
1354.2	221.66	887.17	6161.57
1355.0	225.65	178.92	6340.49
1360.0	248.17	1184.54	7525.03
1360.8	252.78	200.38	7725.41 ✓
1365.0	276.95	1112.46	8837.87

DRAWDOWN
F.L. OF ORIFICE FIRST STAGE
CREST OF INLET SECOND STAGE
CREST OF EMERG. SPWY.



TOPOGRAPHIC MAP OF RESERVOIR AREA

Scale: 1" = 200'

1368.5
1290.0
78.5

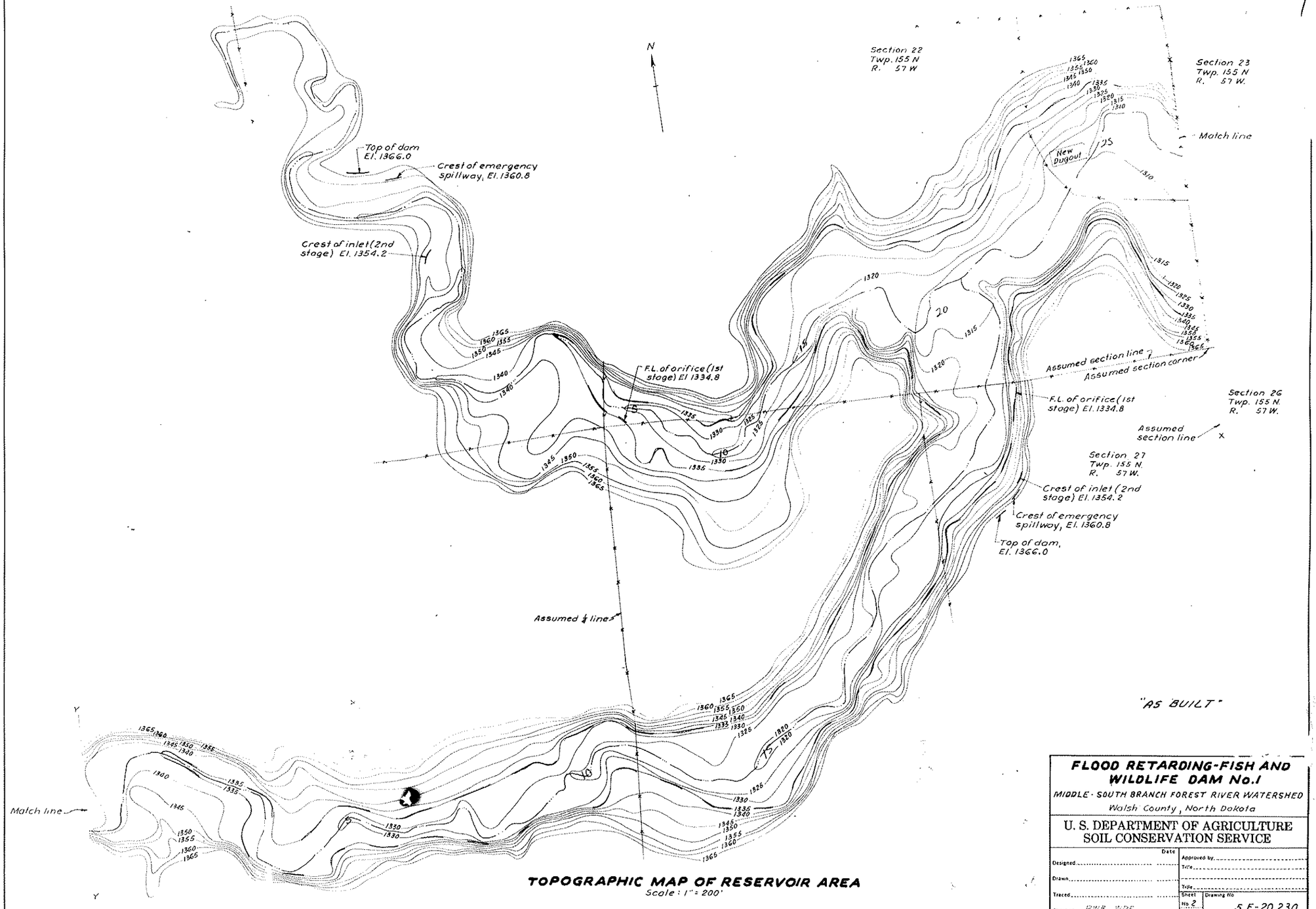
Mategeek Dam

FLOOD RETARDING-FISH AND WILDLIFE DAM No.1

MIDDLE ; SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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Traced		Title	
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TOPOGRAPHIC MAP OF RESERVOIR AREA
Scale: 1" = 200'

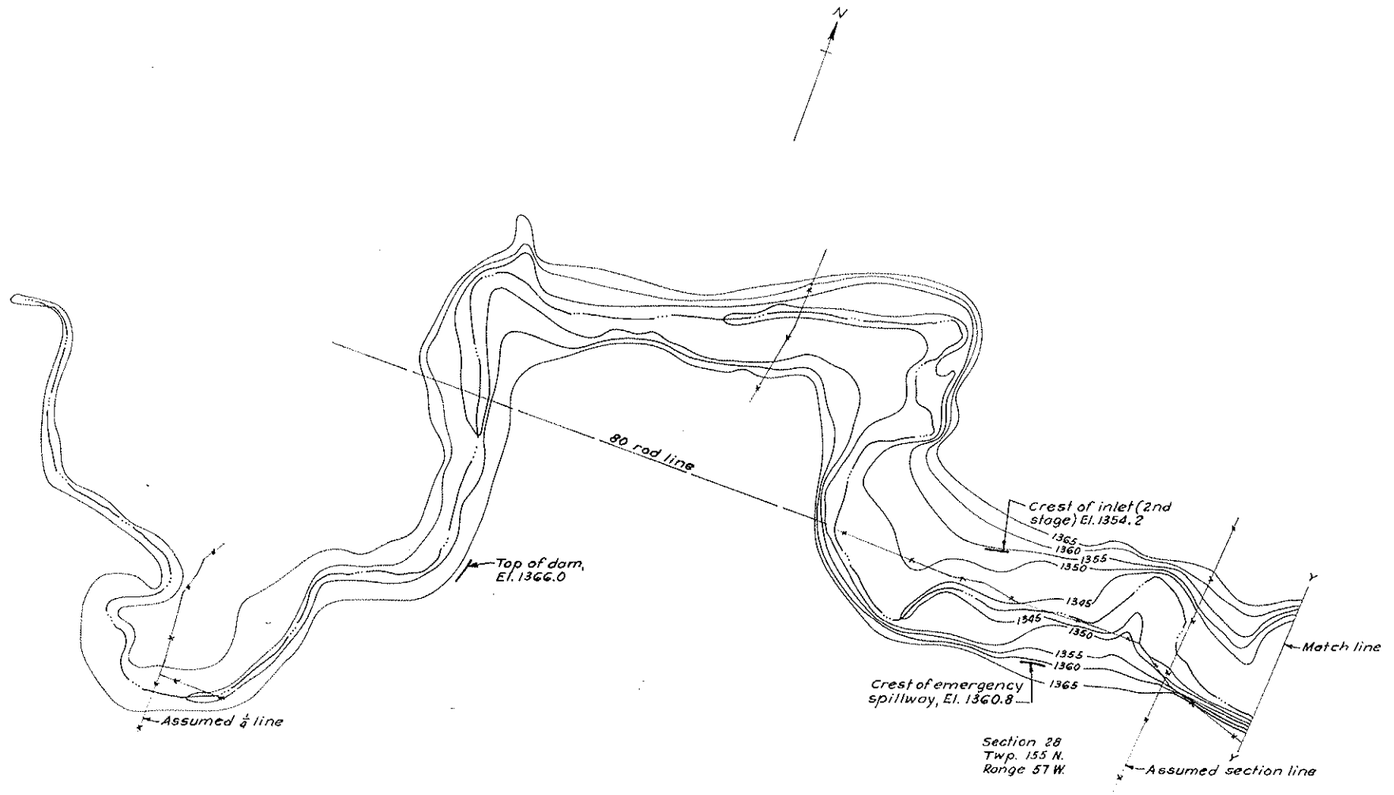
FLOOD RETARDING-FISH AND WILDLIFE DAM No.1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

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TOPOGRAPHIC MAP OF RESERVOIR AREA

Scale: 1" = 200'

"AS BUILT"

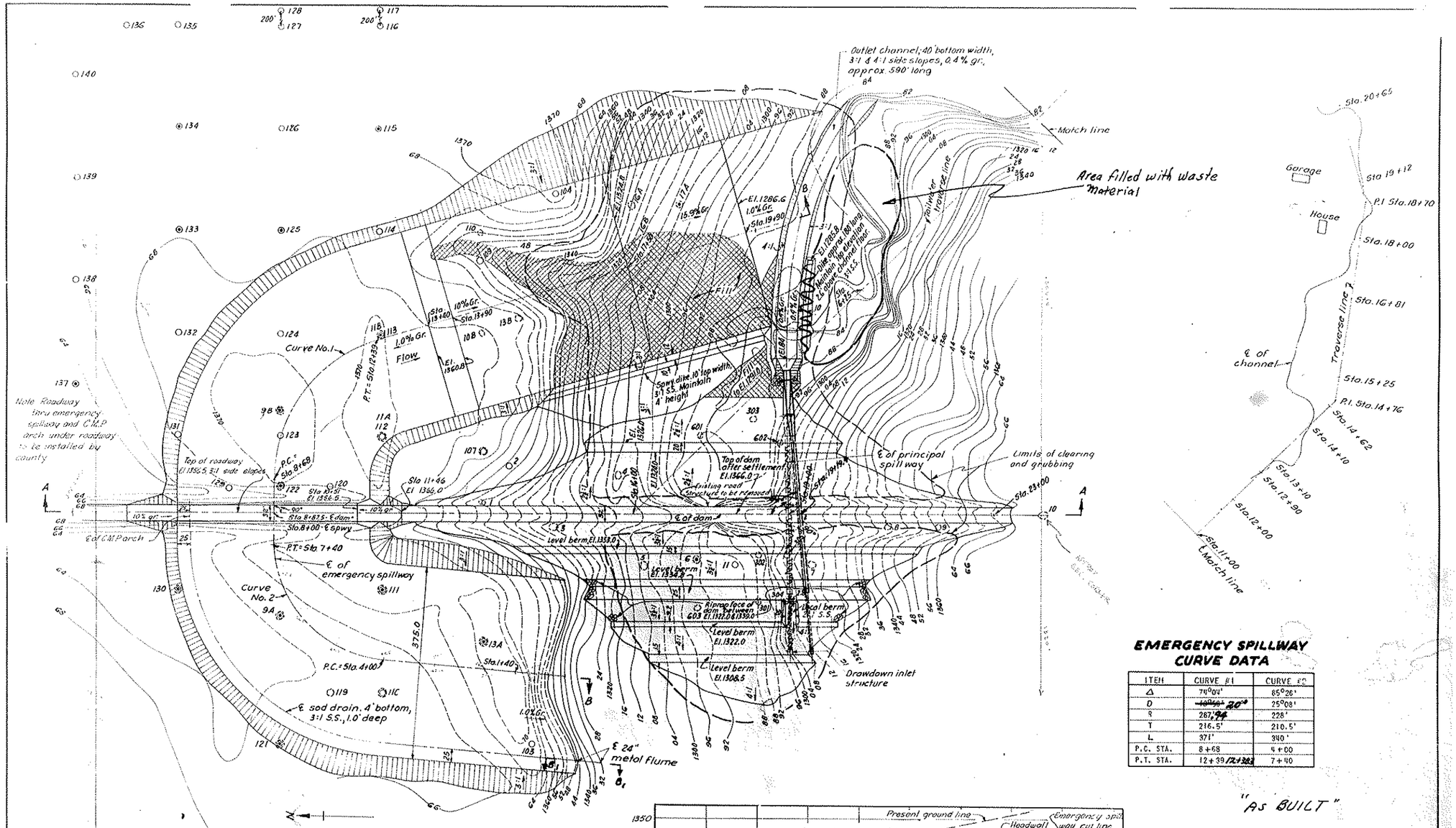
FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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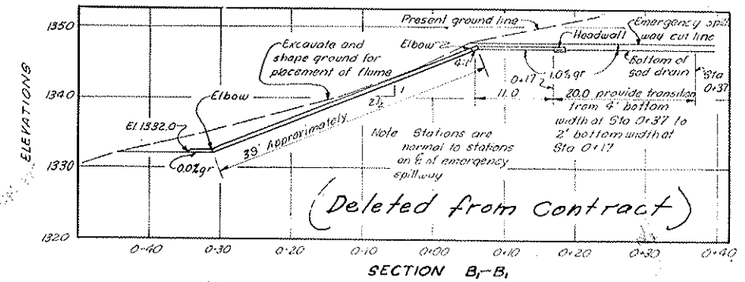
TOPOGRAPHIC MAP OF DAM SITE

Scale: 1" = 100'

EMERGENCY SPILLWAY CURVE DATA

ITEM	CURVE #1	CURVE #2
Δ	74°04'	85°26'
D	~~19°56'~~ 20°	25°08'
R	287.94	228'
T	216.5'	216.5'
L	371'	340'
P.C. STA.	8+68	4+00
P.T. STA.	12+39 ~~12+383~~	7+40

"AS BUILT"



SECTION B_1–B_1

DETAILS OF FLUME OUTLET FOR SOD DRAIN

Scale 1" = 10'

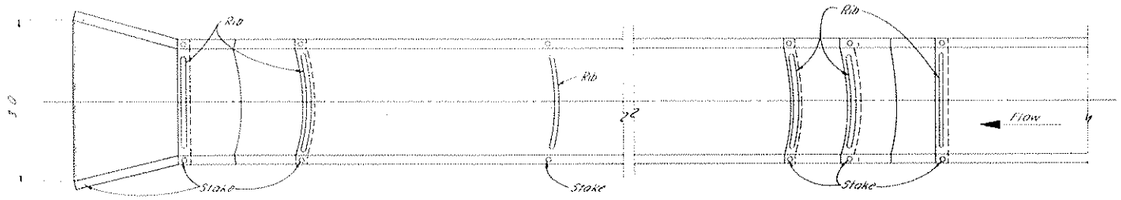
FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

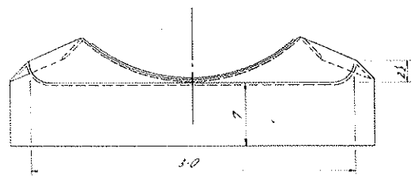
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
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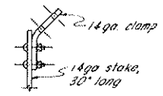
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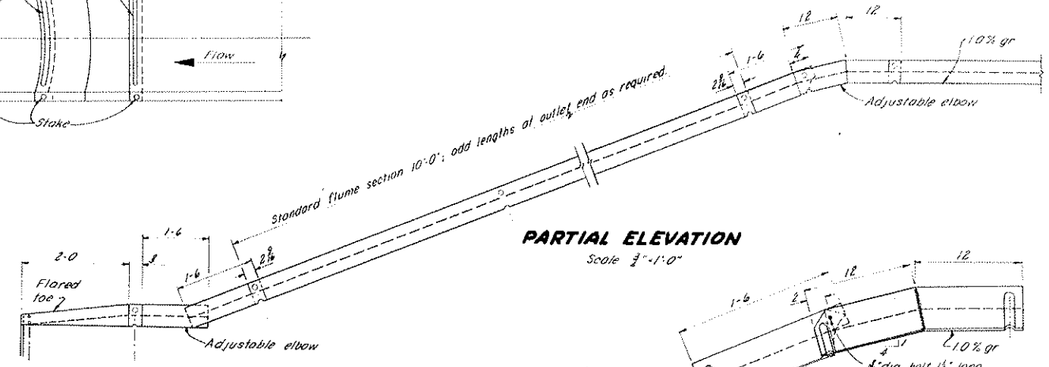
PARTIAL PLAN
Scale 1/4"=1'-0"



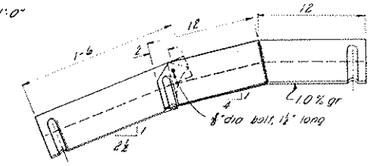
FLARED TOE DETAIL
Scale 1/2"=1'-0"



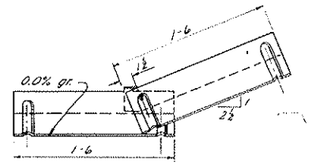
STAKE DETAIL
No scale



PARTIAL ELEVATION
Scale 3/4"=1'-0"



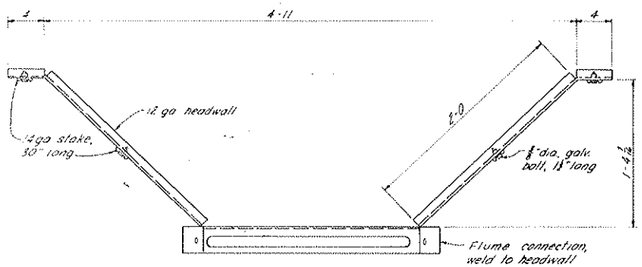
ADJUSTABLE TOP OF SLOPE ELBOW
Scale 1½"=1'-0"



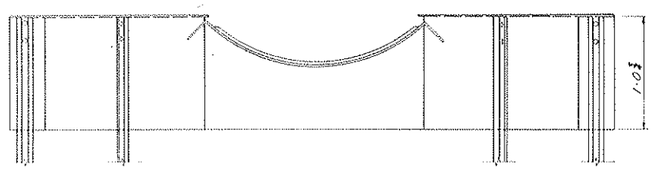
ADJUSTABLE TOE OF SLOPE ELBOW
Scale 1½"=1'-0"

MATERIAL LIST FOR FLUME

ITEM	QUANTITY
24" X 10'-0" STANDARD FLUME SECTION	4
24" X 5'-6" FLUME SECTION	1
24" X 12" X 12" WELDED ELBOW (TOP OF SLOPE)	1
24" X 1'-6" ADJUSTABLE ELBOW (TOP OF SLOPE)	1
24" X 1'-6" X 1'-6" ADJUSTABLE ELBOW (TOE OF SLOPE)	1
3/8" X 30" TENSION ROD, THREADED 3" ON EACH END WITH TWO WASHERS AND NUTS	12
3'-0" X 2'-3" FLARED TOE	1
12 GA., 30" LONG STAKE OR 14 GA., 30" LONG STAKE	24
HEADWALL STRUCTURE WITH BOLTS AND STAKES (PER DETAIL)	1
14 GA. CLAMPS	24
3/8" DIA. BOLTS, 1 1/2" LONG WITH WASHERS AND NUTS	48

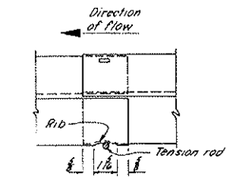


PLAN

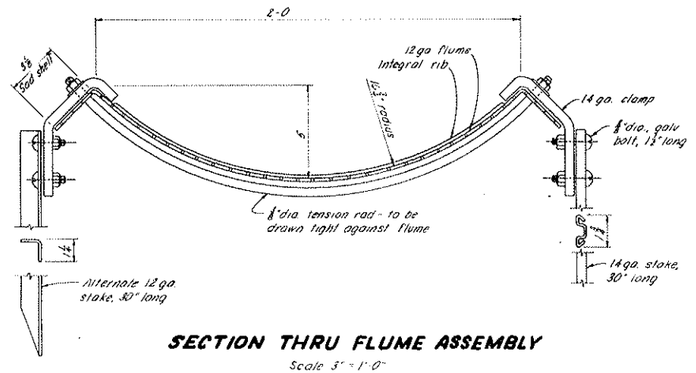


ELEVATION

DETAIL OF HEADWALL
Scale 1½"=1'-0"



DETAIL OF LAP JOINT IN FLUME
Scale: 3"=1'-0"



SECTION THRU FLUME ASSEMBLY
Scale 3"=1'-0"

AS BUILT PLANS

NOTES:
1. HEADWALL, FLUME, FLARED TOE TO BE MADE FROM 12 GA. COPPER STEEL.
2. ALL SHEET METAL PARTS HOT DIP GALVANIZED AFTER FABRICATION, MINIMUM 2 OZ. COATING.
3. ALL STAKES, CLAMPS AND BOLTS TO BE GALVANIZED.

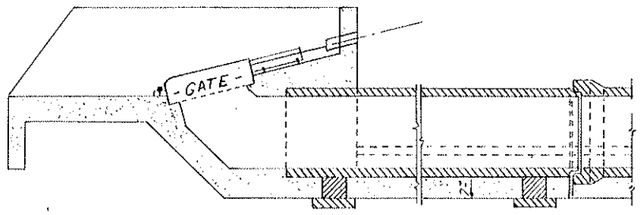
"Deleted from Contract"

DETAILS OF FLUME OUTLET FOR SOD DRAIN

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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SECTIONAL ELEVATION A-A
Scale 1" = 1'-0"

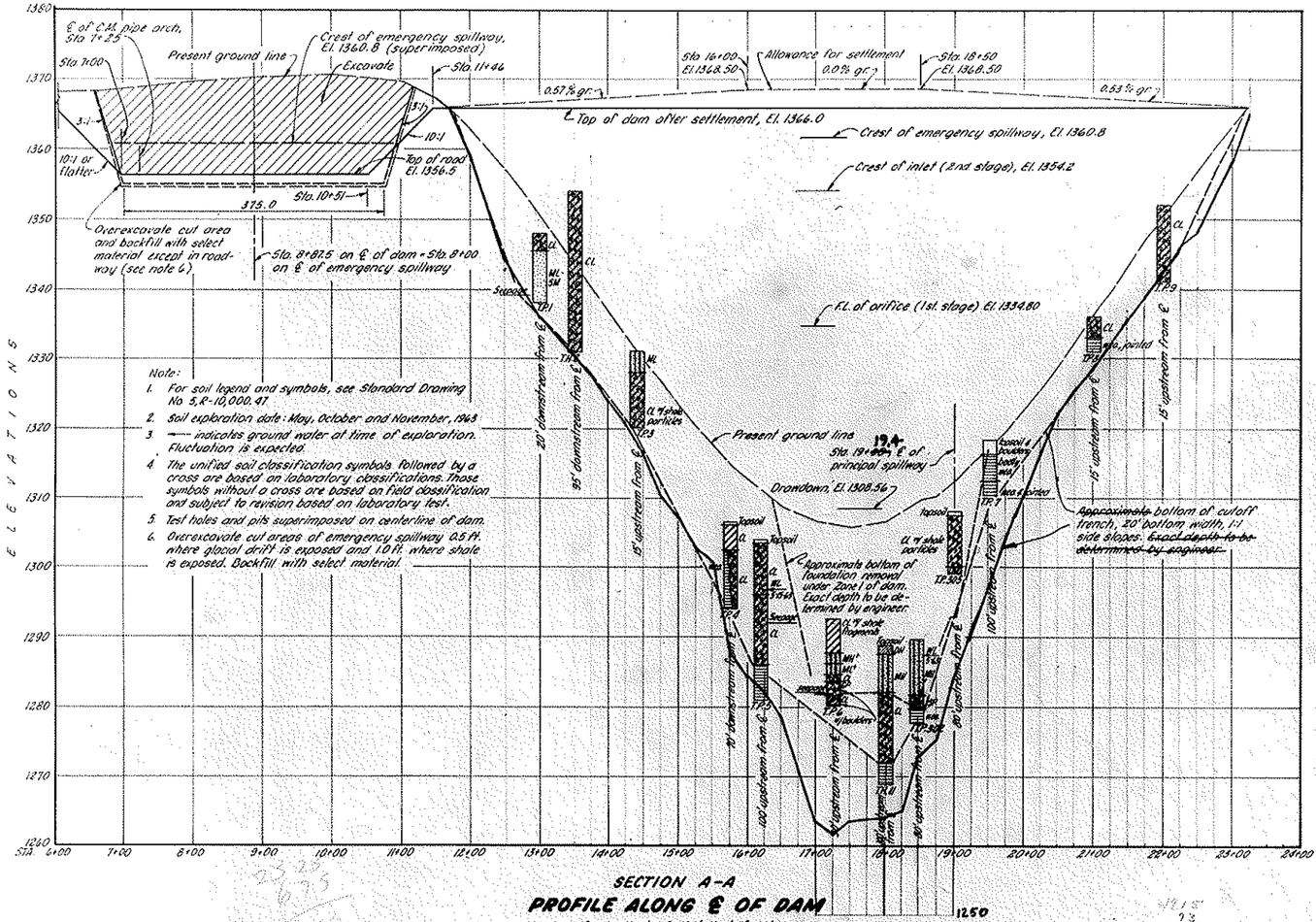
"AS Built" Installation of Gate

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1
MI.-SO. BR. FOREST RIVER WATERSHED
Walsh County North Dakota

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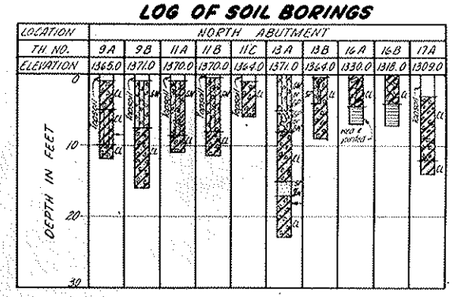


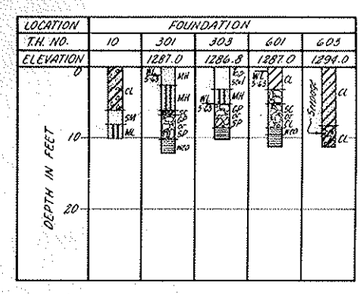
SECTION A-A

PROFILE ALONG ℄ OF DAM

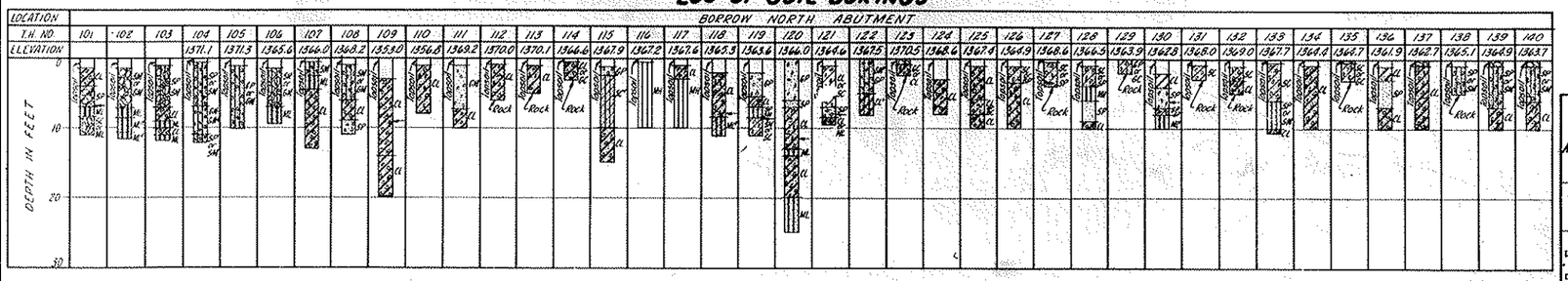
Scale: Horiz. 1"=100', Vert. 1"=10'

LOG OF SOIL BORINGS





LOG OF SOIL BORINGS



"AS BUILT"

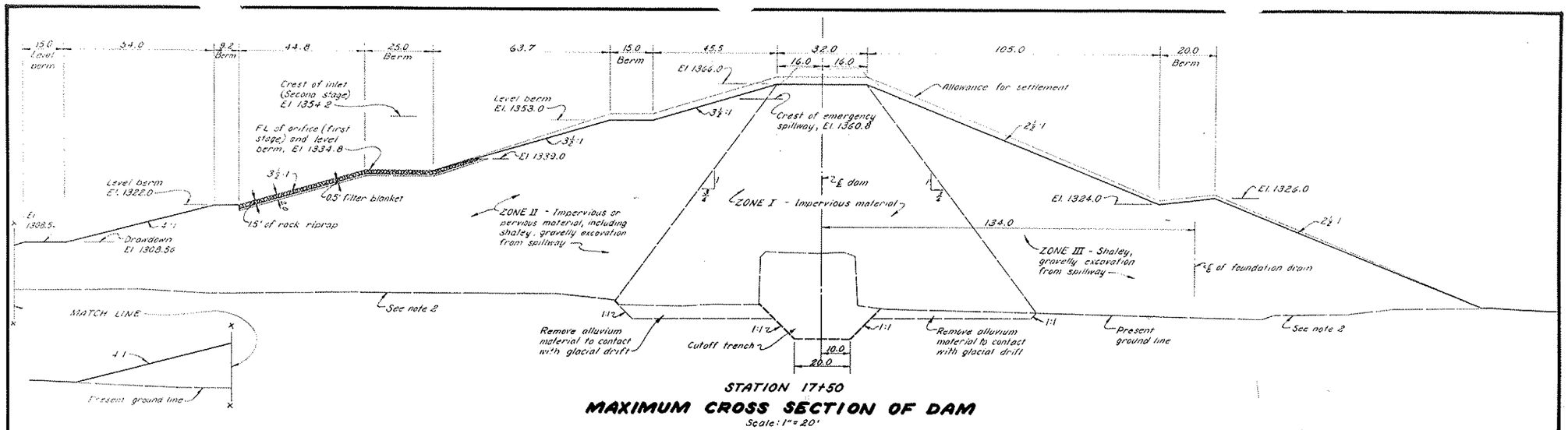
FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

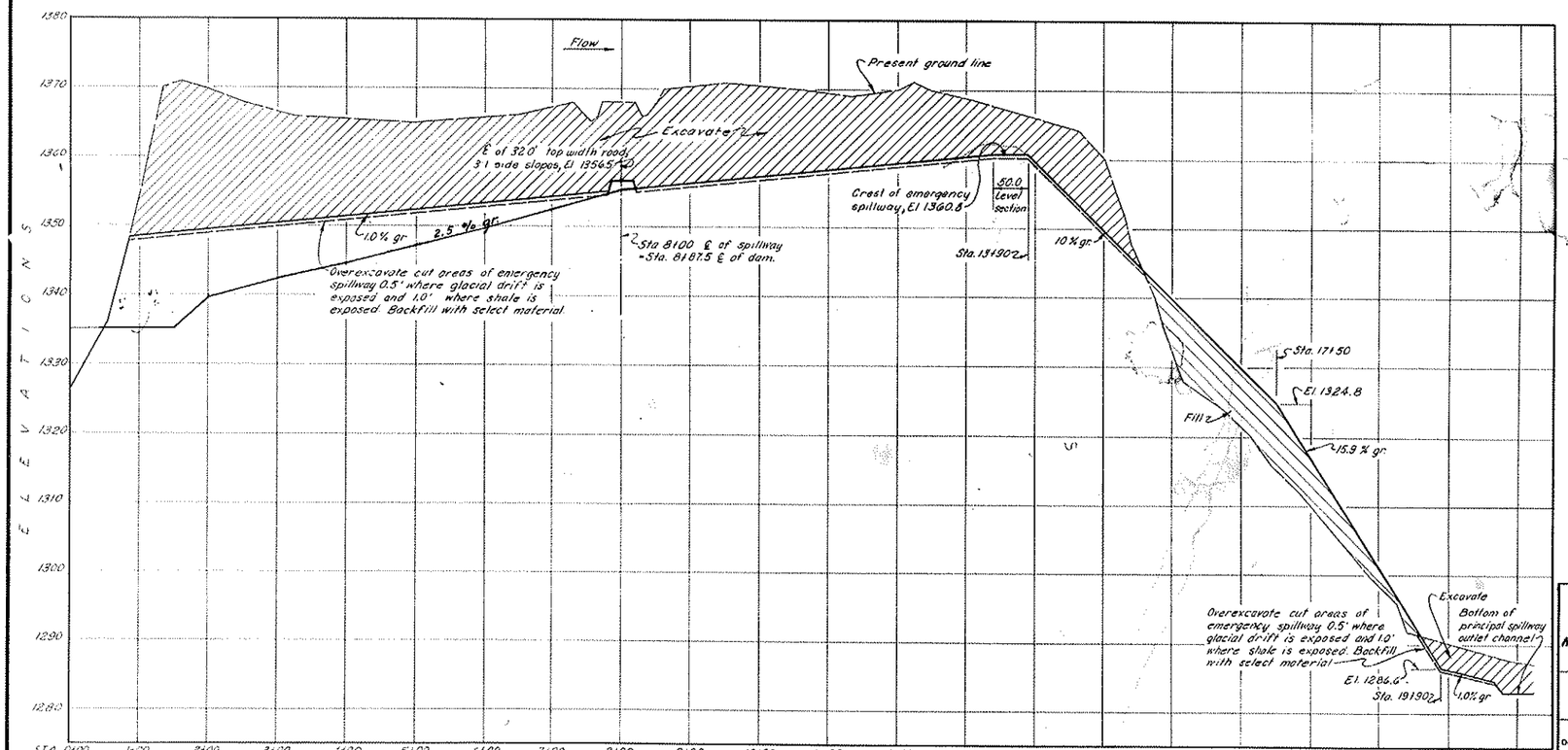
	Date		
Designed E.J.P., J.M.M.		Approved by	
Drawn E.J.P.		Title	
Traced		Title	
Checked D.E.M., W.P.E.		Sheet No. 5 of 35	Drawing No. 5,E-20,230



STATION 17+50

MAXIMUM CROSS SECTION OF DAM

Scale: 1" = 20'



SECTION B-B

PROFILE ALONG ℄ OF EMERGENCY SPILLWAY

Scale: Horiz. 1" = 100'; Vert 1" = 10'

NOTES:

1. THE FILTER BLANKET FOR THE ROCK RIPRAP SHALL CONSIST OF A WELL GRADED, TOUGH, HARD, DURABLE MATERIAL WITH MAXIMUM SIZE OF 3" AND WITH LESS THAN 50% PASSING A NO. 4 SIEVE AND LESS THAN 10% PASSING A NO. 200 SIEVE.
2. FOUNDATION REMOVAL SHALL INCLUDE:
   A. REMOVING ALL ALLUVIUM MATERIAL TO CONTACT WITH GLACIAL DRIFT UNDER ZONE I OF THE EMBANKMENT BETWEEN APPROXIMATE CENTERLINE STATIONS 17+00 AND 18+50.
   B. REMOVING ALL ALLUVIUM MATERIAL WITH DRY DENSITY OF LESS THAN 80 P.C.F. UNDER THE REMAINDER OF THE EMBANKMENT.

"AS BUILT"

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed		Approved by	
Drawn		Title	
Traced		Title	
Checked RWB, WRE	5-64	Sheet No. 6 of 32	Drawing No. 5,E-20,230

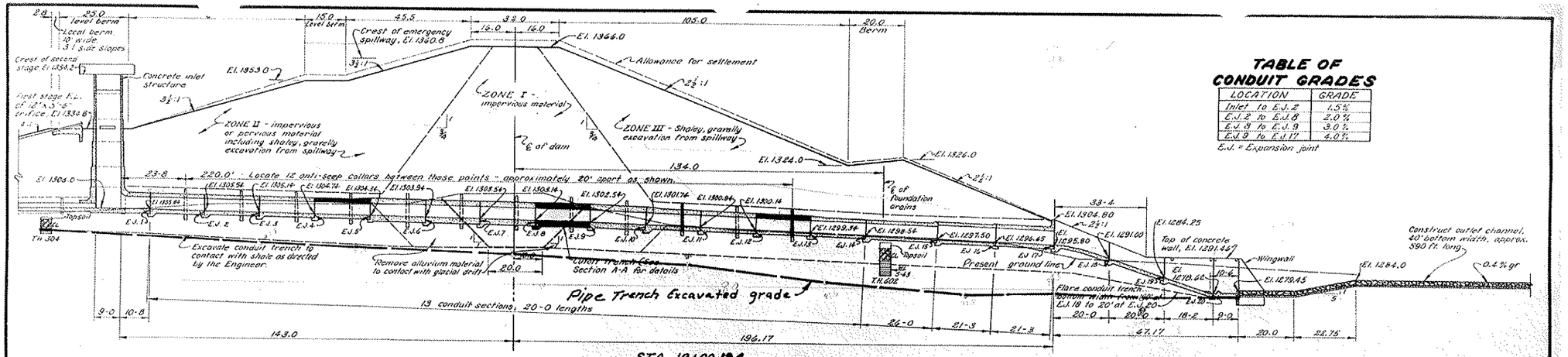


TABLE OF CONDUIT GRADES

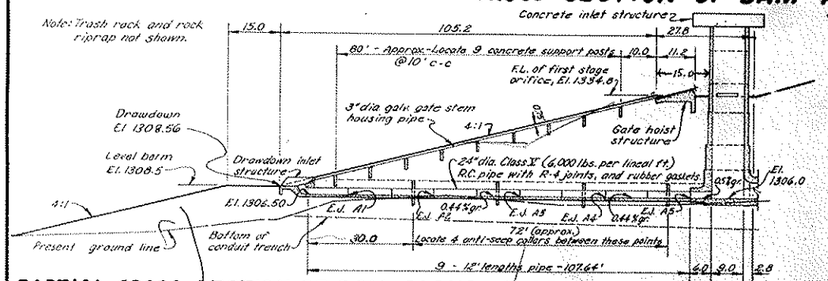
LOCATION	GRADE
Inlet to E.J. 2	1.5%
E.J. 2 to E.J. 8	2.0%
E.J. 8 to E.J. 9	3.0%
E.J. 9 to E.J. 17	4.0%

E.J. = Expansion joint

CROSS SECTION OF DAM ALONG ℄ OF PRINCIPAL SPILLWAY

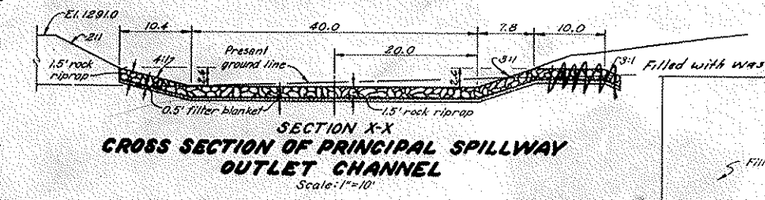
STA. 19+00 to 19+4

Scale: 1" = 20'



PARTIAL CROSS SECTION OF DAM ALONG ℄ OF PRINCIPAL SPILLWAY

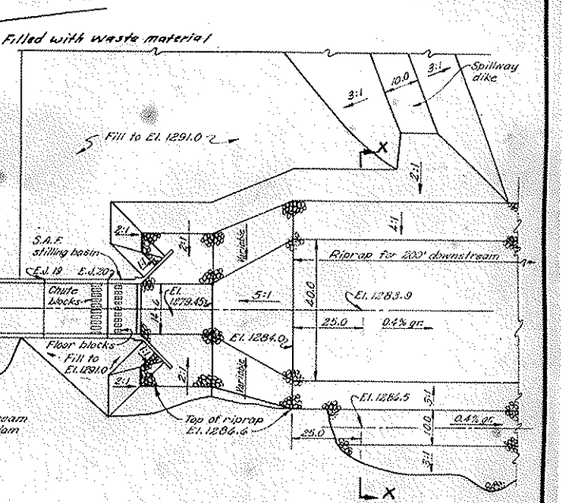
Scale: 1" = 20'

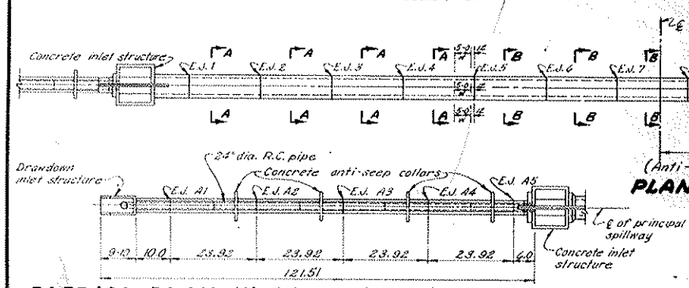


SECTION X-X

CROSS SECTION OF PRINCIPAL SPILLWAY OUTLET CHANNEL

Scale: 1" = 10'



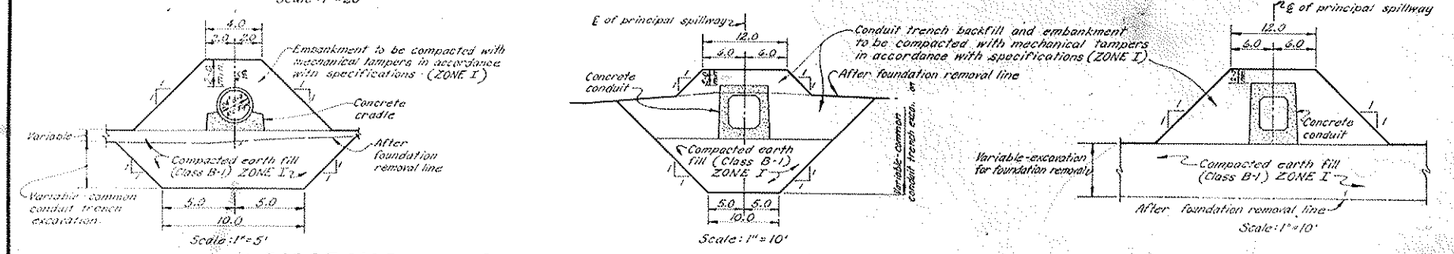


PLAN VIEW OF PRINCIPAL SPILLWAY

Scale: 1" = 20'

PARTIAL PLAN VIEW OF PRINCIPAL SPILLWAY

Scale: 1" = 20'



DIAGRAMS OF CONDUIT TRENCH - EXCAVATION, BACKFILL AND EMBANKMENT

"AS BUILT"

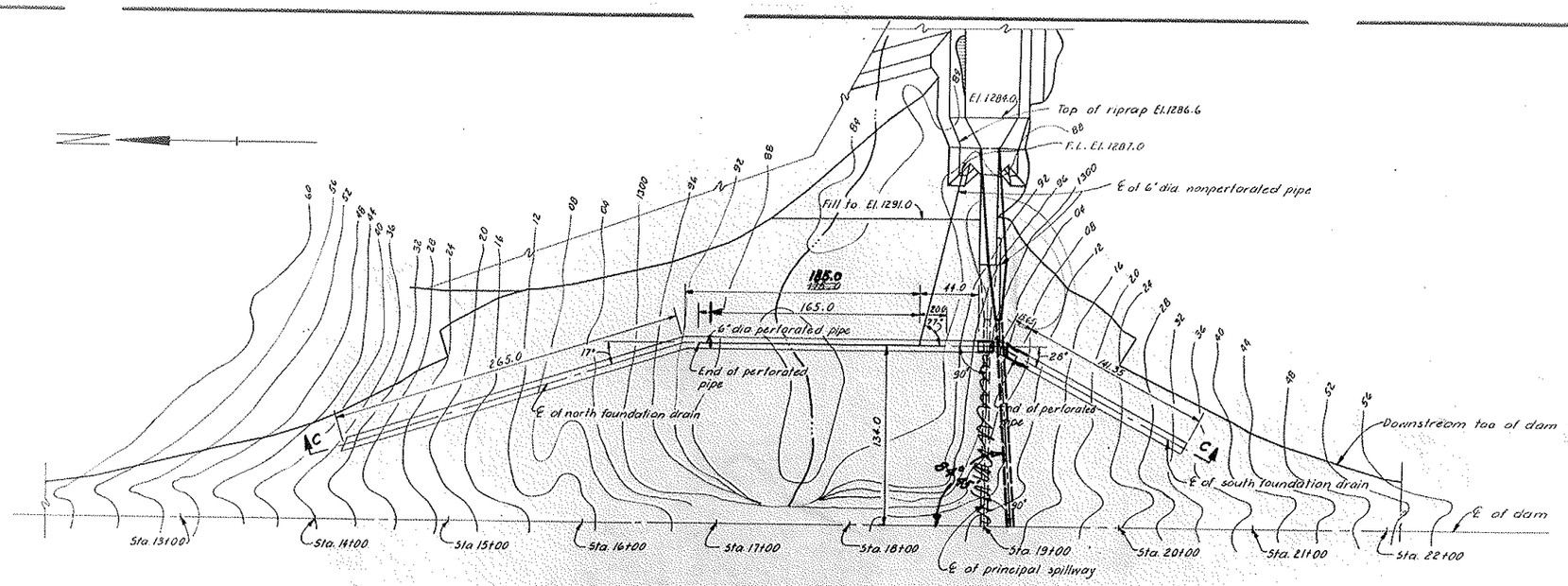
FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

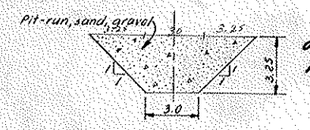
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed JMM, CEM		Approved by	
Drawn		Title	
Traced		Title	
Checked DEM, WRE	5-44	Sheet No. 7 of 35	Drawing No. 5, E-20, 230



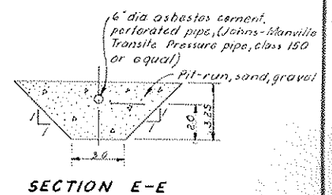
PARTIAL PLAN OF BASE OF DAM SHOWING FOUNDATION DRAINS

Scale: 1" = 50'

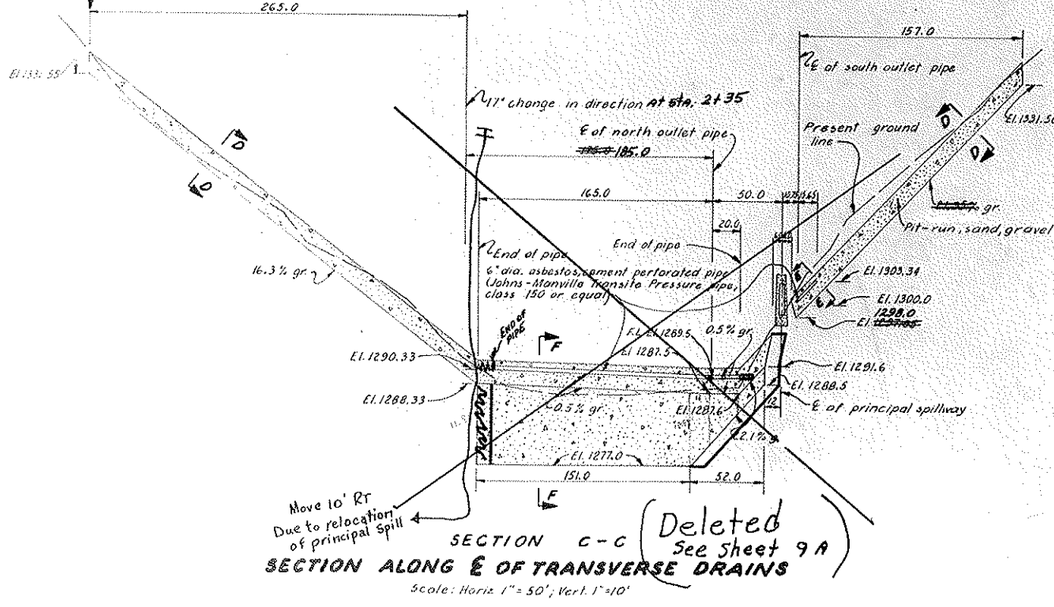


additional 10 ft. of D-D 7.52 cu yds.

SECTION D-D



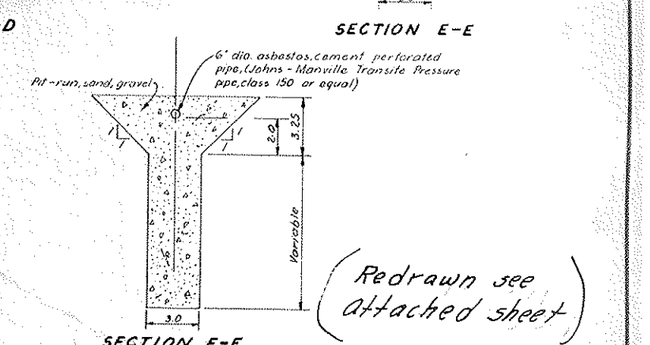
SECTION E-E



SECTION C-C

SECTION ALONG ℄ OF TRANSVERSE DRAINS

Scale: Horiz. 1" = 50'; Vert. 1" = 10'



(Redrawn see attached sheet)

SECTION F-F

DETAILS OF TRANSVERSE DRAINS AS BUILT PLANS

Scale: 1" = 4'

NOTES:

1. PROVIDE END CAP ON OUTLET END OF OUTLET PIPES. FOR DETAILS OF END CAPS, SEE STANDARD DRAWING NO. 6,R-10,000.55.
2. PLUG UPPER END OF PIPES WITH 6" OF CONCRETE.
3. THE DEPTH OF FILL OVER THE DRAIN PIPE SHALL BE AT LEAST 2' BEFORE PASSING HEAVY EQUIPMENT OVER THE PIPE.
4. WHERE TRANSVERSE DRAIN TRENCH IS ABOVE THE GROUND LINE, PLACE COMPACTED EARTH FILL TO ELEVATION AT TOP OF DRAINS AND EXCAVATE DRAIN IN COMPACTED FILL.
5. THE PIT-RUN SAND GRAVEL SHALL HAVE A MINIMUM OF 15% LARGER THAN 1/4" WITH A MAXIMUM SIZE OF 3" AND WITH LESS THAN 5% PASSING THE NO. 200 SIEVE.

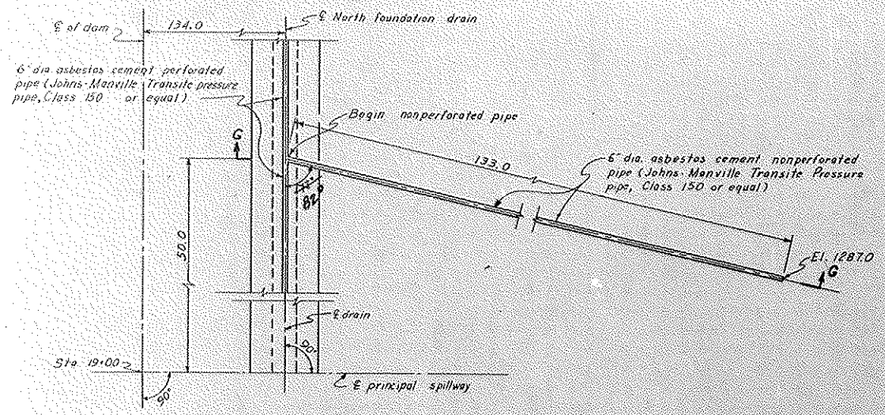
FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

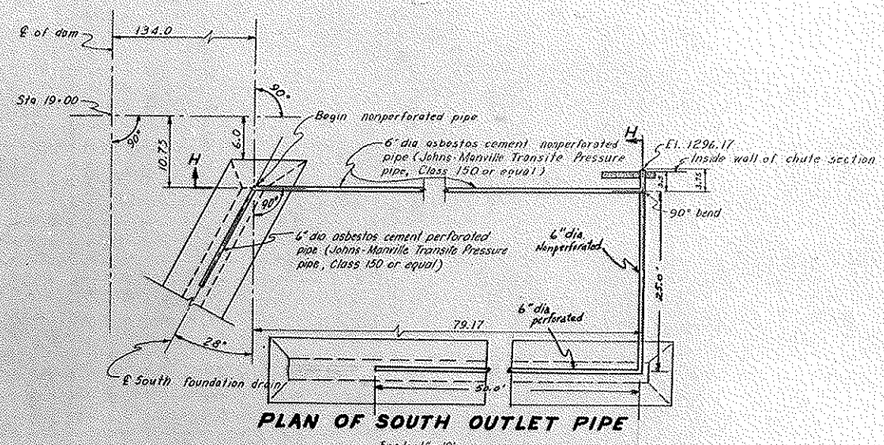
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed E.J.P., R.M.B.		Approved by	
Drawn		Title	
Traced		Title	
Checked D.E.M., H.R.F.	5-64	Sheet No. 8 of 35	Drawing No. 5,E-20,230



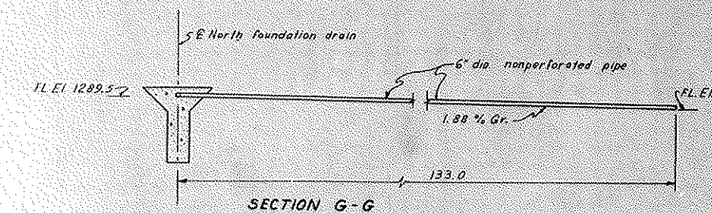
PLAN OF NORTH OUTLET PIPE

Scale: 1" = 10'



PLAN OF SOUTH OUTLET PIPE

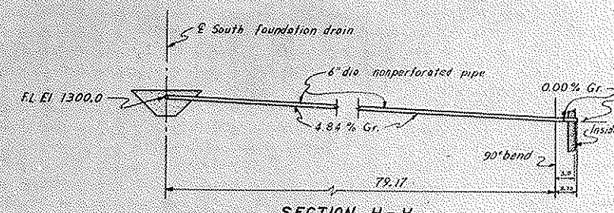
Scale: 1" = 10'



SECTION G-G

SECTION ALONG ℄ OF NORTH OUTLET PIPE

Scale 1" = 10'



SECTION H-H

SECTION ALONG ℄ OF SOUTH OUTLET PIPE

Scale: 1" = 10'

TABLE OF QUANTITIES FOR FOUNDATION DRAINS

ITEM	UNIT	QUANTITY
EXCAVATION	CU.YDS.	750
PIT-RUN SAND GRAVEL	CU.YDS.	~~500~~ 751
6" DIA. ASBESTOS CEMENT NON-PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150 OR EQUAL)	LIN.FT.	216
6" DIA. ASBESTOS CEMENT PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150 OR EQUAL)	LIN.FT.	201

AS BUILT

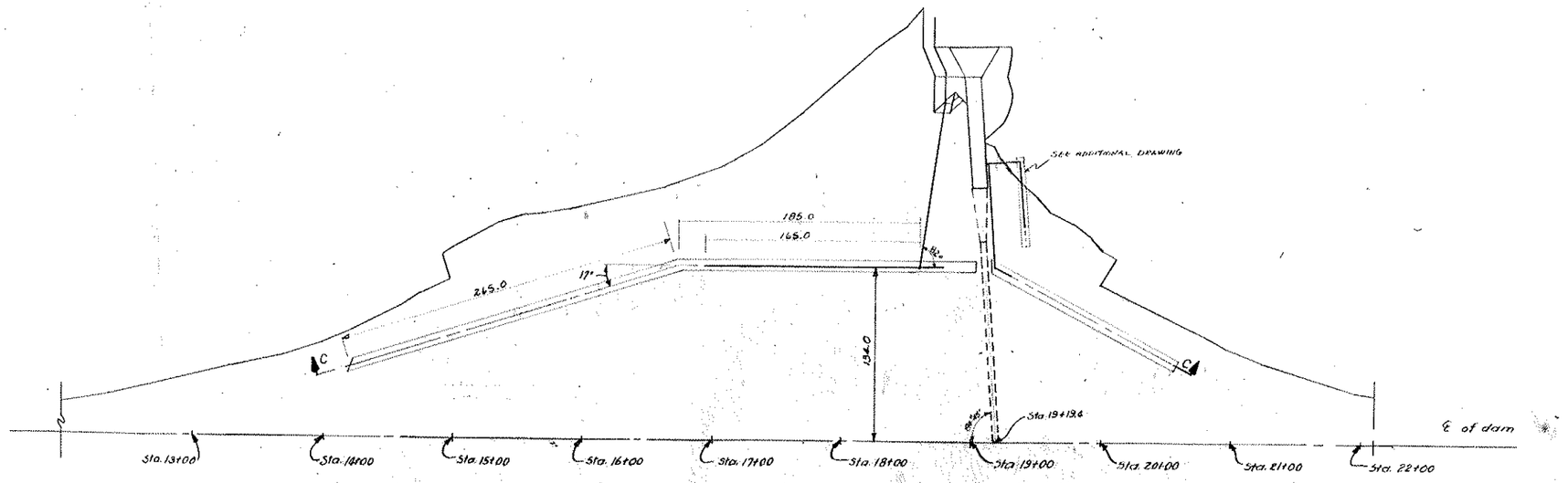
FLOOD RETARDING-FISH AND WILDLIFE DAM No.1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

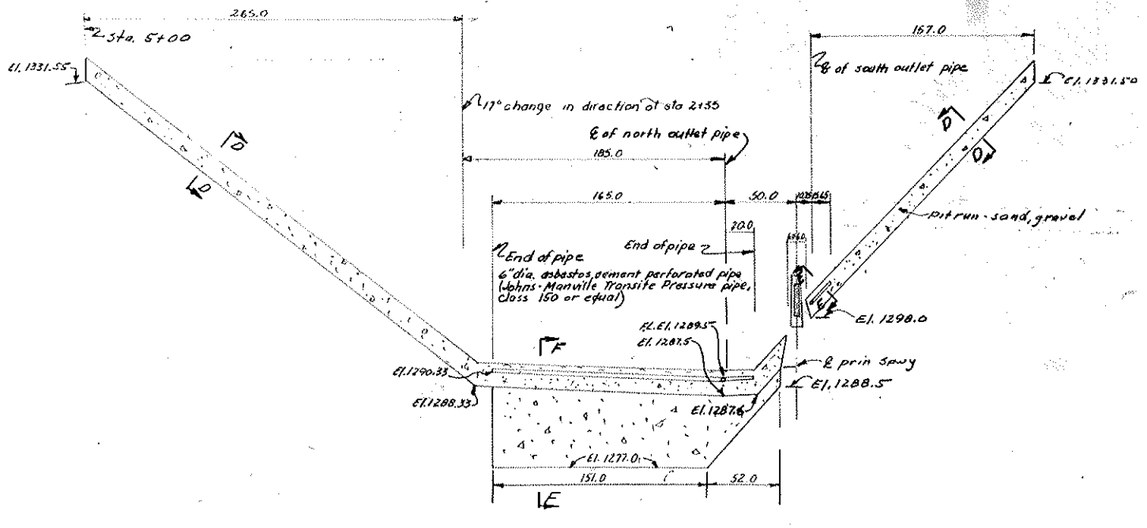
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R.W.B. Date	Approved by	
Drawn	Title	
Traced	Sheet No 9 of 35 sheets	Drawing No. 5,E-20,230
Checked D.E.M. W.R.E.		



PLAN FOUNDATION DRAIN

Scale 1" = 50'



SECTION C - C

SECTION ALONG ℄ OF TRANSVERSE DRAINS

Scale: Horiz. 1" = 50'; Vert. 1" = 10'

"AS BUILT"

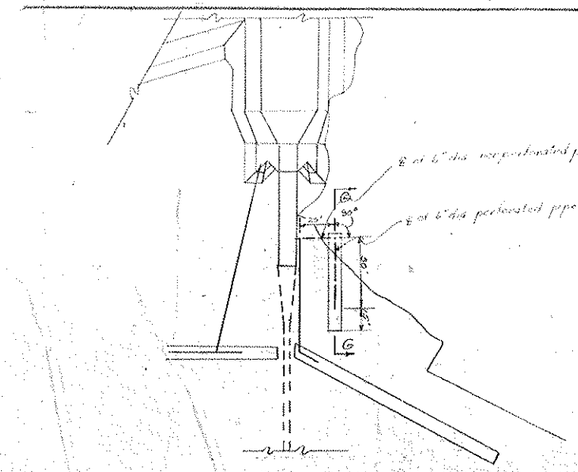
FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1

"As Built"

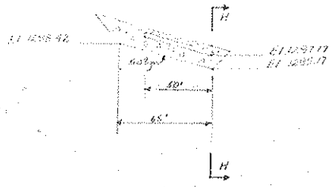
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
Drawn		Title
Traced		Title
Checked		Sheet No 19 of 23 — Drawing No S,E-20,270

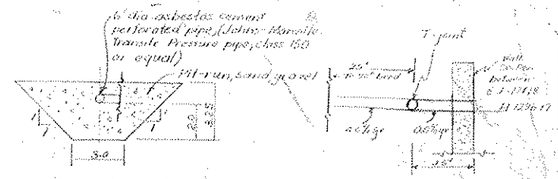
Form SCS 313 (November 1965)



PLAN OF SOUTH OUTLET DRAIN
Scale 1"=50'



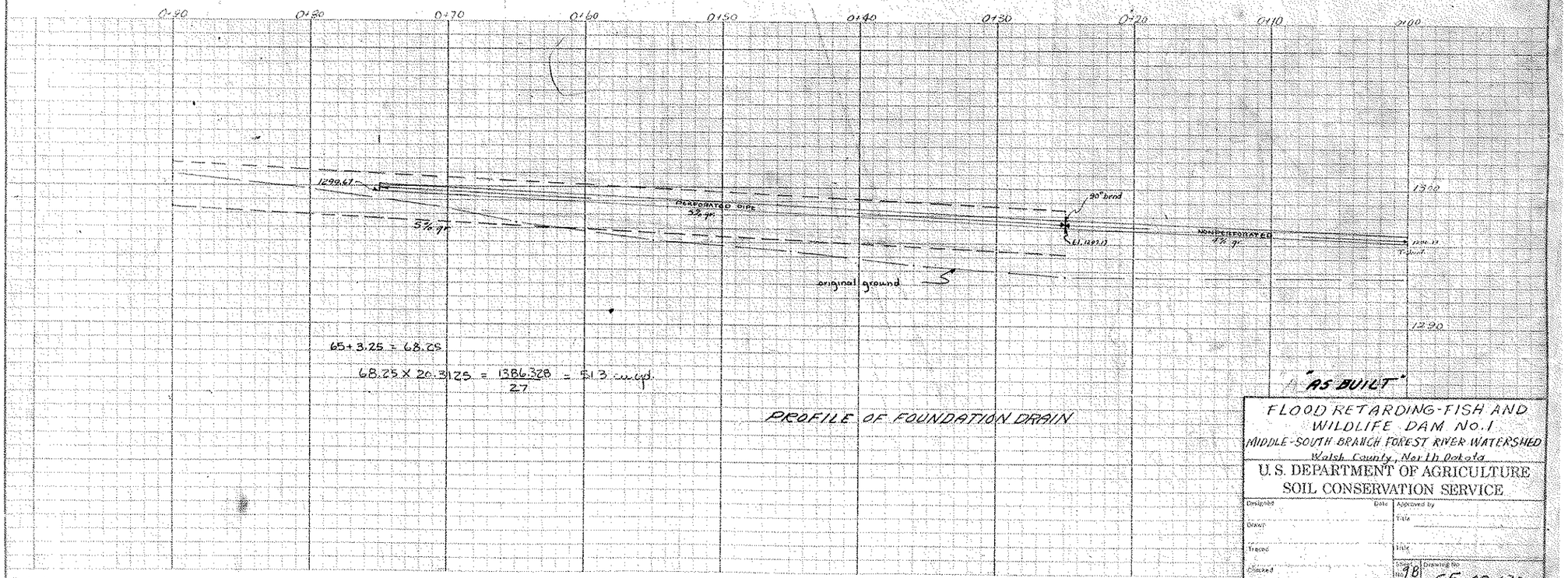
SECTION G-G
SECTION ALONG ℄ OF TRANSVERSE DRAIN
Scale: Horiz. 1"=50'; Vert. 1"=10'



SECTION H-H
DETAILS OF TRANSVERSE DRAIN
Scale: 1"=4'

TABLE OF QUANTITIES FOR FOUNDATION DRAIN

ITEM	UNIT	QUANTITY
PIT-RUN SAND GRAVEL	CU. YDS.	53
6" DIA. ASBESTOS CEMENT NON-PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150 OR EQUAL)	LIN. FT.	25
6" DIA. ASBESTOS CEMENT PERFORATED PIPE (JOHNS-MANVILLE TRANSITE PRESSURE PIPE, CLASS 150 OR EQUAL)	LIN. FT.	50

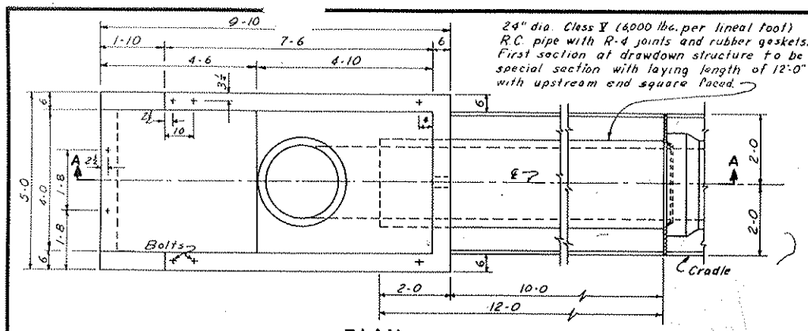


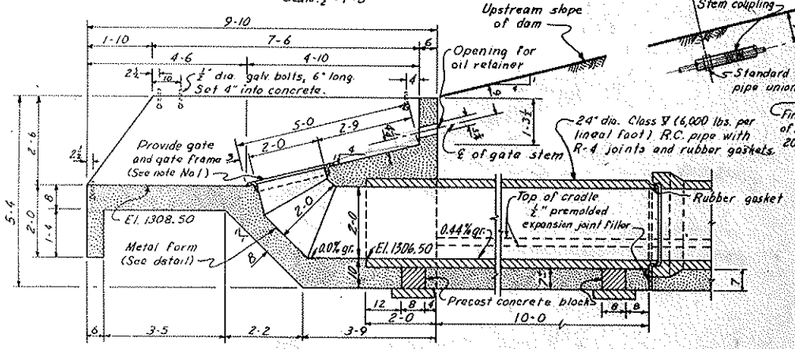
PROFILE OF FOUNDATION DRAIN

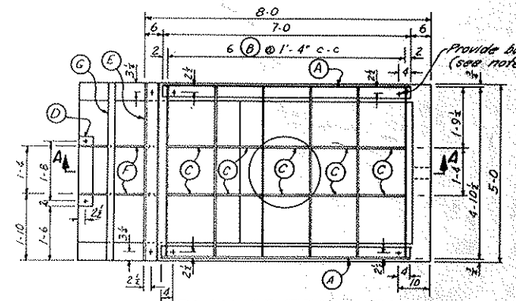
"AS BUILT"

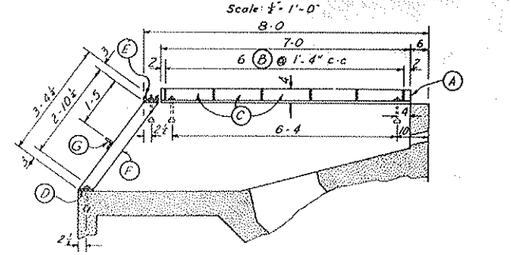
FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

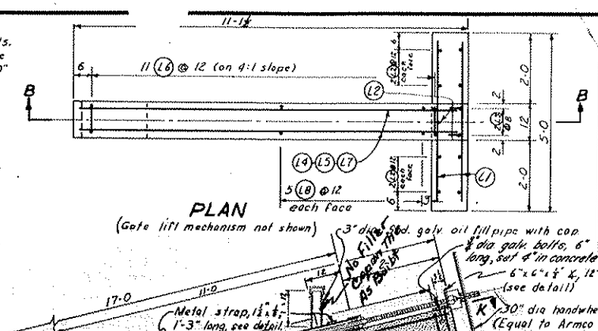
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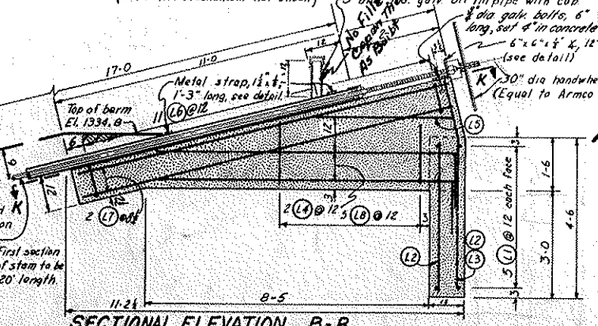






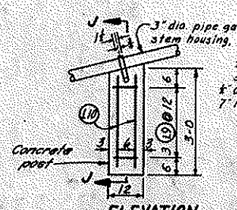


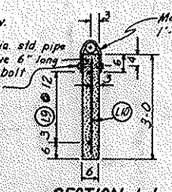




DETAILS OF GATE HOIST STRUCTURE

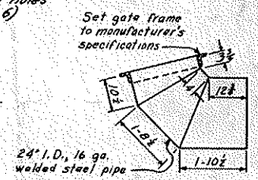
Scale: 1/2" = 1'-0"





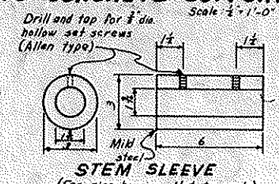
DETAIL OF PIPE FASTENING TO CONCRETE SUPPORTS

Scale: 1/2" = 1'-0"



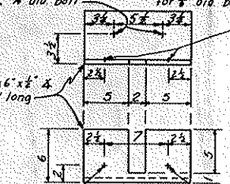
DETAIL OF METAL FORM FOR INLET STRUCTURE

Scale: 1/2" = 1'-0"



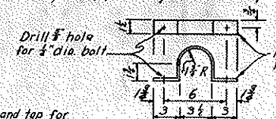
STEM SLEEVE

(For pipe housing - Not to scale)



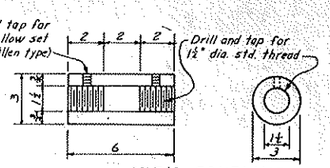
DETAIL OF BASE ANGLE FOR HANDWHEEL LIFT

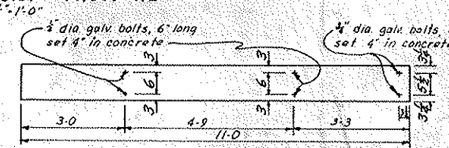
Scale: 1½" = 1'-0"



DETAIL OF PIPE FASTENING TO GATE HOIST STRUCTURE

Scale: 1½" = 1'-0"

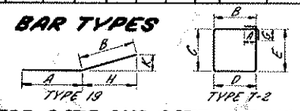




BAR SCHEDULE FOR GATE HOIST STRUCTURE AND CONCRETE SUPPORTS

MARK	SIZE	QUANTITY	LENGTH	TYPE	A	B	C	D	E	G	H	K	SPACINGS	TOTAL LENGTH
L1	4	10	4-6	STR.									12	46-0
L2	4	9	4-3	STR.									12	38-3
L3	4	2	5-10	19	1-7	4-3					1-6 1/2	0-4 1/2	-	11-8
L4	4	4	10-0	2	8-6	1-6							12	40-0
L5	4	2	4-0	STR.									-	8-0
L6	4	11	3-4	T-2	0-2	0-8	0-10	0-8	0-10	0-2			12	36-8
L7	4	4	10-9	STR.									-	43-0
L8	4	10	1-9	STR.									12	17-6
L9	4	27	0-9	STR.									12	20-3
L10	4	18	2-6	STR.									8	45-0
														305-4

BAR TYPES



MATERIAL LIST FOR GATE AND GATE LIFTING MECHANISM

ITEM	UNIT	QUANTITY
GATE STEM 1 1/2" DIA.	LIN.FT.	113-8
PIPE HOUSING 3" DIA. STD. GALV. WITH PIPE UNION AND COUPLINGS	LIN.FT.	107-2
STEM COUPLINGS	EACH	4
STEM SLEEVES	EACH	5
OIL RETAINER (STANDARD ARMCO OR EQUAL)	EACH	2
30" DIA. HANDWHEEL LIFT (EQUAL TO ARMCO HB-30) WITH BRONZE NUT	EACH	1
24" DIA. STEEL SLIDE GATE, WITH SPIGOT BACK AND 3'-3 9/16" FRAME (ARMCO MODEL 50-10C(OR EQUAL)	EACH	1

QUANTITIES FOR GATE HOIST INLET STRUCTURE AND APPURTENANCES

ITEM	UNIT	QUANTITY
CONCRETE (CLASS A)	CU.YDS.	21.72
REINFORCING STEEL	LBS.	1,170
STRUCTURAL STEEL	LBS.	350

NOTES:

1. PROVIDE 24" DIA. STEEL SLIDE GATE WITH SPIGOT BACK AND 39 9/16" HIGH GATE FRAME EQUAL TO ARMCO MODEL 50-10C. (SET GATE FRAME AND ANCHOR BOLTS ACCORDING TO MANUFACTURER'S SPECIFICATIONS).
2. AT EXPANSION JOINTS FILL SPACE BETWEEN PIPE SECTIONS ABOVE TOP OF CRADLE WITH A RUBBER TYPE JOINT SEALING COMPOUND SIMILAR TO SERVISEAL BLACK "VERTISEAL".
3. FILL GATE STEM HOUSING WITH 600 W. OR EQUAL, CYLINDER OIL TO WITHIN 6" OF THE TOP OF THE OIL FILL PIPE.
4. TRASH RACK ANGLES, BARS AND PLATES TO BE SECURELY WELDED AT JUNCTIONS.
5. TRASH RACK TO BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS.
6. PROVIDE 5/8" DIAMETER HOLES IN TRASH RACK MEMBERS (A), (D) AND (E) FOR 1/2" DIA. BOLTS.
7. ALL BOLTS AND NUTS TO BE GALVANIZED.
8. RADIUS OF BENDS OF REINFORCING BARS = 3 TIMES THE DIAMETER OF THE BAR.
9. LENGTH OF THE GATE STEM IS MEASURED FROM THE CENTER OF THE GATE TO THE BASE OF THE HANDWHEEL LIFT.

MATERIAL LIST FOR TRASH RACK

MARK	ITEM	QUANTITY
A	∠ 5 4" X 4" X 1/4", 7'-0" LONG	2
B	BARS 4" X 1/4", 11'-10" LONG	6
C	BARS 4" X 1/8", 1'-3 1/2" LONG	10
D	BARS 5" X 1/4", 2'-0" LONG	1
E	5⌊ 6.7, 5'-0" LONG	1
F	BARS 8" X 1/4", 3'-4 1/4" LONG	2
G	∠ S 1 1/2" X 1 1/2" X 1/4", 5'-0" LONG	1
	TOTAL WEIGHT OF STRUCTURAL STEEL	218 LBS.

"AS BUILT"

DRAWDOWN STRUCTURE

DETAILS OF DRAWDOWN INLET, GATE HOIST TRASH RACK AND APPURTENANCES

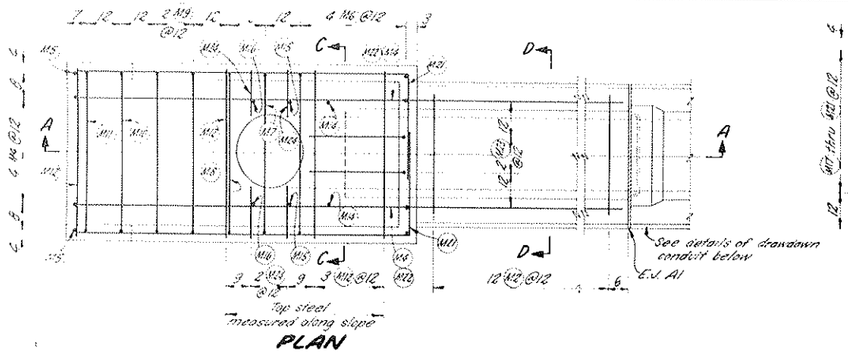
FLOOD RETARDING-FISH AND WILDLIFE DAM No.1

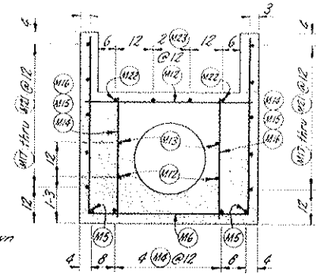
MIDDLE - SOUTH BRANCH FOREST RIVER WATERSHED

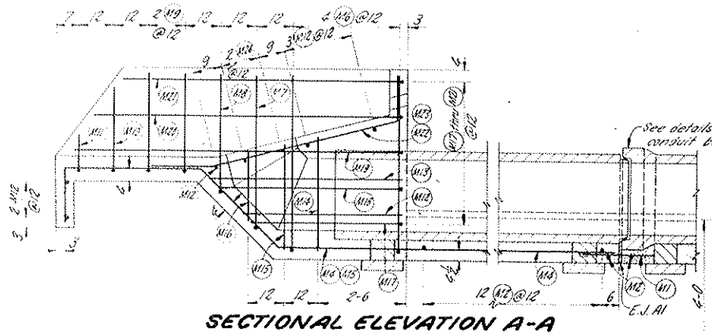
Walsh County, North Dakota

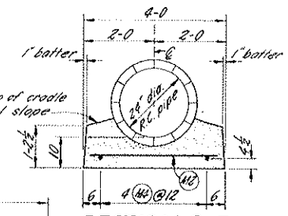
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

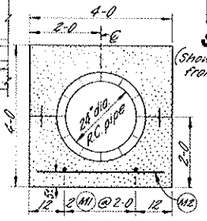
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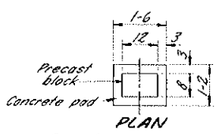


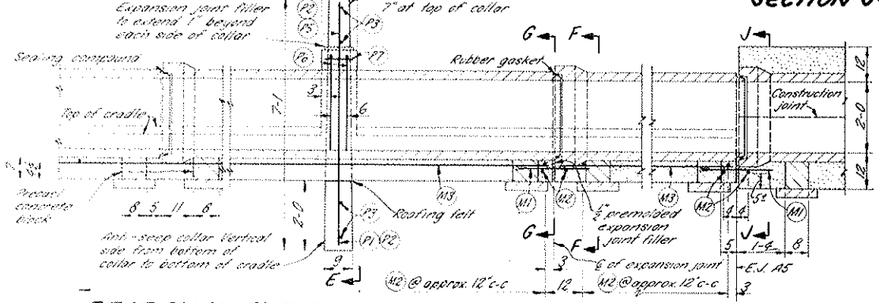


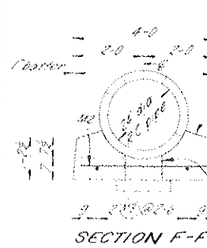


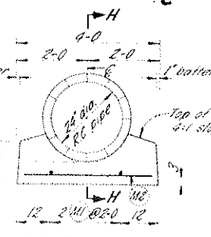


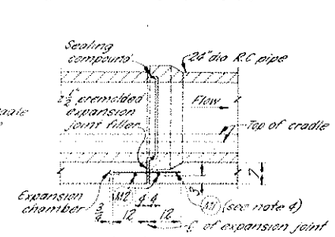






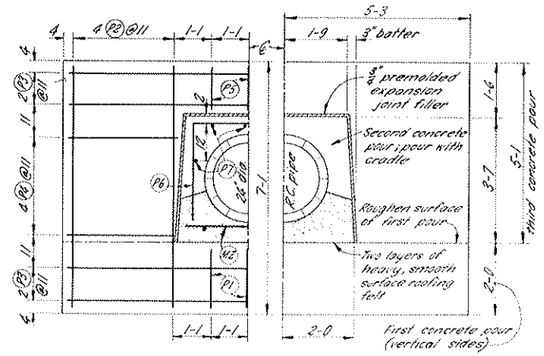






DETAILS OF CRADLE

DETAILS OF EXPANSION JOINTS 1 THRU 4
(Precast concrete block and cradle reinforcing steel not shown)



DETAILS OF ANTI-SEEP COLLAR

BAR SCHEDULE

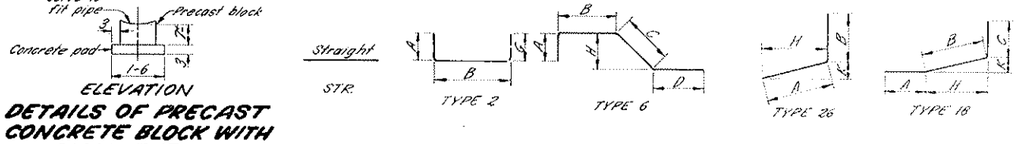
	MARK	LOCATION	SIZE	QUANTITY	LENGTH	TYPE	A	B	C	D	G	H	K	SPACING	TOTAL LENGTH
*	M1	CRADLE	6	10	2-0	STR.								2-0	20-0
	M2	CRADLE & INLET	4	118	3-6	STR.								APPROX. 12	413-0
	M3	CRADLE	6	8	23-6	STR.								2-6	188-0
	M4	DRAWDOWN INLET	5	4	21-9	6	1-6	3-10	3-2	3-3		2-9		12	87-0
	M5	DRAWDOWN INLET	4	2	12-0	6	1-6	3-10	3-2	3-6		2-9			24-0
	M6	DRAWDOWN INLET	4	4	14-0	2	4-9	4-6			4-9			12	56-0
	M7	DRAWDOWN INLET	4	1	13-0	2	4-3	4-6			4-3				13-0
	M8	DRAWDOWN INLET	4	1	11-0	2	3-3	4-6			3-3				11-0
	M9	DRAWDOWN INLET	4	2	10-0	2	2-9	4-6			2-9			12	20-0
	M10	DRAWDOWN INLET	4	1	9-0	2	2-3	4-6			2-3				9-0
	M11	DRAWDOWN INLET	4	1	6-6	2	1-0	4-6			1-0				6-6
	M12	DRAWDOWN INLET	5	8	4-6	STR.								12	36-0
	M13	DRAWDOWN INLET	5	2	5-6	STR.									11-0
	M14	DRAWDOWN INLET	5	2	3-3	STR.									6-6
	M15	DRAWDOWN INLET	5	2	3-0	STR.									6-6
	M16	DRAWDOWN INLET	5	2	2-0	STR.									4-0
	M17	DRAWDOWN INLET	4	2	5-9	2	1-6	4-3							11-6
	M18	DRAWDOWN INLET	4	2	6-3	2	1-0	5-3							12-6
	M19	DRAWDOWN INLET	4	2	12-3	2	3-0	9-3							24-6
	M20	DRAWDOWN INLET	4	2	11-6	2	3-0	8-6							23-0
	M21	DRAWDOWN INLET	4	2	10-9	2	3-0	7-9							21-6
	M22	DRAWDOWN INLET	5	2	8-6	18	1-9	5-4	1-5			5-2	1-3 1/2		17-0
	M23	DRAWDOWN INLET	5	2	3-4	26	2-9	1-3				2-8	0-8	12	6-8
	M24	DRAWDOWN INLET	5	4	1-3	STR.								12	5-0
	P1	ANTI-SEEP COLLAR	4	12	1-6	STR.								1-1	18-0
	P2	ANTI-SEEP COLLAR	4	32	6-9	STR.								1-1	216-0
	P3	ANTI-SEEP COLLAR	4	16	10-3	STR.								1-1	164-0
	P4	ANTI-SEEP COLLAR	4	32	3-0	STR.								1-1	96-0
	P5	ANTI-SEEP COLLAR	4	12	1-3	STR.								1-1	15-0
	P6	ANTI-SEEP COLLAR	4	8	8-8	2	2-9	3-2			2-9			6	69-4
	P7	ANTI-SEEP COLLAR	4	20	0-9	STR.								12	15-0

* PLAIN DOWEL BARS NO. 4 BAR = 1/2" DIA. NO. 5 BAR = 5/8" DIA. NO.6 BAR = 3/4" DIA.

BAR TOTALS

SIZE	LENGTH	WEIGHT, LBS.
4	1426-10	953
5	179-2	187
6	20-6	30
TOTAL		1170

BAR TYPES



NOTES:

1. AT EXPANSION JOINTS, FILL SPACE BETWEEN PIPE SECTIONS ABOVE TOP OF CRADLE WITH A RUBBER TYPE JOINT SEALING COMPOUND SIMILAR TO SERVICISED BLACK "VERTISEAL".
2. RADIUS OF BENDS OF REINFORCING BARS = 3 X THE DIAMETER OF THE BAR.
3. ALL BAR DIMENSIONS ARE OUT TO OUT OF BAR.
4. MARK (M1) PLAIN DOWEL BARS TO BE COATED ON [illegible] UPSTREAM ENDS TO PREVENT BOND. PROVIDE DOWEL SLEEVE WITH CLOSED END AND 3/4" EXPANSION CHAMBER AT UPSTREAM END OF DOWEL.

AS BUILT

Scale: 1/2" = 1'-0"

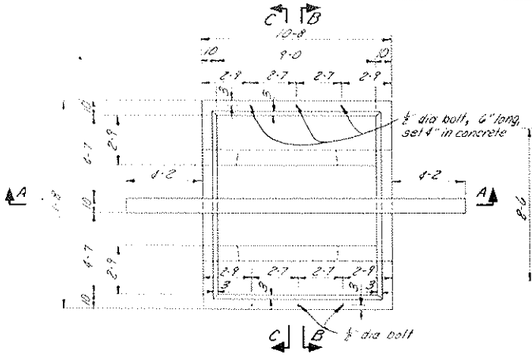
DRAWDOWN STRUCTURE

Reinforcing steel details of Drawdown Inlet and Drawdown appurtenances

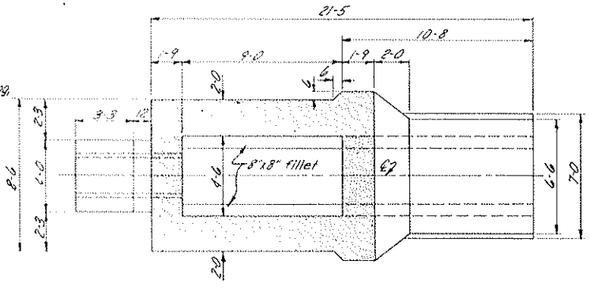
FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

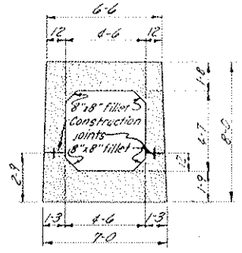
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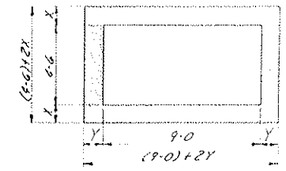
PLAN OF TOP
(Trash rack and concrete platforms not shown)



SECTION H-H

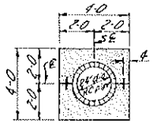


SECTION D-D

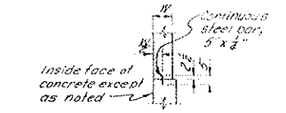


SECTION
J-J, K-K, L-L AND M-M

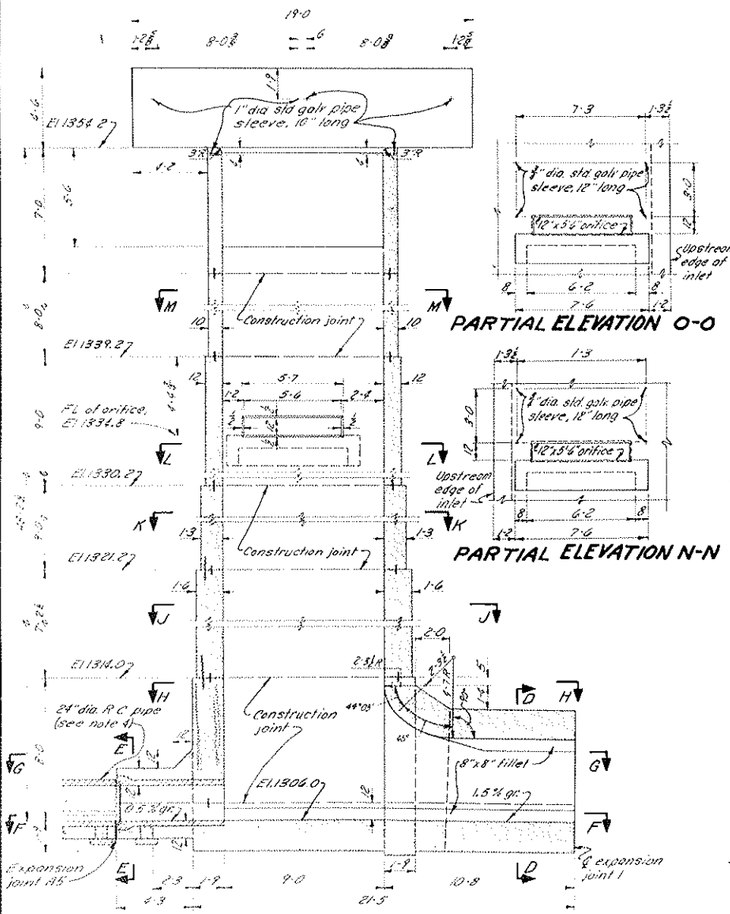
Dimension \ Section	J-J	K-K	L-L	M-M
X	1-6	1-3	12	10
Y	1-6	1-3	12	10



SECTION E-E



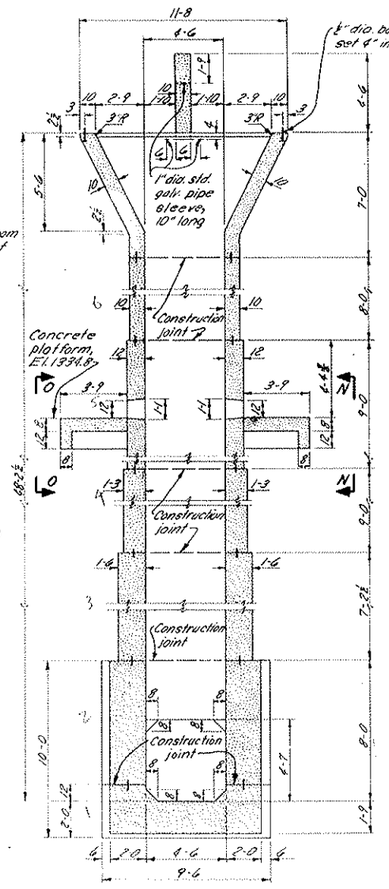
DETAILS OF
CONSTRUCTION JOINT



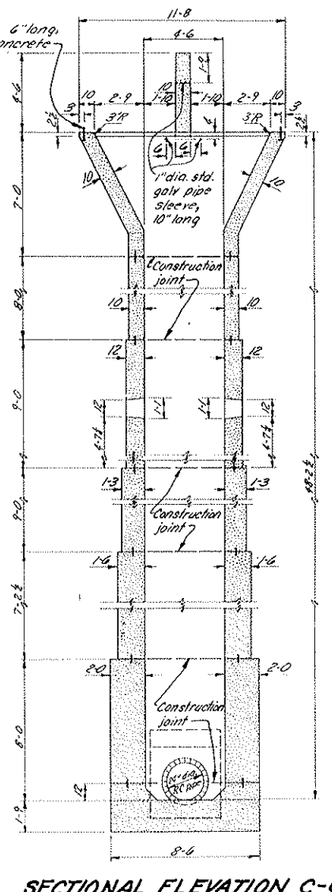
SECTIONAL ELEVATION A-A

PARTIAL ELEVATION O-O

PARTIAL ELEVATION N-N



SECTIONAL ELEVATION B-B



SECTIONAL ELEVATION C-C
(Orifice platforms not shown)

TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
CONCRETE (CLASS A)	CU. YDS.	95.98
REINFORCING STEEL	LBS.	17,066
TRASH RACK	EACH	3

NOTES:

1. CHAMFER ALL EXPOSED EDGES 3/4".
2. PLACE CONTINUOUS 5" X 1/4" STEEL BAR AT CONSTRUCTION JOINTS TO PROVIDE WATER TIGHT JOINTS.
3. FOR DETAILS OF EXPANSION JOINT #1 SEE SHEET 22 AND FOR EXPANSION JOINT A5 SEE SHEET 11.
4. DRAWDOWN PIPE TO BE 24" DIA. CLASS V (6,000 LBS. PER LIN.FT.) R.C. PIPE WITH R-4 JOINTS AND RUBBER GASKETS. FIRST SECTION AT INLET TO BE SPECIAL SECTION WITH LAYING LENGTH OF 6' AND DOWNSTREAM END SQUARE FACED.

AS BUILT

Scale: ½" = 1'-0"

DETAILS OF INLET

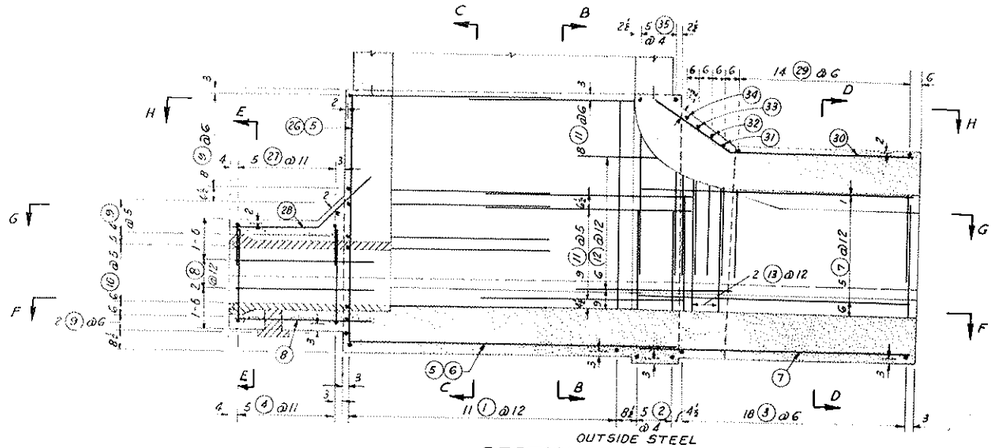
FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

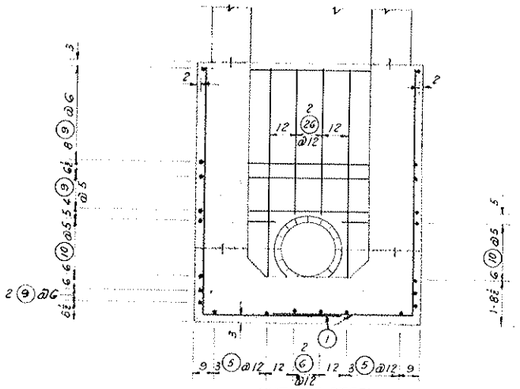
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

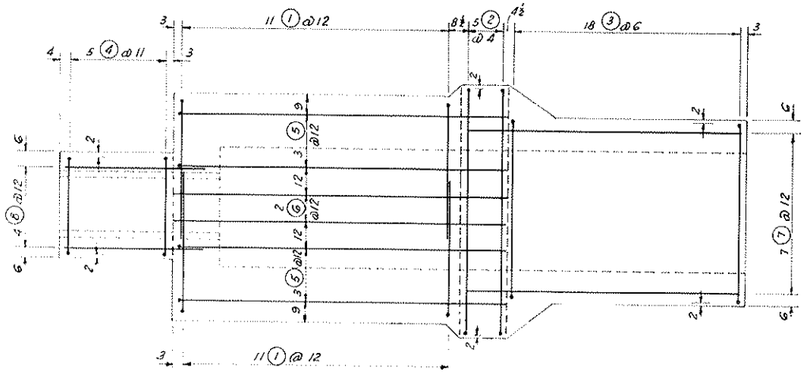
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Traced		Title	
Checked RWB/WFE		Sheet No. 12 of 35	Drawing No. 5, E-20, 230



SECTIONAL ELEVATION A-A



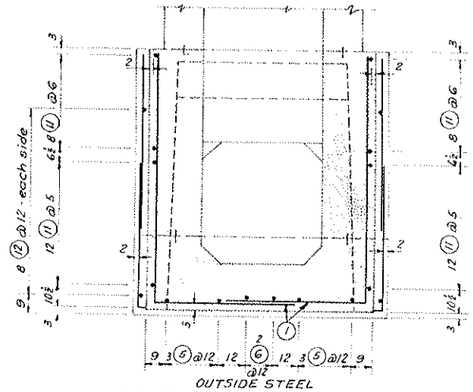
SECTIONAL ELEVATION C-C



BOTTOM STEEL IN BASE

SECTION F-F

(Side wall steel not shown)



SECTIONAL ELEVATION B-B

AS BUILT

Scale $\frac{1}{8}$"=1'-0"

INLET STRUCTURE
REINFORCING STEEL DETAILS

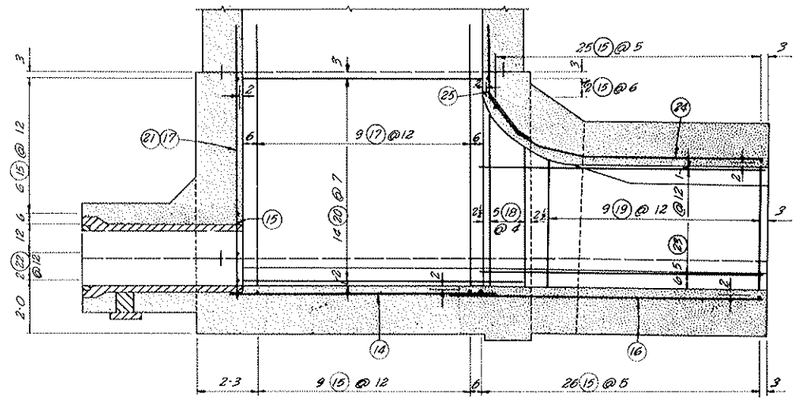
FLOOD RETARDING-FISH AND WILDLIFE DAM No.1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

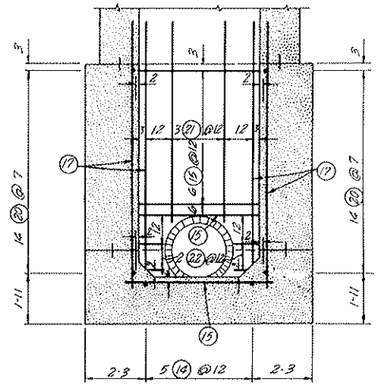
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed J.M.M.	Date	Approved by
Drawn		Title
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Checked R.W.B., W.R.F.		Drawing No. 5,E-20,230



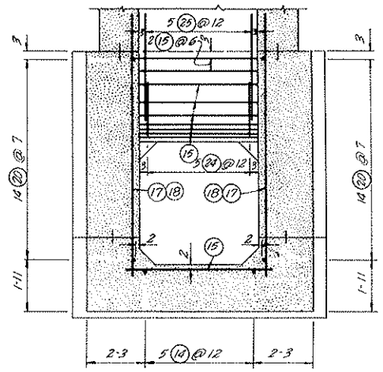
INSIDE STEEL

SECTIONAL ELEVATION A-A



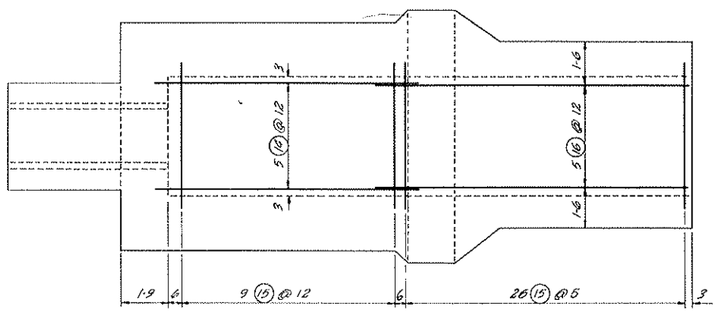
INSIDE STEEL

SECTIONAL ELEVATION C-C



INSIDE STEEL

SECTIONAL ELEVATION B-B



TOP STEEL IN BASE

SECTION F-F

(Side wall steel not shown)

AS BUILT

Scale: 3/8" 1'-0"

INLET STRUCTURE

REINFORCING STEEL DETAILS

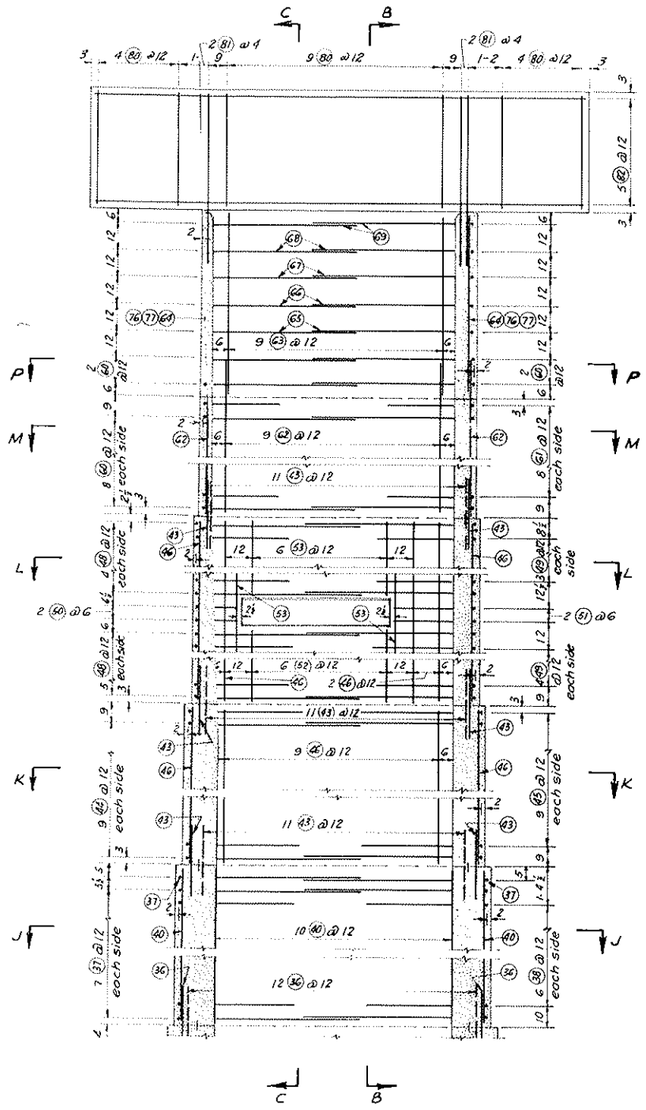
FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

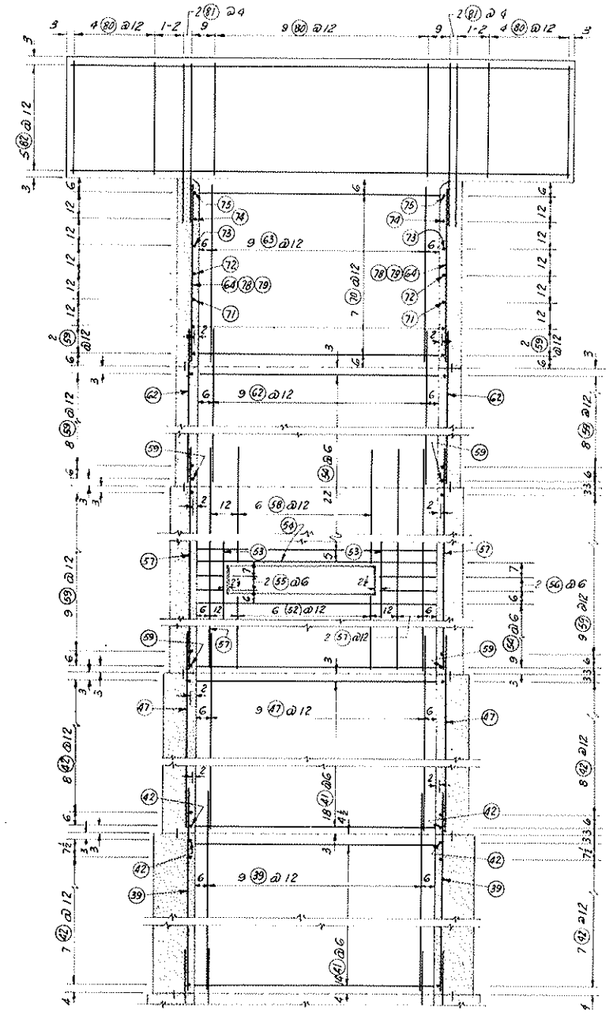
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed JMM		Approved by	
Drawn JMM, JCS		Title	
Traced		Title	
Checked RWB, WRE	5-60	Sheet No. 16 of 35	Drawing No. 5, E-20, 230



OUTSIDE STEEL



INSIDE STEEL

SECTIONAL ELEVATION A-A

AS BUILT

Scale: 3/8" = 1'-0"

INLET STRUCTURE REINFORCING STEEL DETAILS

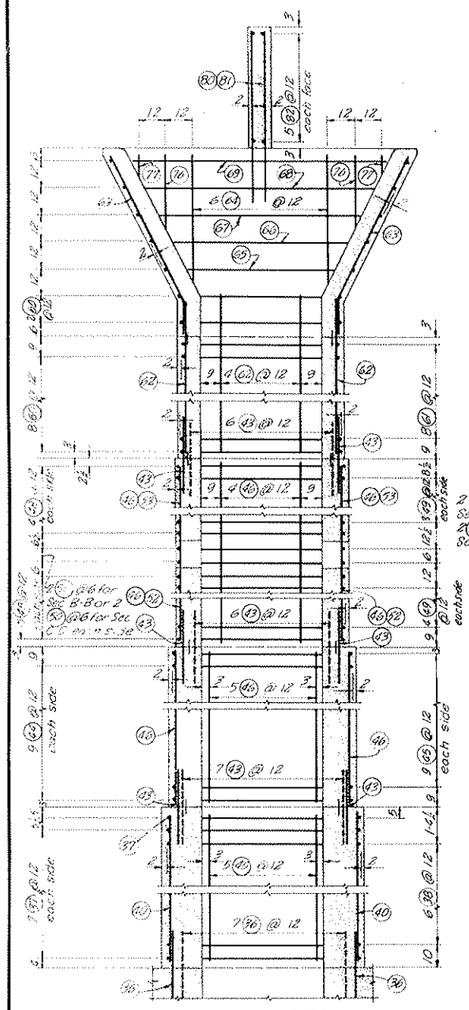
FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

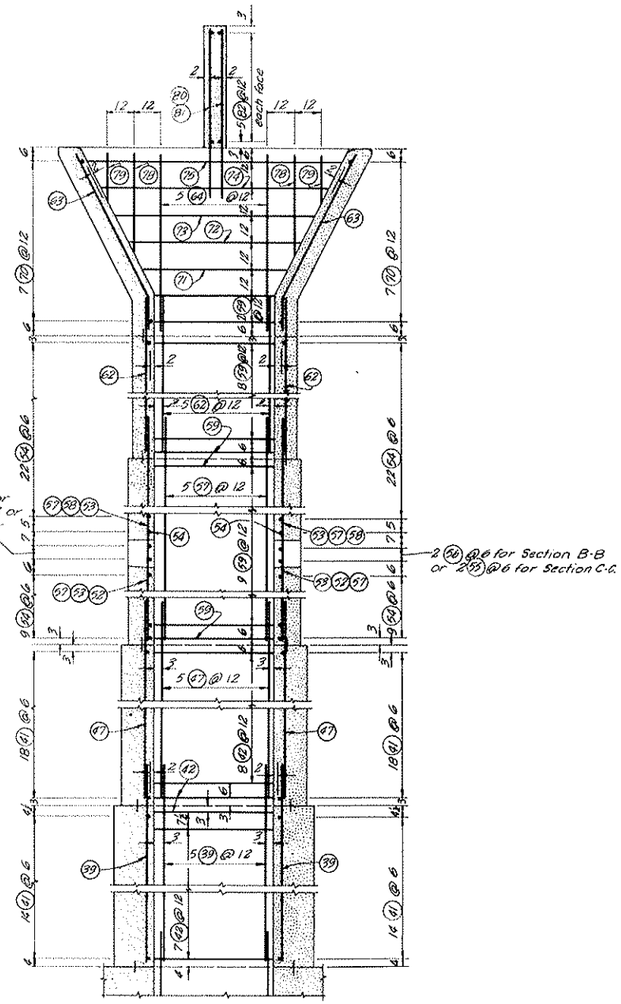
U. S. DEPARTMENT OF AGRICULTURE
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Date		
Designed J.M.M.	Approved by	
Drawn	Title	
Traced	Title	
Checked W.A.E. R.W.B.	Sheet No. 15 of 35	Drawing No. 5,E-20,230



OUTSIDE STEEL

Note Section B-B use bar No 51. Section C-C identical except for bar No 51 which becomes bar No 50



INSIDE STEEL

Note. Section B-B use bar No. 56. Section C-C identical except for bar No. 56 which becomes bar No. 55

SECTION B-B AND C-C

AS BUILT

Scale 3/4"=1'-0"

INLET STRUCTURE REINFORCING STEEL DETAILS

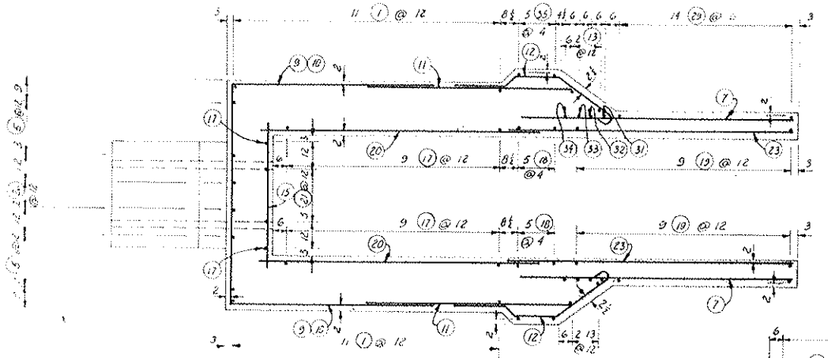
FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

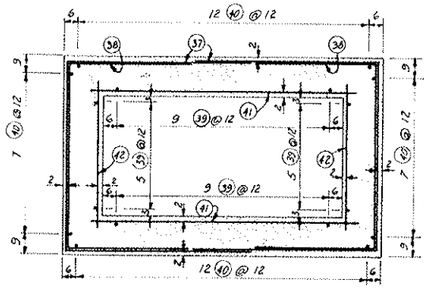
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

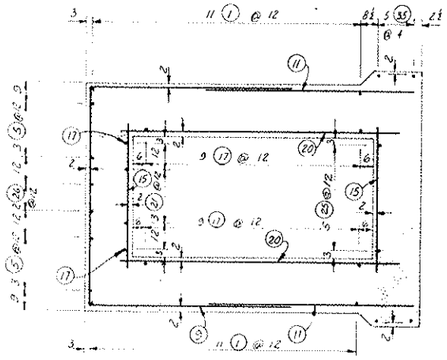
	Date		
Designed J.M.M.		Approved by	
Drawn J.C.S.		Title	
Traced		Title	
Checked R.W.B. W.R.C.	3-64	Sheet No. 16 of 35	Drawing No. 5,E-20,230



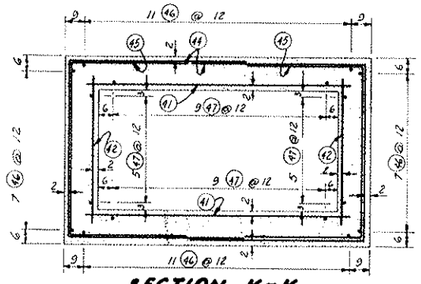
SECTION G-G
(Fillets not shown)



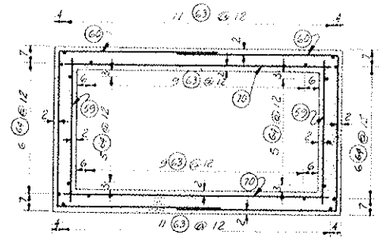
SECTION J-J



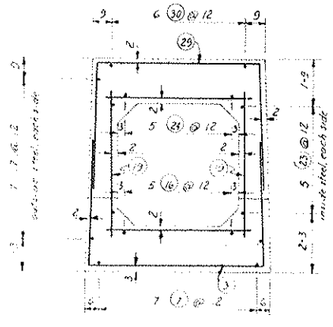
SECTION H-H



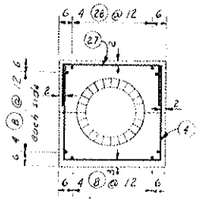
SECTION K-K



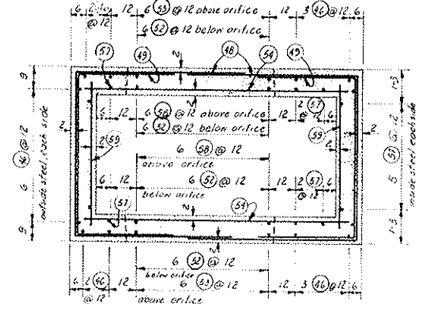
SECTION P-P



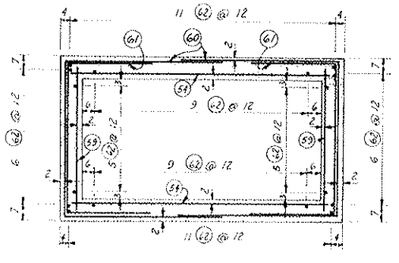
SECTION D-D



SECTION E-E



SECTION L-L



SECTION M-M

AS BUILT

Scale 1/4"=1'-0"

INLET STRUCTURE
REINFORCING STEEL DETAILS

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	Approved by	
Designed	J.M.M.	Title	
Drawn		Title	
Traced		Sheet No. 17 of 35 sheets	Drawing No. 5,E-20,230
Checked	R.W.B., W.R.E. 5-64		

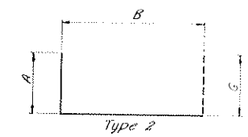
BAR SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	∩	SPACING INCHES
1	7	22	14-6	319-0	2	2-4	5-2										12
2	8	5	20-2	100-10	2	5-6	9-2										4
3	5	19	[illegible]	[illegible]	22	5-6	6-8					5-6					8
4	5	4	10-10	54-2	2	3-7	3-8					3-6	5-0		0-1 3/4		11
5	7	2	21-6	129-0	2	9-3	12-3					3-6					12
6	7	2	12-3	24-6	STR.												12
7	4	21	10-3	215-3	STR.												12
8	4	12	5-3	63-0	STR.												12
9	8	14	23-4	327-8	2	7-7	8-2					7-7					12
10	8	12	10-5	125-0	2	7-7	2-10										5 & 6
11	5	40	7-9	310-0	STR.												5
12	5	16	7-9	124-0	21	1-0	2-6	1-8	0-8	1-11	0-5 1/2	2-9 1/2		0-6	2-1 1/2		5 & 6
13	4	4	7-6	30-0	STR.												12
14	5	1	10-0	50-0	STR.												12
15	7	27	5-6	375-6	STR.												12
16	5	5	11-9	58-9	STR.												5 & 12
17	5	20	10-9	215-0	STR.												12
18	5	10	7-6	75-0	STR.												12
19	5	18	7-7	138-6	STR.												4
20	8	24	10-5	244-0	STR.												12
21	7	2	23-3	46-6	STR.												7
22	5	2	1-6	3-0	STR.												12
23	5	12	10-9	127-6	STR.												12
24	5	5	10-10	54-2	20	0-2	1-5	1-2	1-6	1-4 5/8	0-3 3/4	0-11 7/8	0-7 1/2	0-11 1/2	1-2		12
25	5	5	[illegible]	[illegible]	20	3-0	1-8	0-6		1-3 5/8	1-0 1/2	0-3 3/8	0-5				12
26	5	2	5-6	11-0	STR.												12
27	5	6	6-10	34-2	2	1-7	3-8					1-7					12
28	5	4	6-0	24-0	19	2-2	2-10										11
29	7	14	15-10	221-8	23	4-10	6-2					4-10	2-0		2-0		12
30	5	6	10-6	63-0	19	7-0	3-6						4-10		0-1 3/4		6
31	7	1	16-2	16-2	23	5-0	6-2					5-0	2-11		1-11		12
32	7	1	16-8	16-8	23	5-3	6-2					5-3	5-6		0-1 7/4		
33	7	1	17-6	17-6	23	5-8	6-2					5-8	5-3		0-2		
34	7	1	18-2	18-2	23	6-0	6-2					6-0	5-8		0-2		
35	8	5	22-4	111-8	2	6-7	9-2					6-7	6-0		0-2 1/4		
36	5	38	3-4	114-6	STR.												4
37	7	16	21-4	342-0	2	7-1	7-2					7-1					12
38	7	12	16-2	194-0	2	4-6	7-2					4-6					12
39	5	28	9-0	252-0	STR.												12
40	4	38	5-10	259-8	STR.												12
41	7	64	10-0	640-0	STR.												12
42	5	34	5-6	187-0	STR.												6
43	4	156	2-0	312-0	STR.												12
44	7	18	20-3	363-6	2	6-9	6-8					6-9					12
45	7	12	16-2	194-0	2	4-6	6-8					4-6					12
46	4	58	8-9	507-6	STR.												12
47	5	28	10-3	287-0	STR.												12
48	5	18	18-10	339-0	2	6-4	6-2					6-4					12
49	6	18	10-6	191-6	2	3-9	6-2					3-9					12
50	6	3	14-8	28-8	2	6-4	6-2					1-10					6
51	6	2	15-6	31-0	2	6-4	6-2					3-0					6
52	4	24	4-4	104-0	STR.												12
53	4	16	3-3	53-0	STR.												12
54	8	64	10-0	640-0	STR.												12
55	6	4	1-8	7-8	STR.												6
56	6	4	3-0	12-0	STR.												6
57	4	16	10-3	169-0	STR.												6
58	4	12	4-9	57-0	STR.												12
59	5	42	5-6	231-0	STR.												12
60	5	20	17-10	356-8	2	6-0	5-10					6-0					12
61	5	16	12-4	197-4	2	3-3	5-10					3-3					12
62	4	62	3-3	[illegible]	STR.												12
63	5	2	7-3	14-6	19	1-3	6-0										12
64	4	22	6-6	143-0	STR.								5-4		2-8		12
65	5	2	17-0	34-0	2	6-0	7-0					6-0					
66	5	2	20-0	40-0	2	6-0	8-0					6-0					
67	5	2	21-0	42-0	2	6-0	9-0					6-0					
68	5	2	22-0	44-0	2	6-0	10-0					6-0					
69	5	2	23-0	46-0	2	6-0	11-0					6-0					
70	5	14	10-0	140-0	STR.												12
71	4	2	6-6	13-0	STR.												
72	4	2	7-6	15-0	STR.												
73	4	2	8-6	17-0	STR.												
74	4	2	9-6	19-0	STR.												
75	4	2	10-6	21-0	STR.												
76	4	8	3-6	14-0	STR.												
77	4	4	1-6	6-0	STR.												
78	4	4	4-6	18-0	STR.												
79	4	4	5-6	10-0	STR.												
80	5	24	[illegible]	[illegible]	STR.												12
81	5	6	[illegible]	[illegible]	STR.												4
82	5	42	18-9	157-6	STR.												12

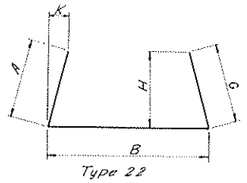
NO. 4 BAR = 1/2" DIA. NO. 5 BAR = 5/8" DIA. NO. 6 BAR = 3/4" DIA. NO. 7 BAR = 7/8" DIA. NO. 8 BAR = 1" DIA.

BAR TYPES

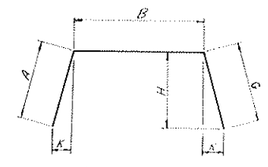
Straight
Str.



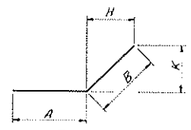
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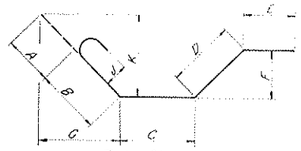
Type 22



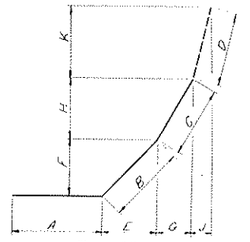
Type 23



Type 19



Type 21



Type 20

BAR TOTALS

SIZE	LENGTH	WEIGHT (LBS)
4	3259-11	2,178
5	2393-4	2,496
6	1755-8	2,637
7	3312-6	6,771
8	1343-2	3,586
	TOTAL	17,666

NOTES:

1. RADIUS OF BENDS FOR BARS EQUALS THREE TIMES THE DIAMETER OF THE BAR.
2. ALL DIMENSIONS ARE OUT TO OUT OF BAR.
3. DOWEL BARS AT EXPANSION JOINT #1 ARE NOT SHOWN. FOR DETAILS OF PLACEMENT, SEE SHEET 22.
4. ALL DIMENSIONS SHOWING DISTANCE FROM FACE OF CONCRETE TO STEEL DESIGNATE THE CLEAR DISTANCE.

AS BUILT

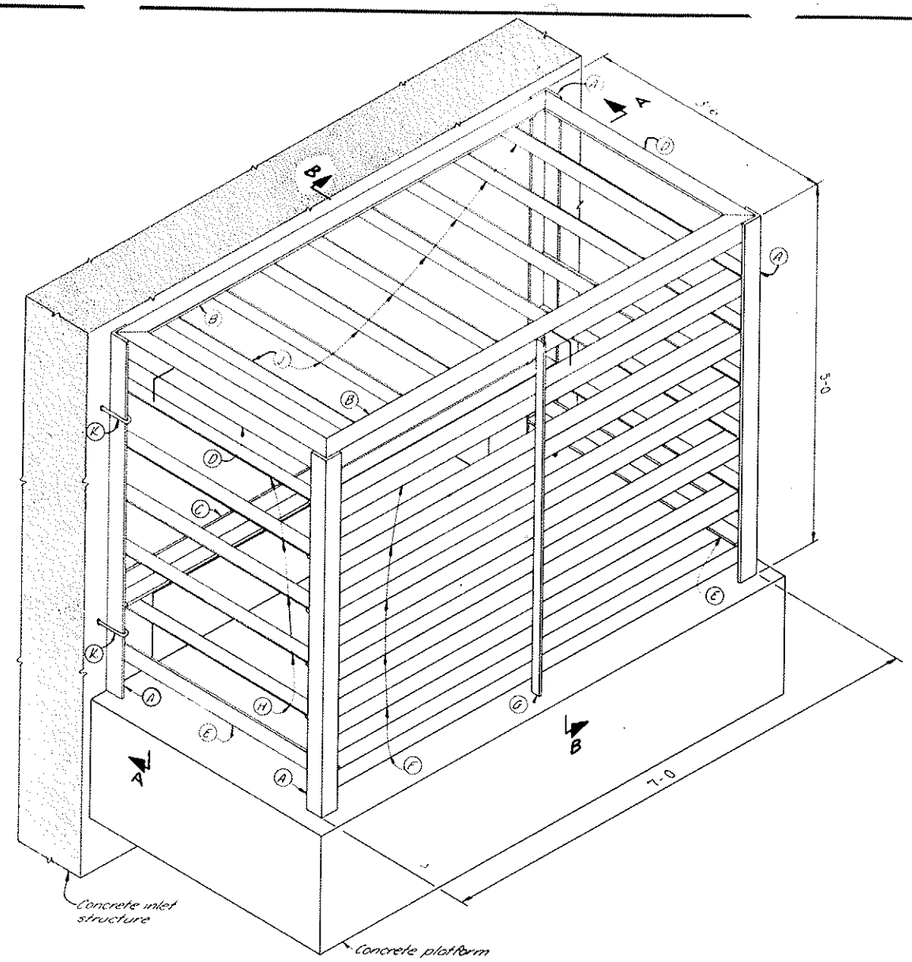
INLET STRUCTURE BAR SCHEDULE

FLOOD RETARDING-FISH AND WILDLIFE DAM NO.1

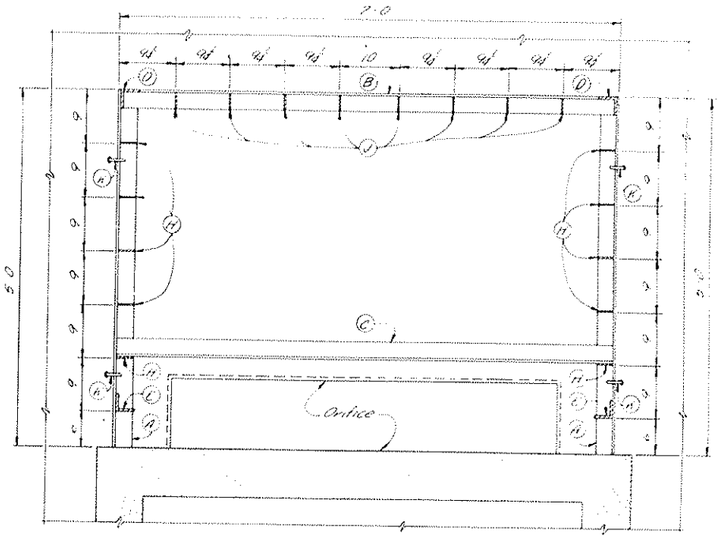
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed JMM		Approved by	
Drawn JCS		Title	
Traced		Title	
Checked RWB, WRE	5-66	Sheet No. 18 of 35	Drawing No. 5-E-20,230



ISOMETRIC VIEW OF TRASH RACK
Scale 1"-1'-0"
(Two required)

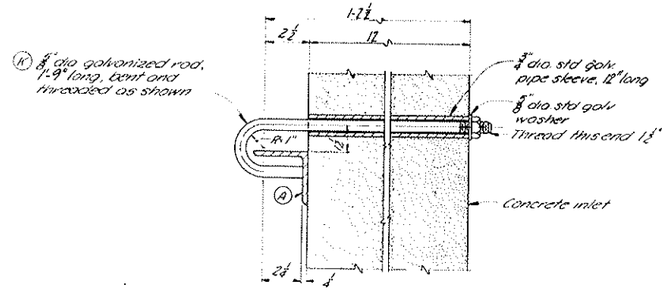


SECTIONAL ELEVATION A-A
Scale 1"-1'-0"

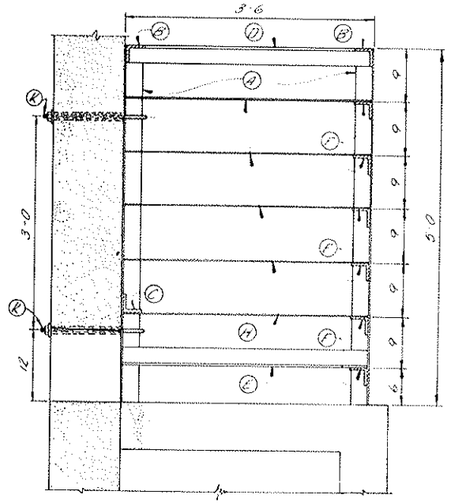
MATERIAL LIST FOR ONE TRASH RACK

MARK	ITEM	QUANTITY
A	∠ 3" X 3" X 1/2" 5'-0" LONG	4
B	∠ 3" X 3" X 1/2" 6'-11" LONG	2
C	∠ 3" X 3" X 1/2" 6'-11" LONG	1
D	∠ 3" X 3" X 1/2" 3'-5" LONG	2
E	∠ 3" X 3" X 1/2" 3'-5" LONG	2
F	∠ 3" X 3" X 3/8" 6'-11" LONG	6
G	∠ 1 1/2" X 1 1/2" X 1/4" 4'-11" LONG	1
H	BAR 2 1/2" X 1/4" 3'-5" LONG	10
J	BAR 2 1/2" X 1/4" 3'-4" LONG	6
K	5/8" DIA. J BOLT WITH WASHER AND NUT (ALL GALV.) PER DETAIL	4
TOTAL WEIGHT OF ONE RACK	953 LBS.	
TOTAL WEIGHT OF TWO RACKS	1906 LBS	

1. CLIP MARK (B) AND (D) ANGLES AS SHOWN.
2. ALL ANGLES AND BARS TO BE SECURELY WELDED AT JUNCTIONS.
3. TRASH RACK TO BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS.



DETAIL OF FASTENING BOLT
SECTIONAL PLAN
Scale 3"-1'-0



SECTIONAL ELEVATION B-B
Scale 1"-1'-0

AS BUILT

DETAILS OF ORIFICE TRASH RACK FOR CONCRETE INLET STRUCTURE (2 REQ'D)

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

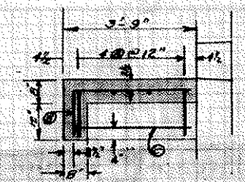
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed J.M.M.	Date	Approved by
Drawn		Title
Traced		Date
Checked R.W.B., W.R.E.	Sheet No. 19 of 35	Drawing No. 5,E-20,230

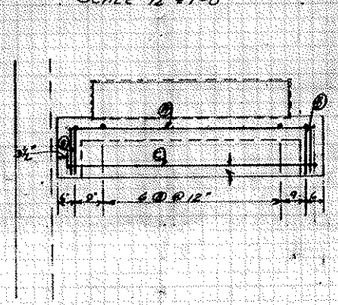
NO. DAK
EJP 10-29-65

DAM #1 - NS BRANCH FOREST RIVER

1 - 2



SCALE ½" = 1'-0"



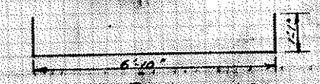
SCALE ½" = 1'-0"

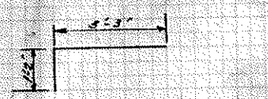
As built

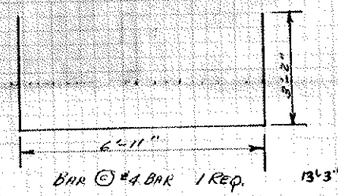
NO. DAK.
EJP 10-29-65

DAM #1 - MS BRANCH FOREST RIVER

2 - 2

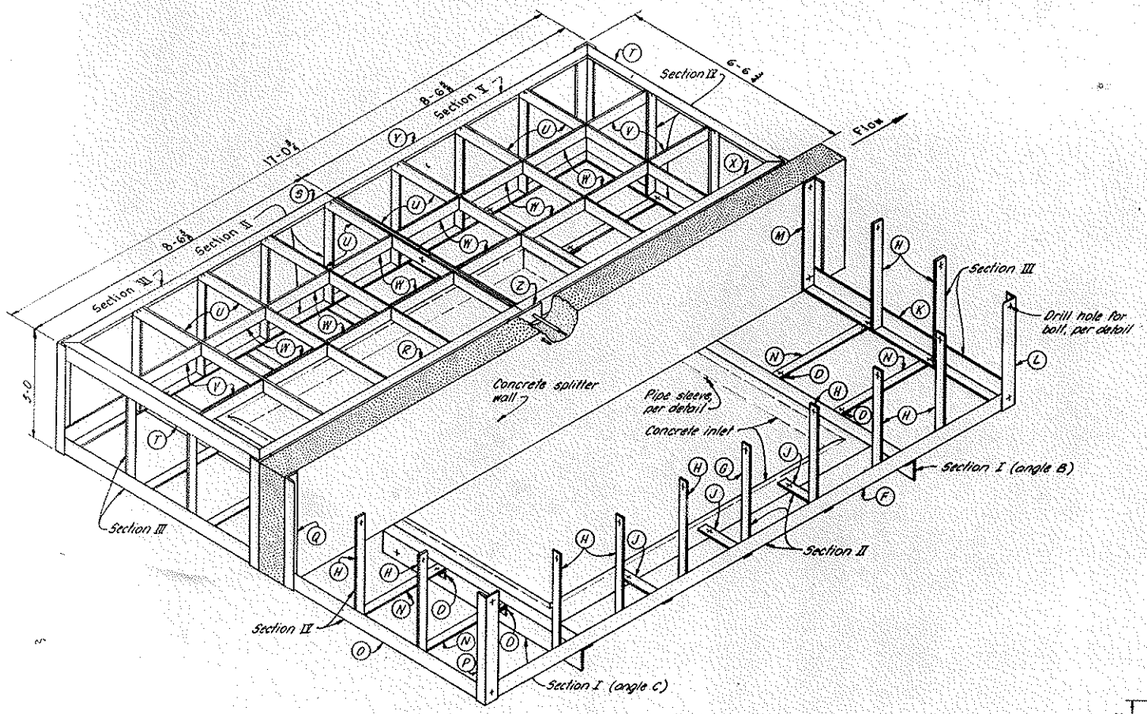




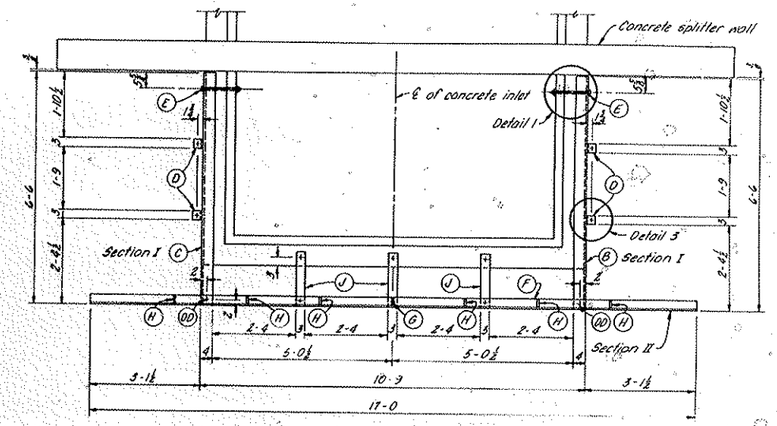


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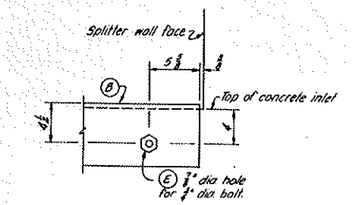
19A
35 5-E, 20, 230



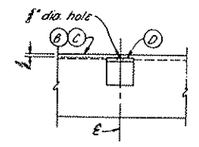
ISOMETRIC VIEW OF TRASH RACK FOR TOP OF INLET
Scale: ½" = 1'-0"



PLAN OF SECTION I AND II
Scale: ½" = 1'-0"



DETAIL 1
(Detail of ℄ would be similar)
Scale: 1½" = 1'-0"



DETAIL 3
Scale: 1½" = 1'-0"

* MATERIAL LIST FOR TRASH RACK

MARK	ITEM	QUANTITY
B	∠S 7" X 4" X 1/2", 6'-6" LONG	2
C	∠S 7" X 4" X 1/2", 6'-6" LONG	2
D	∠S 3" X 3" X 3/8", 0'-3" LONG	8
E	BOLT 3/4" DIA., GALV. 11 1/2" LONG	10
F	∠S 6" X 3 1/2" X 1/2", 17'-0" LONG	2
G	BAR 3" X 1/2", 2'-11" LONG	2
H	BAR 3" X 3/8", 2'-11" LONG	20
J	BAR 3" X 3/8", 1'-6" LONG	6
K	∠S 6" X 3 1/2" X 1/2", 6'-6" LONG	2
L	∠S 5" X 3 1/2" X 3/8", 3'-0" LONG	2
M	∠S 5" X 3 1/2" X 3/8", 3'-0" LONG	2
N	BAR 3" X 3/8", 3'-1 1/2" LONG	8
O	∠S 6" X 3 1/2" X 1/2", 6'-6" LONG	2
P	∠S 5" X 3 1/2" X 3/8", 3'-0" LONG	2
Q	∠S 5" X 3 1/2" X 3/8", 3'-0" LONG	2
R	∠S 5" X 3 1/2" X 3/8", 8'-6" LONG	2
S	∠S 5" X 3 1/2" X 3/8", 8'-6" LONG	2
T	∠S 5" X 3 1/2" X 3/8", 6'-6" LONG	4
U	BAR 4" X 3/8", 6'-5" LONG	16
V	BAR 4" X 3/8", 2'-3 1/2" LONG	8
W	BAR 4" X 3/8", 2'-0" LONG	24
X	∠S 6" X 3 1/2" X 3/8", 8'-6" LONG	2
Y	∠S 5" X 3 1/2" X 3/8", 8'-6" LONG	2
Z	BAR 5" X 3/8", 1'-2" LONG (SPACER)	2
AA	BAR 3" X 1/2", 0'-4" LONG (SPACER)	2
BB	BOLT 1/2" DIA. GALV. 0'-2" LONG	4
CC	BOLT 1/2" DIA. GALV. 0'-1 1/2" LONG	44
DD	BOLT 5/8" DIA. GALV. 0'-2" LONG	4
	TOTAL WEIGHT OF STRUCTURAL STEEL 3863 LBS.	

* TOTAL FOR BOTH HALVES OF TRASH RACK

NOTES:
1. CLIP ANGLES AS SHOWN.
2. ANGLES AND BARS ARE TO BE SECURELY WELDED AT JUNCTIONS AS SHOWN ON EACH SECTION. SECTIONS ARE BOLTED TOGETHER TO FORM A COMPLETE TRASH RACK.
3. TRASH RACK TO BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS.
4. PROVIDE WASHER WHEN REQUIRED TO PREVENT DIRECT CONTACT BETWEEN BOLT HEAD OR NUT AND CONCRETE SURFACE.

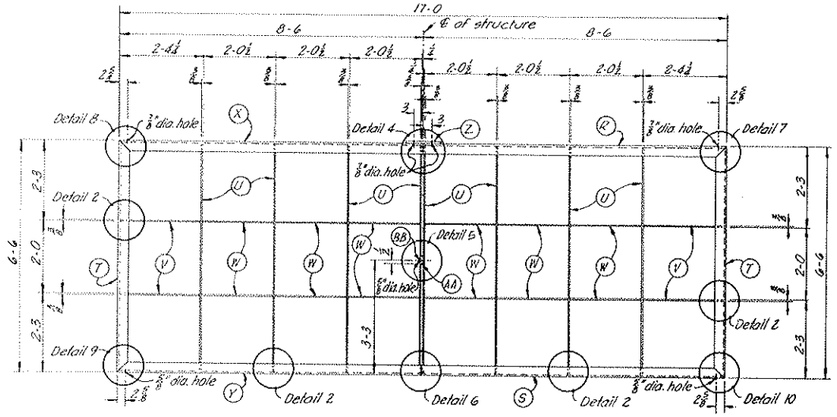
"AS BUILT"

DETAILS FOR TRASH RACK FOR TOP OF INLET

FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1
MIDDLE SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

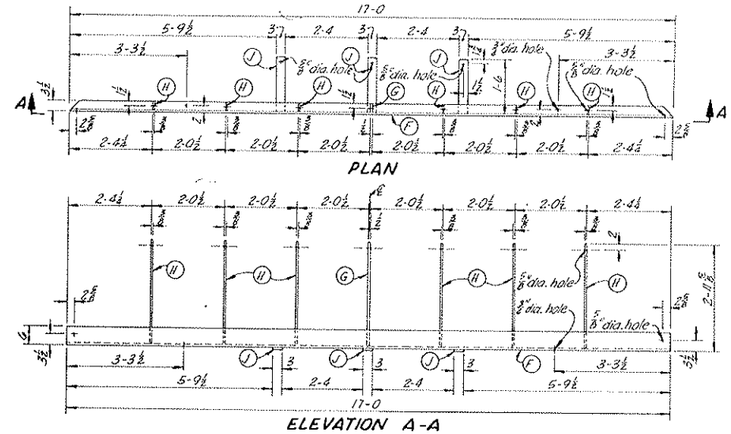
Date	
Designed D.E.M., J.M.M.	Approved by
Drawn R.A.V.	Title
Traced	Title
Checked R.W.B., W.R.E.	Sheet No. 20 of 35 — Drawing No. 5,E-20,230



SECTION V
Scale: ½"=1'-0"
(Two required)

SECTION VI
Scale: ½"=1'-0"
(Two required)

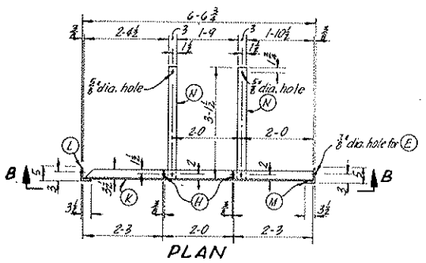
PLAN



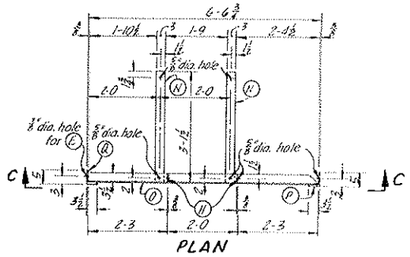
PLAN

ELEVATION A-A

DETAILS OF SECTION II
(Two required)
Scale: ½"=1'-0"



PLAN



PLAN

DETAIL 4
Scale: 1"=1'-0"

DETAIL 5
Scale: 3"=1'-0"

DETAIL 6
Scale: 3"=1'-0"

DETAIL 7
Scale: 3"=1'-0"

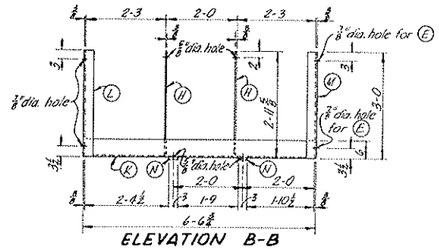
DETAIL 8
Scale: 3"=1'-0"

DETAIL 9
Scale: 3"=1'-0"

DETAIL 10
Scale: 3"=1'-0"

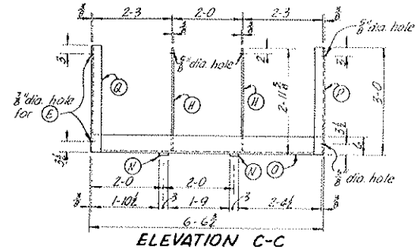
DETAIL 2
Scale: 3"=1'-0"

DETAILS OF SECTIONS V AND VI



ELEVATION B-B

DETAILS OF SECTION III
(Two required)
Scale: ½"=1'-0"



ELEVATION C-C

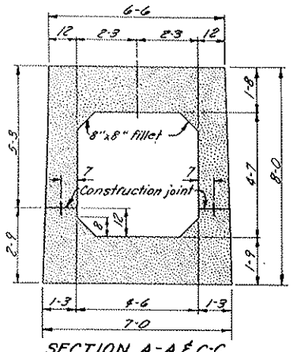
DETAILS OF SECTION IV
(Two required)
Scale: ½"=1'-0"

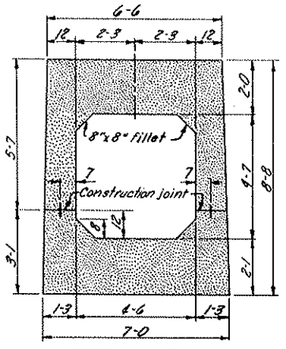
"AS BUILT"

DETAILS OF TRASH RACK FOR TOP OF INLET

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1
MIDDLE - SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed D.E.M., J.M.M.	Date	Approved by	
Drawn R.A.V.		Title	
Traced		Sheet No. 21 of 35	Drawing No. 5,E-20,230
Checked R.W.B., W.R.F.			





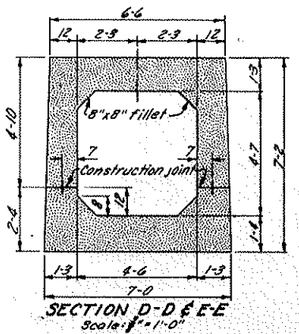
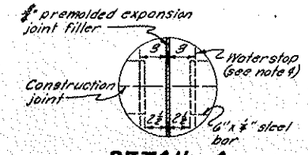


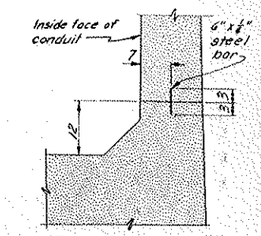
TABLE OF QUANTITIES

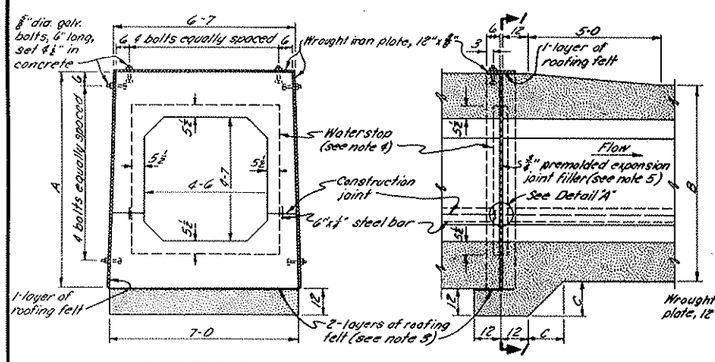
ITEM	CONCRETE (CU. YDS.)	REINFORCING STEEL (LBS)
CONDUIT E.J. 1 TO E.J. 15	380.80	71,501
ANTI-SEEP COLLARS	33.11	1,082

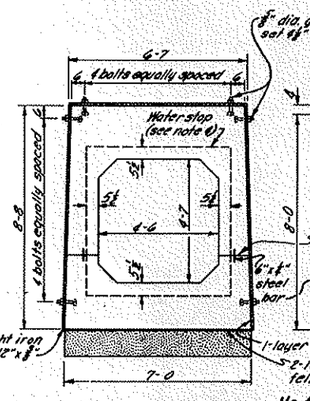
TABLE OF DIMENSIONS FOR EXPANSION JOINTS

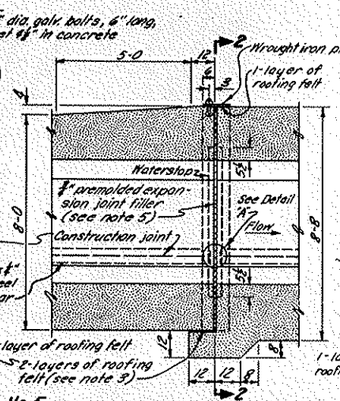
EXPANSION JOINT NO.	A	B	C
1,2,3,4,11 & 12	8-0		
6,7,8 & 9	8-8		
10	8-8	8-0	1-4
13	8-0	7-2	1-5
14		7-2	

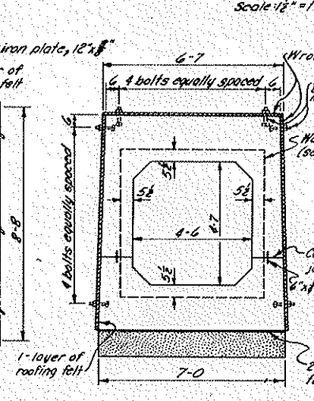


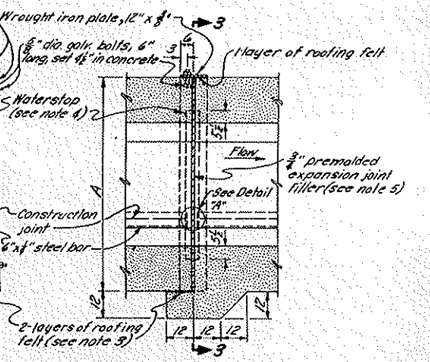




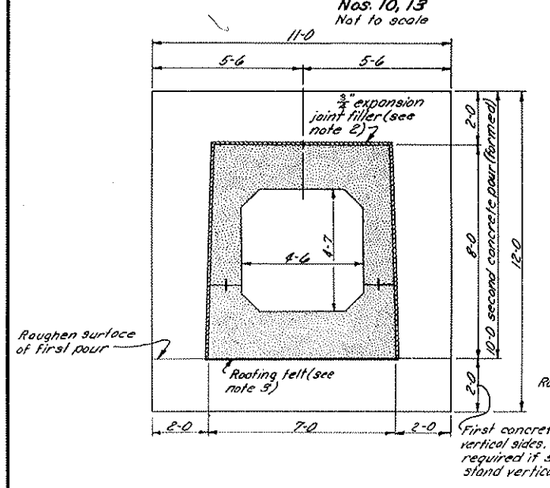


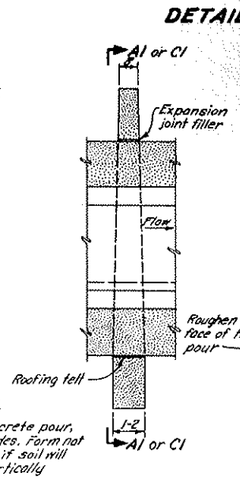


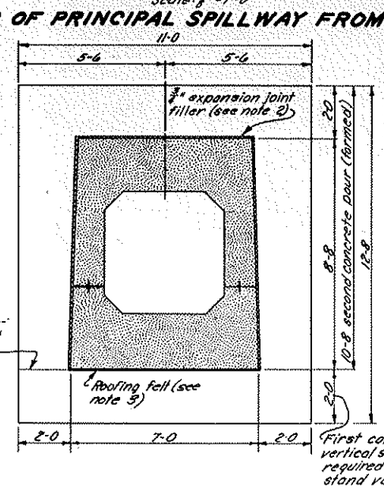


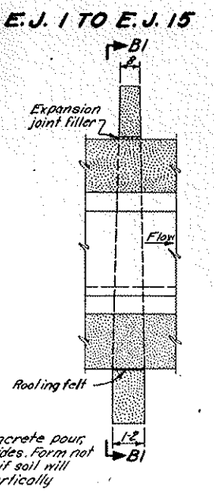


DETAILS OF PRINCIPAL SPILLWAY FROM E.J. 1 TO E.J. 15









NOTES:

1. BATTER SIDES OF ANTI-SEEP COLLARS FROM 1'-2" AT TOP OF FIRST POUR JOINT TO 8" AT TOP OF COLLAR. SIDES OF ANTI-SEEP COLLAR TO BE VERTICAL FROM FIRST POUR JOINT TO BOTTOM OF COLLAR.
2. PLACE PREMOLDED EXPANSION JOINT FILLER BETWEEN ANTI-SEEP COLLAR AND CONDUIT (TOP AND SIDES ONLY)
3. PLACE 2 LAYERS OF HEAVY SMOOTH SURFACE ROOFING FELT BETWEEN (A) BOTTOM OF CONDUIT AND ANTI-SEEP COLLAR AND (B) BOTTOM OF CONDUIT AND EXPANSION JOINT SLEEPER.
4. USE POLYVINYLCHLORIDE WATERSTOP (SIMILAR AND EQUAL TO SEALTIGHT DUO-PVC TYPE NO. 6180D) 6" WIDE AT ALL EXPANSION JOINTS PER DETAIL.
5. SECURE PREMOLDED EXPANSION JOINT FILLER TO CONCRETE FACE OF CONDUIT LAST POURED WITH 3" COPPER NAILS @ 12" C-C, COUNTERSINK NAILS 1/8".
6. FOR LOCATION OF SECTIONS AND WARP BETWEEN SECTIONS, SEE SHEET 7. "
7. ANTI-SEEP COLLARS SHALL BE INSTALLED IN A VERTICAL POSITION. AS BUILT"

DETAILS OF ANTI-SEEP COLLARS

Scale: 3/8" = 1'-0"

PRINCIPAL SPILLWAY BETWEEN E.J.1 AND E.J.15, 4'-6" x 4'-7" CONDUIT

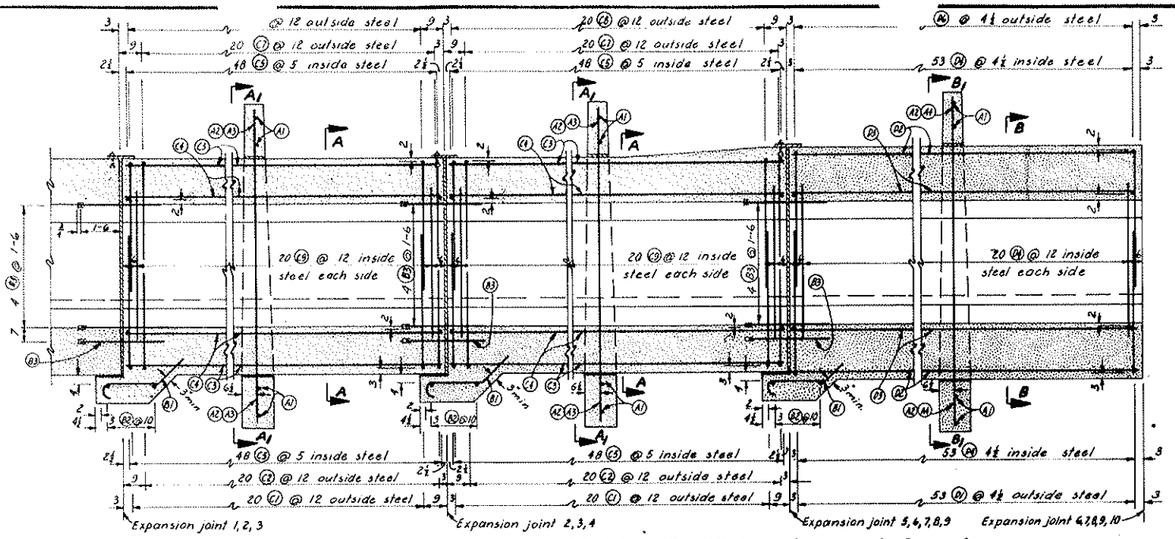
FLOOD RETARDING-FISH AND WILDLIFE DAM No.1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed	CEM	Approved by	
Drawn	CEM	Title	
Traced		Title	
Checked	DEM/WRE	Sheet No. 22 of 35	Drawing No. 5-E-20,230



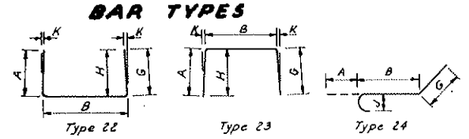
DETAILS OF PRINCIPAL SPILLWAY FROM E.J. 1 TO E.J. 10

BAR SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	A	B	G	H	J	K	SPACING IN INCHES
A1	4	36	10-6	378-0	STR.							12
A2	4	280	1-6	420-0	STR.							12
A3	4	16	11-6	184-0	STR.							12
A4	4	20	12-4	246-8	STR.							12
B1	5	63	4-3	267-9	24	0-9	2-1	1-5		0-5		12
B2	5	27	6-5	175-6	STR.							10
B3	7	109	3-0	324-0	STR.							18
C1	7	80	16-6	1320-0	22	4-11	6-8	4-11	4-11		0-1 3/4	12
C2	7	80	14-2	1133-4	22	3-9	6-8	3-9	3-9		0-1 1/2	12
C3	4	108	19-9	2133-0	STR.							12
C4	6	48	19-9	948-0	STR.							12
C5	7	384	5-6	2112-0	STR.							5
C6	5	32	19-9	632-0	STR.							12
C7	7	80	13-8	1093-4	23	3-9	6-2	3-9	3-9		0-1 1/2	12
C8	7	80	15-10	1266-6	23	4-10	6-2	4-10	4-10		0-2	12
C9	5	160	5-6	880-0	STR.							12
D1	7	265	17-2	4549-2	22	5-3	6-8	5-3	5-3		0-1 3/4	4 1/2
D2	4	140	19-9	2765-0	STR.							12
D3	6	60	19-9	1185-0	STR.							12
D4	7	730	5-6	4015-0	STR.							4 1/2, 12
D5	5	40	19-9	790-0	STR.							12
D6	7	265	16-6	4372-6	23	5-2	6-2	5-2	5-2		0-1 3/4	4 1/2

* PLAIN DOWEL BARS — NO. 4 BAR = 1/2" DIA. NO. 5 BAR = 5/8" DIA. NO. 6 BAR = 3/4" DIA. NO. 7 BAR = 7/8" DIA.

BAR TYPES

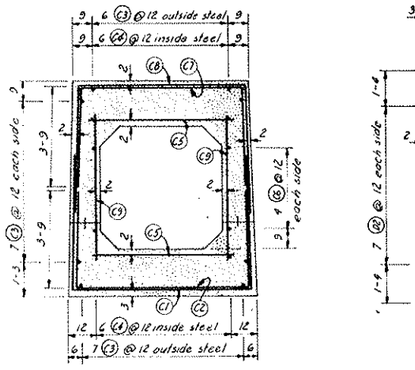


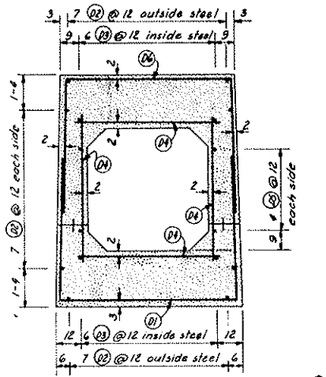
NOTES:

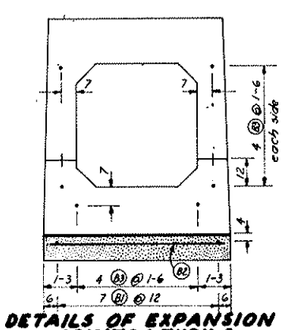
1. PREFIX "A" ON BARS IN ANTI-SEEP COLLARS.
   PREFIX "B" ON BARS IN EXPANSION JOINTS.
   PREFIX "C" ON BARS FOR CONDUIT BETWEEN EXPANSION JOINTS 1 AND 5.
   PREFIX "D" ON BARS FOR CONDUIT BETWEEN EXPANSION JOINTS 5 AND 10.
   E.J. = EXPANSION JOINT
2. ALL DIMENSIONS SHOWING DISTANCE FROM FACE OF CONCRETE TO REINFORCING BARS DESIGNATE THE CLEAR DISTANCE.
3. MARK (B3) PLAIN DOWEL BARS TO BE COATED ON THE UPSTREAM END TO PREVENT BOND. PROVIDE DOWEL SLEEVE WITH CLOSED END AND 3/4" EXPANSION CHAMBER AT UPSTREAM END OF DOWEL.
4. RADIUS OF BENDS OF REINFORCING BARS EQUALS THREE (3) TIMES THE DIAMETER OF THE BAR.
5. ALL BAR DIMENSIONS ARE OUT TO OUT OF BAR.

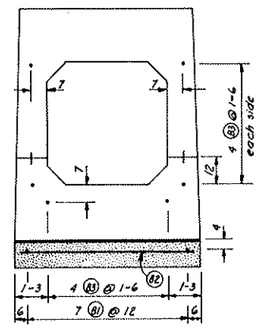
BAR TOTALS

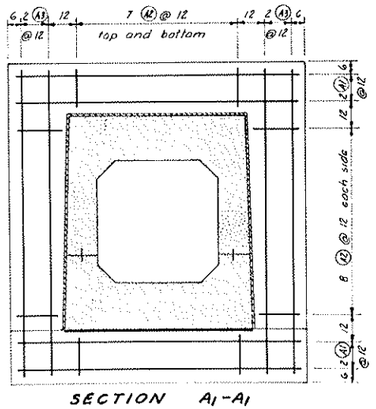
SIZE	LENGTH (FT.)	WEIGHT (LBS.)
4	6,126-8	4,093
5	2,745-3	2,863
6	2,133-0	3,204
7	20,185-10	41,260
	TOTAL	51,420

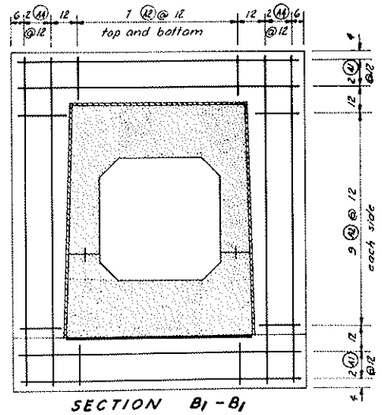












DETAILS OF ANTI-SEEP COLLARS

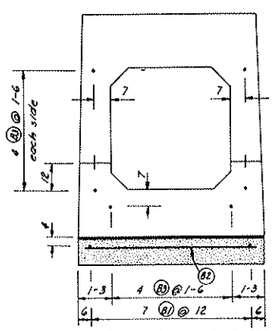


TABLE OF QUANTITIES

ITEM	CONCRETE (CU.YD.)	REINFORCING STEEL (LBS.)
CONDUIT E.J. 1 TO E.J. 10	251.31	50,599
ANTI-SEEP COLLARS	24.94	821

"AS BUILT"

Scale: 3/8" = 1'-0"

PRINCIPAL SPILLWAY BETWEEN E.J. 1 AND E.J. 10 REINFORCING STEEL DETAILS

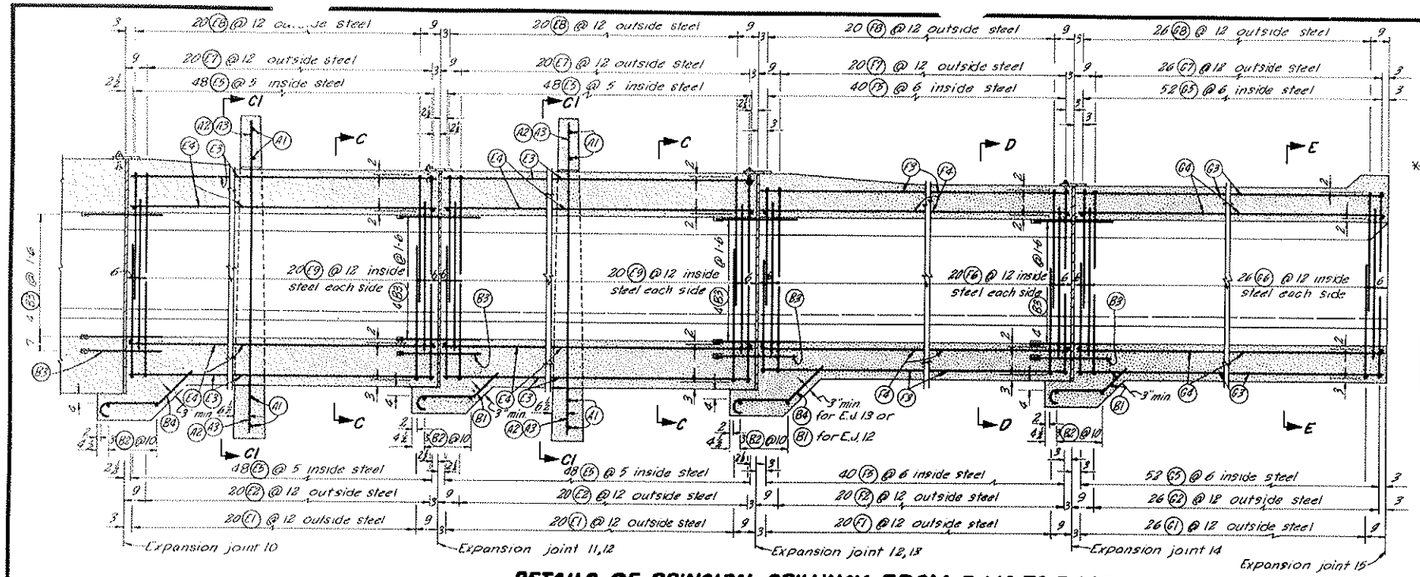
FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed C.F.M. Date
Drawn
Traced
Checked D.E.M. W.R.E. 5-61
Approved by
Title
Title
Sheet No. 23 of 35
Drawing No. S,E-20,230



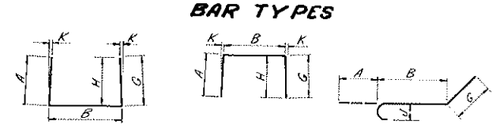
DETAILS OF PRINCIPAL SPILLWAY FROM E.J.10 TO E.J.15

BAR SCHEDULE

MARK	SIZE	QUAN.	LENGTH	TOTAL LENGTH	TYPE	A	B	G	H	J	K	SPACING IF INCH.
A1	4	12	10-6	126-0	STR.							12
A2	4	84	1-6	126-0	STR.							12
A3	4	12	11-6	138-0	STR.							12
B1	5	21	4-3	89-3	22	3-9	2-1	1-5		0-5		12
B2	5	15	6-6	97-6	22							10
B3	7	60	3-0	180-0	STR.							18
B4	5	14	4-6	63-0	22	3-9	2-1	1-5		0-5		12
F1	7	60	16-6	990-0	22	4-11	6-2	6-1	4-1			12
F2	7	60	14-2	850-0	22	3-9	6-8	3-9	3-9		0-1 1/4	12
F3	4	81	19-9	1599-9	STR.						0-1 1/2	12
F4	6	36	19-9	711-0	STR.							12
F5	7	288	5-6	1584-0	STR.							12
F6	5	24	19-1	476-0	STR.							6
F7	5	60	13-6	820-0	23	3-9	6-2	3-9	3-9			12
F8	7	60	15-10	950-0	23	4-10	6-2	4-10	4-10		0-1 1/4	12
F9	5	120	5-6	660-0	STR.						0-2	12
F1	5	20	19-5	390-0	22	3-11	6-8	3-11	2-11			12
F2	5	20	12-6	250-0	22	2-11	6-8	2-11	2-11		0-1 3/4	12
F3	4	25	19-9	493-9	STR.						0-1 1/4	12
F4	5	20	19-9	395-0	STR.							12
F5	6	80	5-6	440-0	STR.							12
F6	5	40	5-6	220-0	STR.							6
F7	5	20	12-0	240-0	23	2-11	6-2	2-11	2-11			12
F8	5	20	15-0	300-0	23	4-5	6-2	4-5	4-5		0-1 1/4	12
G1	5	26	14-6	377-0	22	3-11	6-8	3-11	2-11		0-1 3/4	12
G2	5	26	12-6	325-0	22	2-11	6-8	2-11	2-11		0-1 1/4	12
G3	4	25	25-6	637-6	STR.							12
G4	5	20	25-6	510-0	STR.							12
G5	6	104	5-6	572-0	STR.							6
G6	5	52	5-6	286-0	STR.							12
G7	5	26	12-0	312-0	23	2-11	6-2	2-11	2-11		0-1 1/4	12
G8	5	26	15-0	390-0	23	4-5	6-2	4-5	4-5		0-1 3/4	12

* PLAIN DOWEL BARS NO. 4 BARS = 1/2" DIA. NO. 5 BARS = 5/8" DIA.
NO. 6 BARS = 3/4" DIA. NO. 7 BARS = 7/8" DIA.

BAR TYPES



BAR TOTALS

SIZE	LENGTH (FT.)	WEIGHT (LBS)
4	3,121-0	2,065
5	5,278-9	5,506
6	1,723-0	2,588
7	5,374-0	10,984
	TOTAL	21,163

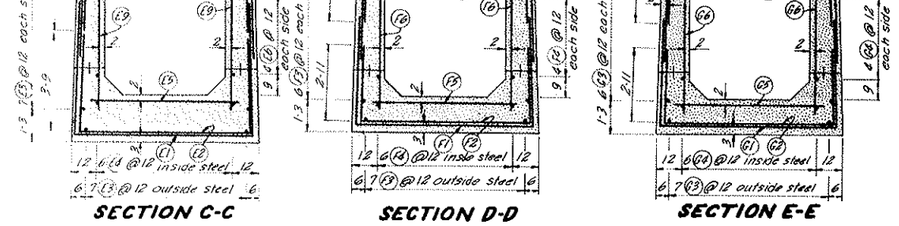
TABLE OF QUANTITIES

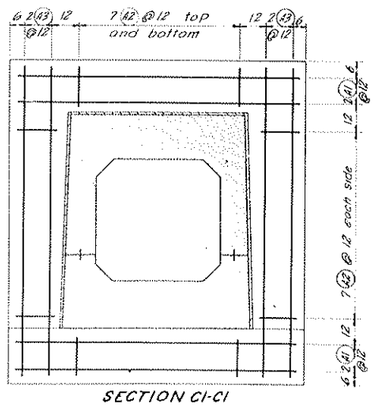
ITEM	CONCRETE (CU.YDS.)	REINFORCING STEEL (LBS.)
CONDUIT E.J. 10 TO E.J. 15	129.49	20,902
ANTI-SEEP COLLARS	6..7	261

NOTES:

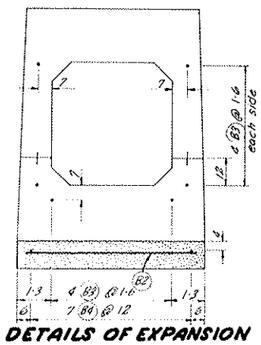
1. PREFIX "A" ON BARS IN ANTI-SEEP COLLARS.
   PREFIX "B" ON BARS IN EXPANSION JOINTS.
   PREFIX "E" ON BARS FOR CONDUIT BETWEEN EXPANSION JOINTS 10 AND 11.
   PREFIX "F" ON BARS FOR CONDUIT BETWEEN EXPANSION JOINTS 13 AND 14.
   PREFIX "G" ON BARS FOR CONDUIT BETWEEN EXPANSION JOINTS 14 AND 15.
   E.J.= EXPANSION JOINT.
2. ALL DIMENSIONS SHOWING DISTANCE FROM FACE OF CONCRETE TO REINFORCING BARS DESIGNATE THE CLEAR DISTANCE.
3. MARK (B3) PLAIN DOWEL BARS TO BE COATED ON THE UPSTREAM END TO PREVENT BOND. PROVIDE DOWEL SLEEVE WITH CLOSED END AND 3/4" EXPANSION CHAMBER AT UPSTREAM END OF DOWEL.
4. RADIUS OF BENDS OF REINFORCING BARS EQUALS THREE(3) TIMES THE DIAMETER OF THE BAR.
5. ALL BAR DIMENSIONS ARE OUT TO OUT OF BAR.

"AS BUILT"

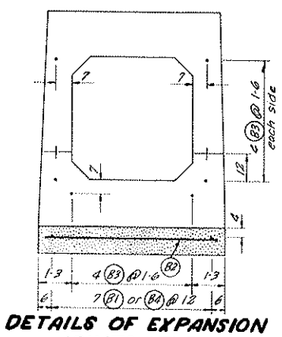




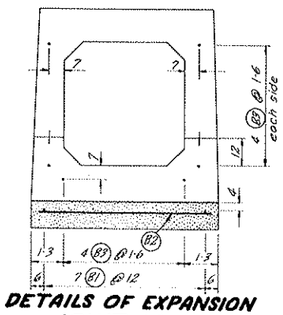
DETAILS OF ANTI-SEEP COLLARS



DETAILS OF EXPANSION JOINT 10



DETAILS OF EXPANSION JOINTS 11 THRU 13



DETAILS OF EXPANSION JOINT 14

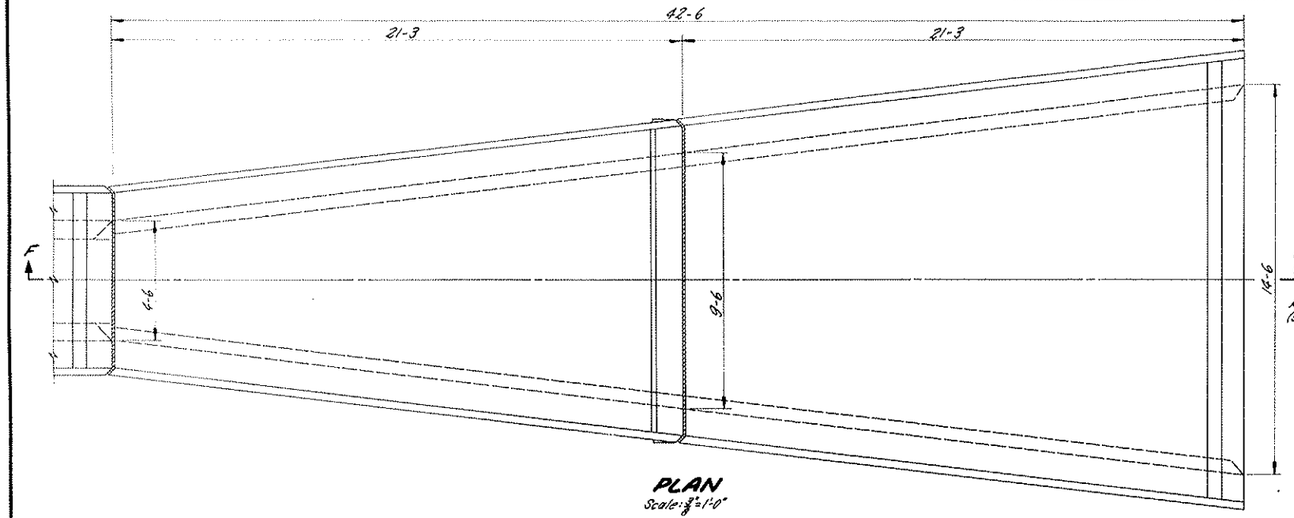
Scale: 1/10"

PRINCIPAL SPILLWAY BETWEEN E.J.10 AND E.J.15 REINFORCING STEEL DETAILS

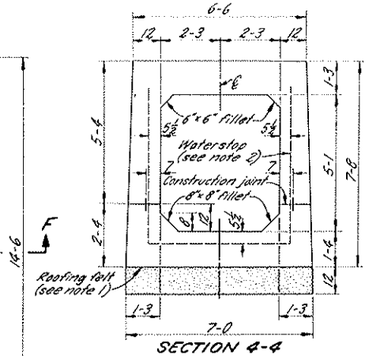
FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

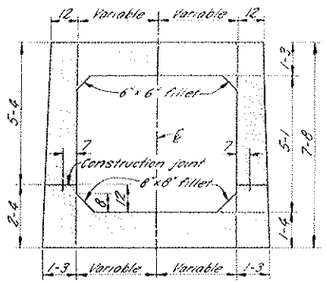
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Drawn C.E.M.		Title	
Traced		Title	
Checked DEM, WRE	5-64	Sheet No. 23 of 39	Drawing No. 5, E-20, 230



PLAN
Scale: 3/32"=1'-0"



SECTION 4-4

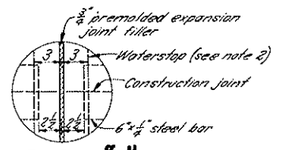


SECTION G-G
Scale: 3/8"=1'-0"

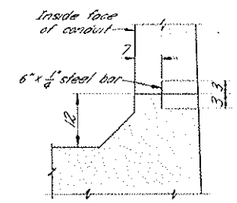
DETAILS OF EXPANSION JOINT 15
Scale: 3/8"=1'-0"

TABLE OF QUANTITIES

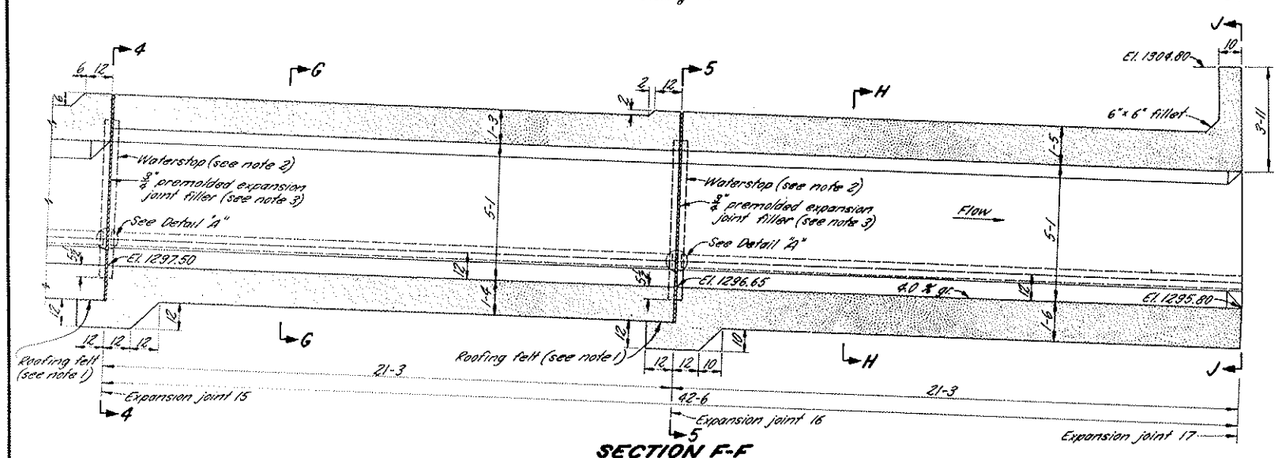
ITEM	UNIT	QUANTITY
Concrete (Class A)	Cu. Yds.	73.36
Reinforcing steel	Lbs.	14,485



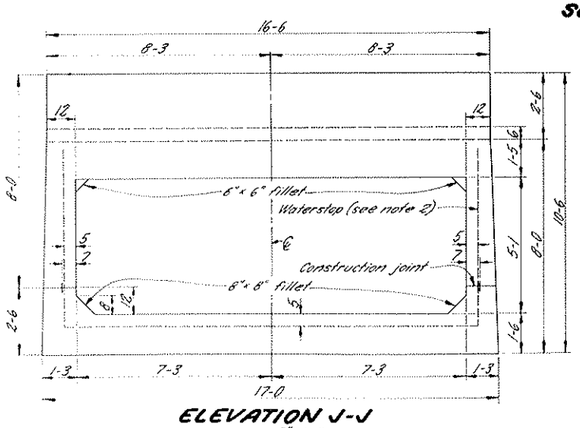
DETAIL "A"
Scale: 1½"=1'-0"



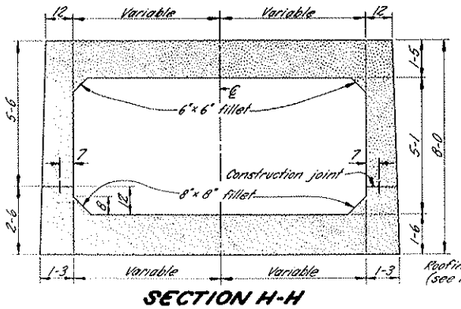
DETAILS OF CONSTRUCTION JOINT
Scale: 3/8"=1'-0"



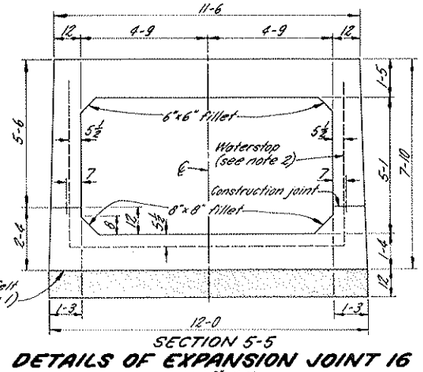
SECTION F-F
Scale: 3/8"=1'-0"



ELEVATION J-J
Scale: 3/8"=1'-0"



SECTION H-H
Scale: 3/8"=1'-0"



SECTION 5-5

DETAILS OF EXPANSION JOINT 16
Scale: 3/8"=1'-0"

NOTES:

1. PLACE 2 LAYERS OF HEAVY SMOOTH SURFACE ROOFING FELT BETWEEN BOTTOM OF CONDUIT AND EXPANSION JOINT SLEEPER.
2. USE POLYVINYLCHLORIDE WATERSTOP (SIMILAR AND EQUAL TO SEALTIGHT DUO-PVC TYPE NO. 6180D) 6" WIDE AT ALL EXPANSION JOINTS PER DETAIL.
3. SECURE PREMOLDED EXPANSION JOINT FILLER TO CONCRETE FACE OF CONDUIT LAST POURED WITH 3" COPPER NAILS @ 12" C-C, COUNTERSINK NAILS 1/8".

"AS BUILT"

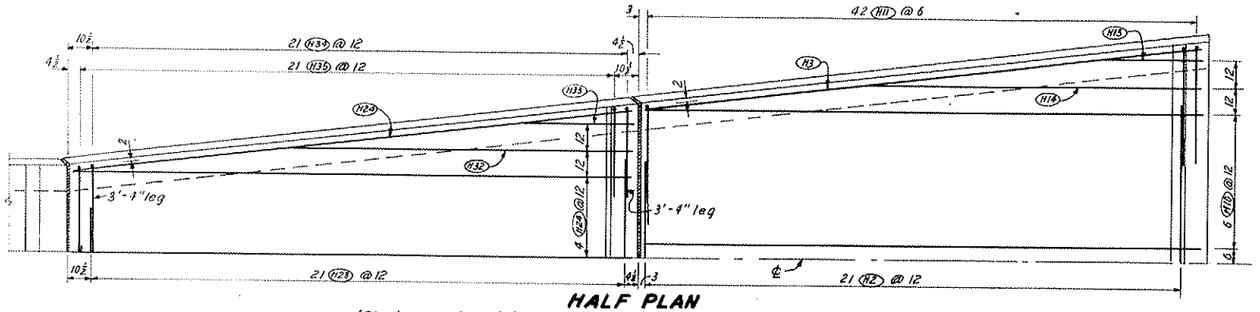
PRINCIPAL SPILLWAY DETAILS OF TRANSITION SECTIONS, E.J. 15 TO E.J. 17

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

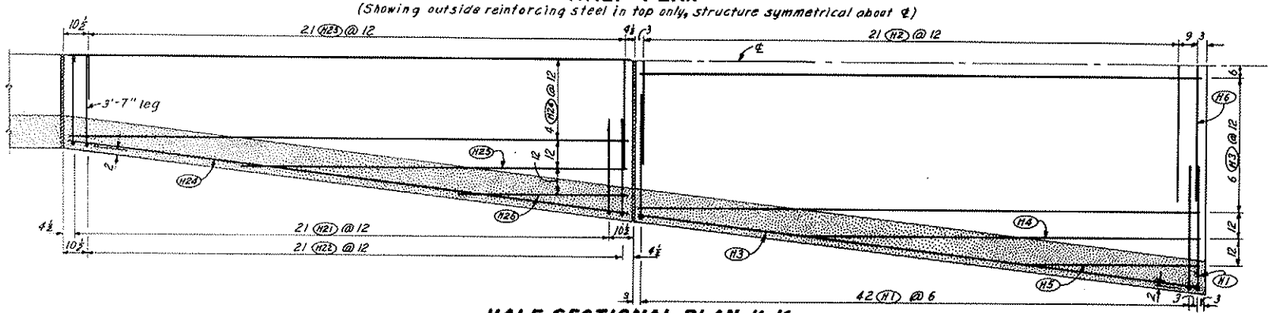
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed R.W.B.		Approved by	
Drawn C.E.M.		Title	
Traced		Title	
Checked D.E.M. W.R.E.		Sheet No. 25 of 35	Drawing No. 5,E-20,230



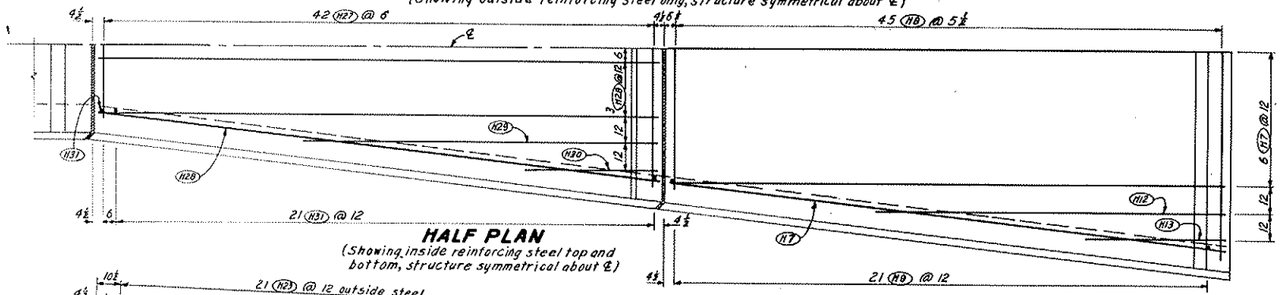
HALF PLAN

(Showing outside reinforcing steel in top only, structure symmetrical about ℄)



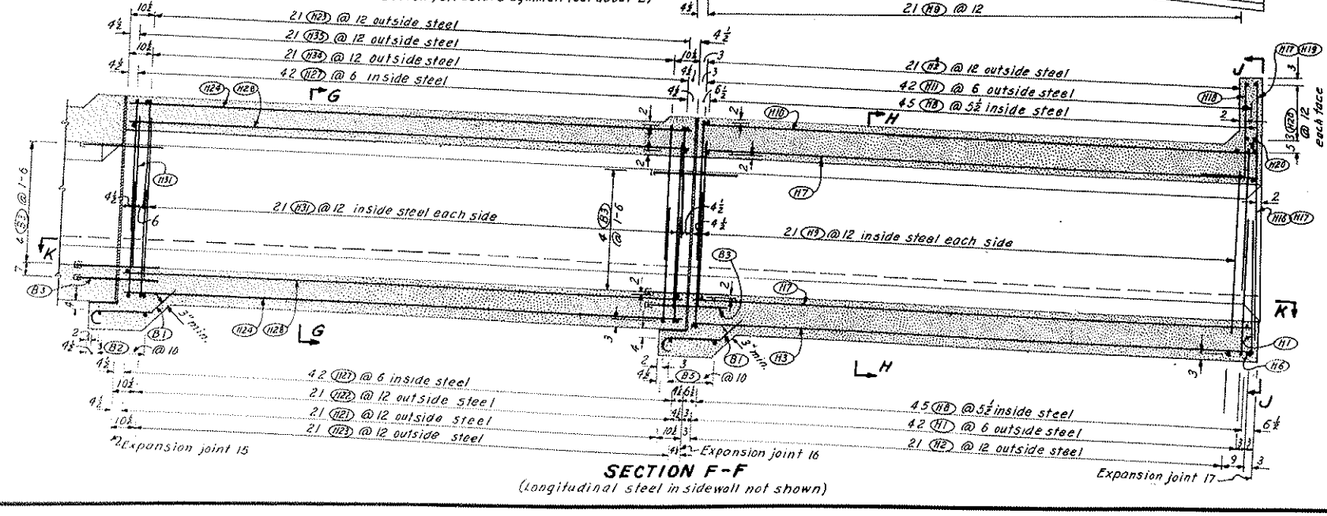
HALF SECTIONAL PLAN K-K

(Showing outside reinforcing steel only, structure symmetrical about ℄)



HALF PLAN

(Showing inside reinforcing steel top and bottom, structure symmetrical about ℄)



SECTION F-F

(Longitudinal steel in sidewall not shown)

"AS BUILT"

Scale: ⅛"=1'-0"

PRINCIPAL SPILLWAY
TRANSITION SECTIONS E.J. 15 TO E.J.17
REINFORCING STEEL DETAILS

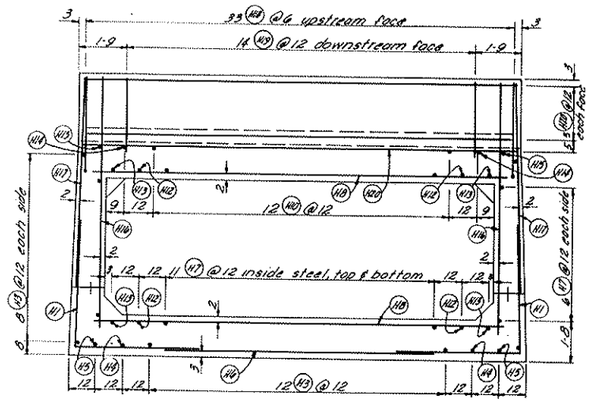
FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

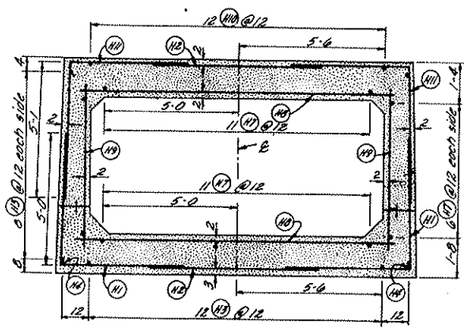
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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Drawn C.E.M.		Title	
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ELEVATION J-J

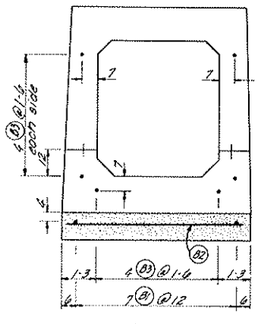


SECTION H-H

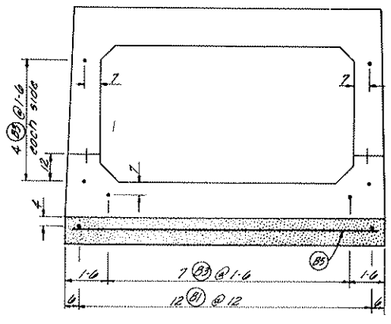
BAR SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	A	B	G	H	J	K	SPACING IN INCHES
B1	5	19	4-3	80-9	24	0-9	2-1	1-5		0-5		12
B2	5	3	6-6	19-6	STR.							10
B3	7	27	3-0	81-0	STR.							18
B5	5	3	11-6	34-6	STR.							10
H1	8	86	9-6	831-4	25	4-8	5-0		5-0		0-2	6
H2	4	2 SETS OF 21 BARS	5-0 TO 10-0 @ 3" INCREMENTS	316-0	STR.							
H3	4	28	21-0	588-0	STR.							12
H4	4	2	14-6	29-0	STR.							12
H5	4	2	6-0	12-0	STR.							
H6	4	1	10-0	10-0	STR.							
H7	5	34	20-9	705-6	STR.							12
H8	8	2 SETS OF 45 BARS	10-4 1/2 TO 15-10 1/2 @ 1 1/2 INCREMENTS	1184-3	STR.							
H9	5	42	6-0	252-0	STR.							5 1/2
H10	4	12	20-9	249-0	STR.							12
H11	8	84	9-6	798-0	26	4-5	5-1		5-1		0-2	12
H12	5	4	13-0	52-0	STR.							6
H13	5	4	5-0	20-0	STR.							
H14	4	2	12-6	25-0	STR.							
H15	4	2	4-0	8-0	STR.							
H16	5	2	9-6	19-0	STR.							
H17	5	2	7-9	15-6	STR.							
H18	5	33	5-2	170-6	25	1-7	3-7		3-7		0-1 3/4	6
H19	4	14	2-9	38-6	STR.							12
H20	4	7	16-3	113-9	STR.							12
H21	6	42	7-10	329-6	25	3-7	4-3		4-3		0-1 1/2	12
H22	6	42	7-7	316-6	25	3-7	4-0		4-0		0-1 1/2	12
H23	4	2 SETS OF 21 BARS	2-6 TO 7-6 @ 3" INCREMENTS	210-0	STR.							12
H24	4	30	21-0	630-0	STR.							11, 12
H25	4	2	14-6	29-0	STR.							
H26	4	2	6-0	12-0	STR.							
H27	6	2 SETS OF 42 BARS	5-6 TO 10-7 1/2 @ 1 1/2" INCREMENTS	677-3	STR.							
H28	5	24	21-0	504-0	STR.							6
H29	5	4	13-0	52-0	STR.							12
H30	5	4	5-0	20-0	STR.							
H31	5	44	6-0	264-0	STR.							
H32	4	2	12-6	25-0	STR.							12
H33	4	2	4-0	8-0	STR.							
H34	6	42	7-4	308-0	26	3-4	4-0		4-0		0-1 1/2	13
H35	6	42	8-3	346-6	26	3-4	4-11		4-11		0-2	12

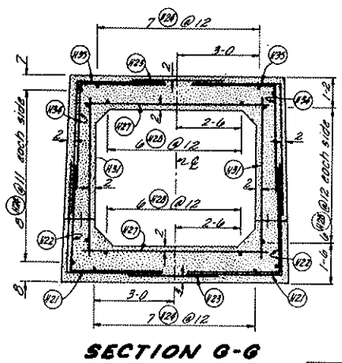
* PLAIN DOWEL BARS NO. 4 BAR = 1/2" DIA. NO. 5 BAR = 5/8" DIA. NO. 6 BAR = 3/4" DIA. NO. 7 BAR = 7/8" DIA. NO. 8 BAR = 1" DIA.



DETAILS OF EXPANSION JOINT 15

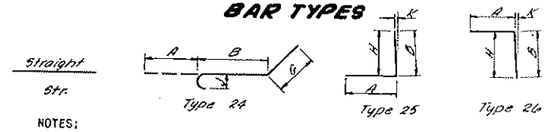


DETAILS OF EXPANSION JOINT 16



SECTION G-G

BAR TYPES



NOTES;

1. PREFIX "B" ON BARS IN EXPANSION JOINTS. PREFIX "H" ON BARS FOR TRANSITION SECTIONS BETWEEN E.J. 15 AND E.J. 17. E.J. = EXPANSION JOINT.
2. ALL DIMENSIONS SHOWING THE DISTANCE FROM FACE OF CONCRETE TO REINFORCING BARS DESIGNATE THE CLEAR DISTANCE.
3. MARK (B1) PLAIN DOWEL BARS TO BE COATED ON THE UPSTREAM END TO PREVENT BOND. PROVIDE DOWEL SLEEVE WITH CLOSED END AND 3/4" EXPANSION CHAMBER AT UPSTREAM END OF DOWEL.
4. RADIUS OF BENDS OF REINFORCING BARS EQUALS THREE (3) TIMES THE DIAMETER OF THE BAR.
5. ALL BAR DIMENSIONS ARE OUT TO OUT OF BAR.

BAR TOTALS

SIZE	LENGTH (FT.)	WEIGHT (LBS.)
4	2,302-3	1,536
5	2,209-3	2,304
6	1,979-3	2,373
7	81-0	166
8	2,810-7	7,564
	TOTAL	14,465

"AS BUILT"

Scale: 3/8" = 1'-0"

PRINCIPAL SPILLWAY TRANSITION SECTIONS E.J.15 TO E.J.17 REINFORCING STEEL DETAILS

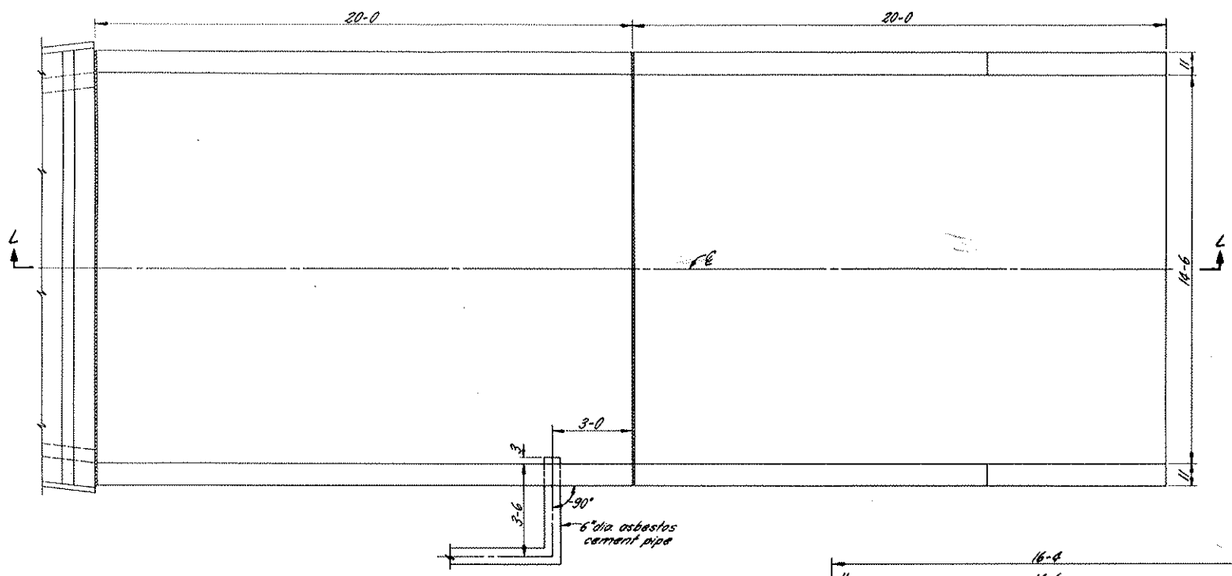
FLOOD RETARDING-FISH AND WILDLIFE DAM NO.1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

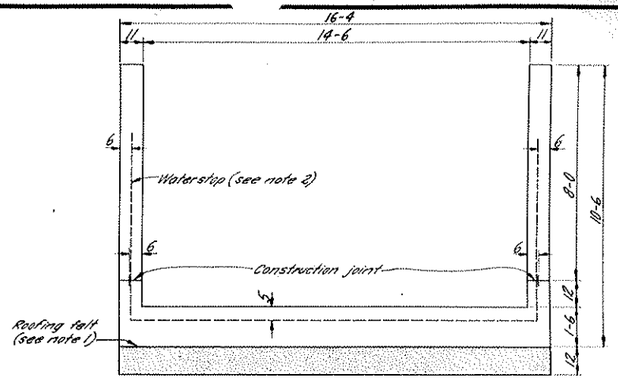
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date		Approved by	
Designed	R.W.B.	Title	
Drawn	C.E.M.	Title	
Traced		Sheet No.	27 of 35
Checked	O.E.A. W.R.E.	Drawing No.	5, E-20, 230

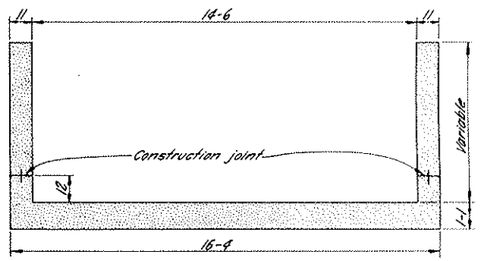


PLAN
Scale: 3/8"=1'-0"

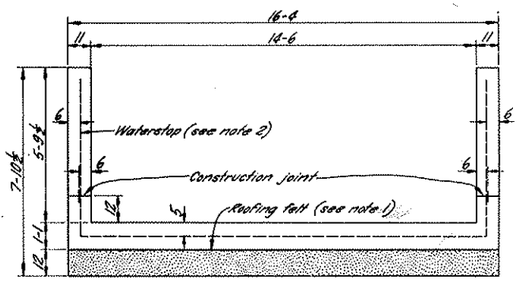


SECTION M-M

DETAILS OF EXPANSION JOINT 17
Scale: 3/8"=1'-0"



SECTION O-O
Scale: 3/8"=1'-0"

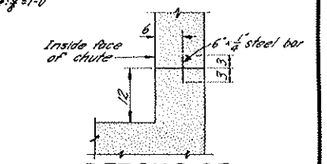


SECTION N-N

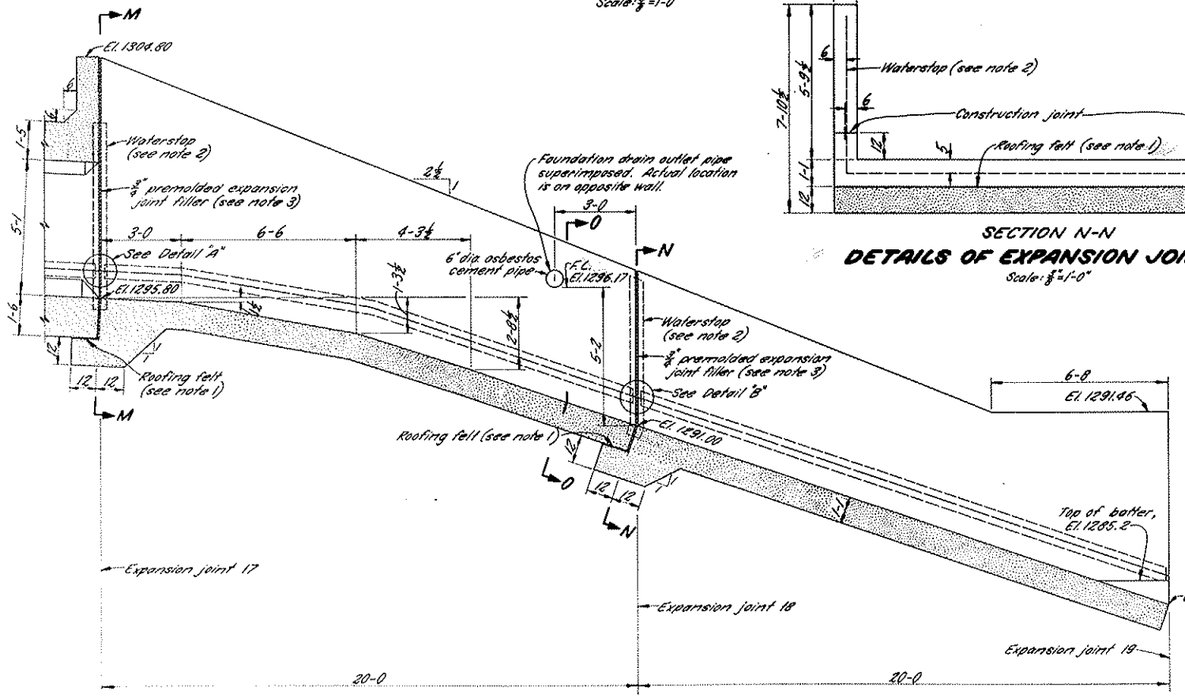
DETAILS OF EXPANSION JOINT 18
Scale: 3/8"=1'-0"

TABLE OF QUANTITIES

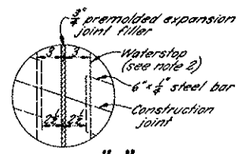
ITEM	UNIT	QUANTITY
Concrete (Class A)	Cu. yds.	47.78
Reinforcing steel	Lbs.	6,554



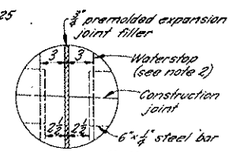
DETAILS OF CONSTRUCTION JOINT
Scale: 3/8"=1'-0"



SECTION L-L
Scale: 3/8"=1'-0"



DETAIL "B"
Scale: 1½"=1'-0"



DETAIL "A"
Scale: 1½"=1'-0"

NOTES:
1. PLACE 2 LAYERS OF HEAVY SMOOTH SURFACE ROOFING FELT BETWEEN BOTTOM OF STRUCTURE AND EXPANSION JOINT SLEEPER AND BETWEEN OUTSIDE SURFACE OF ASBESTOS CEMENT PIPE AND SIDEWALLS.
2. USE POLYVINYLCHLORIDE WATERSTOP (SIMILAR AND EQUAL TO SEALTIGHT DUO-PVC TYPE NO. 6180D) 6" WIDE AT ALL EXPANSION JOINTS PER DETAIL.
3. SECURE PREMOLDED EXPANSION JOINT FILLER TO CONCRETE FACE LAST PLACED WITH 3" COPPER NAILS @ 12" C-C. COUNTERSINK NAILS 1/8".
4. PROVIDE END CAP ON OUTLET END OF OUTLET PIPE. FOR DETAILS OF END CAP, SEE STANDARD DRAWING NO. 5, R-10,000.55.

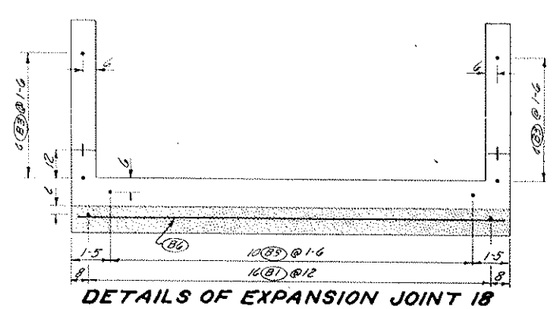
"AS BUILT"

PRINCIPAL SPILLWAY DETAILS OF CHUTE SECTIONS E.V. 17 TO E.V. 19

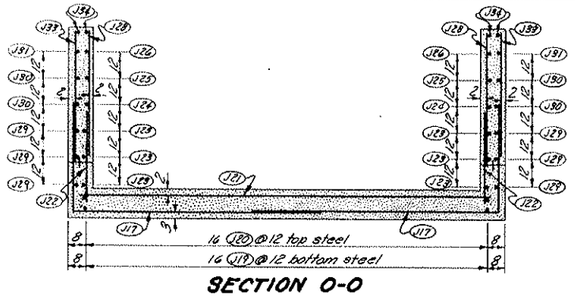
FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

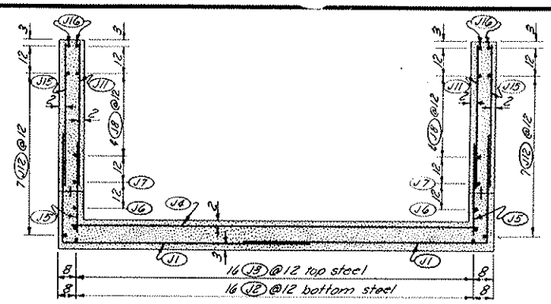
	Date		
Designed D.E.M.		Approved by	
Drawn J.G.S. C.E.M.		Title	
Traced		Title	
Checked R.W.B. W.R.E.		Sheet No. 29 of 35	Drawing No. 5,E-20,230



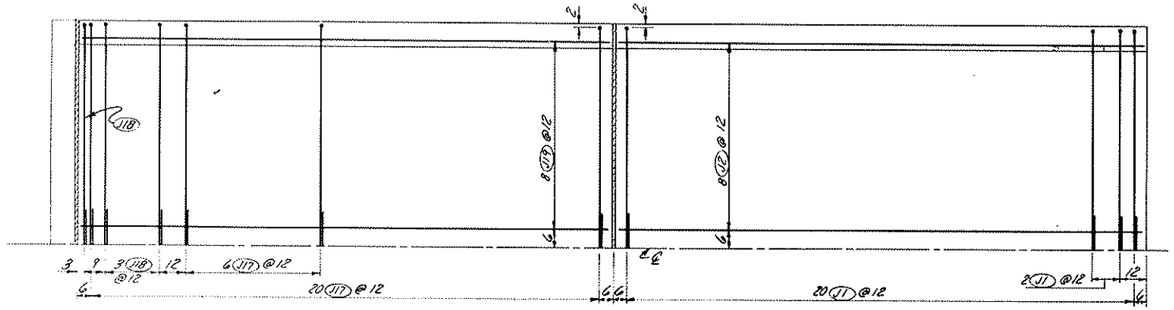
DETAILS OF EXPANSION JOINT 18



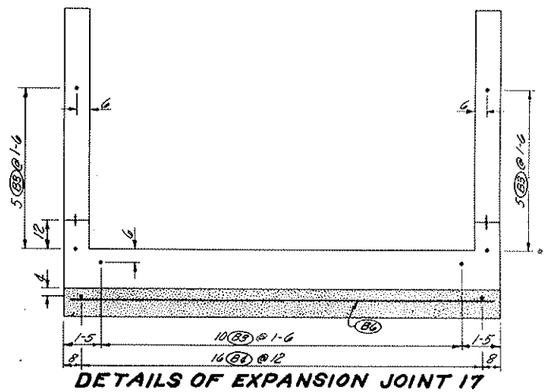
SECTION O-O



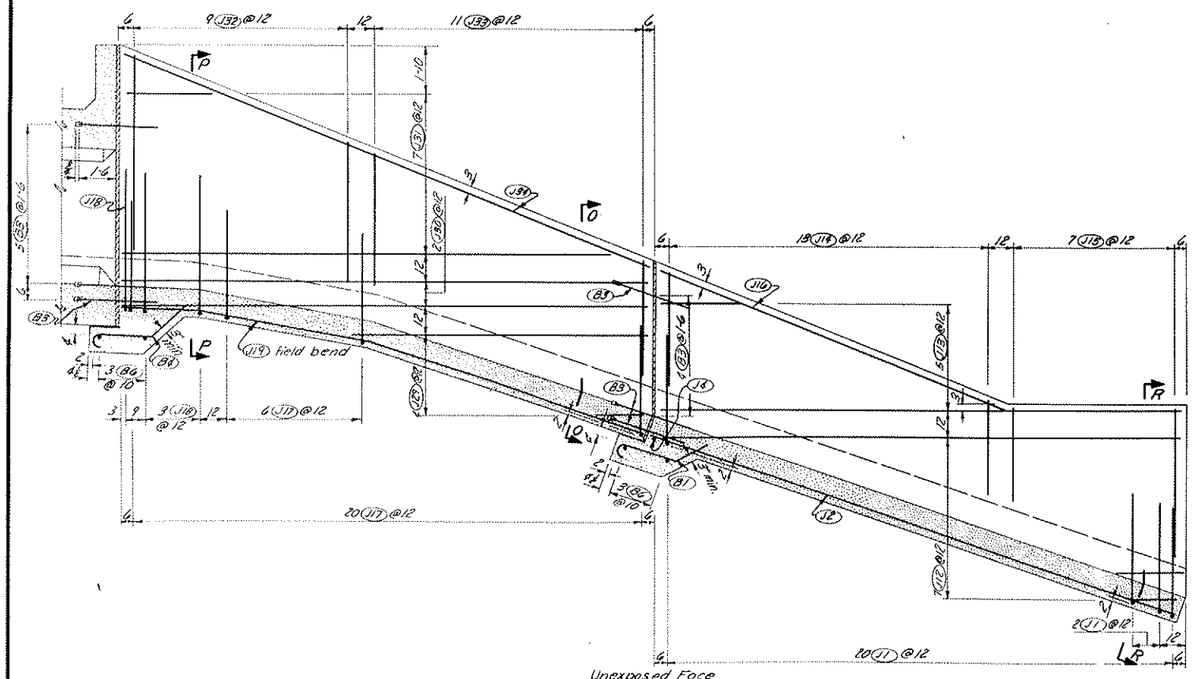
SECTION R-R



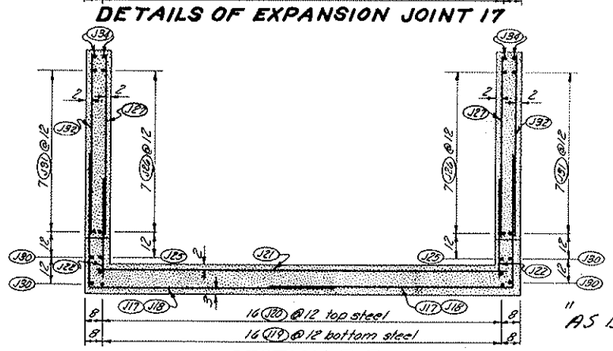
HALF PLAN
Bottom steel in floor



DETAILS OF EXPANSION JOINT 17



SECTION L-L



"AS BUILT"

SECTION P-P

Scale: 3/8" = 1'-0"

PRINCIPAL SPILLWAY CHUTE SECTIONS E.J. 17 TO E.J. 19 REINFORCING STEEL DETAILS

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

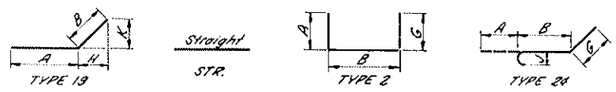
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date		Approved by	
Designed	DEM	Title	
Drawn	CEM	Title	
Traced		Sheet No. 29 of 55	Drawing No. 5,E-20,230
Checked	RWB/WPE		

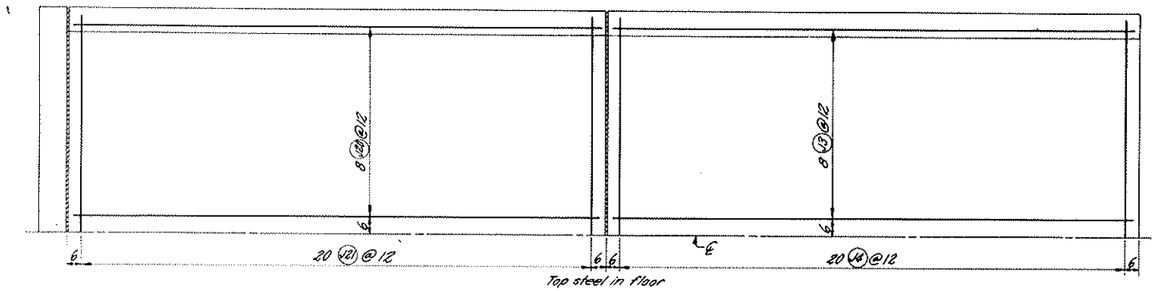
BAR TYPES



BAR SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	A	B	G	H	J	K	SPACING IN INCHES
* 81	5	16	4-3	68-0	24	0-9	2-1	1-5		0-5		12
* 83	7	38	3-0	114-0	STR.							18
* 84	5	16	4-6	72-0	24	0-9	2-1	1-8		0-5		12
* 86	5	6	15-6	93-0	STR.							10
J1	8	44	13-4	586-8	2	4-1	9-3					12
J2	4	16	20-9	332-0	STR.							12
J3	5	16	20-9	332-0	STR.							12
J4	6	21	15-6	325-6	STR.							12
J5	5	40	3-4	133-4	STR.							12
J6	5	2	4-0	8-0	STR.							-
J7	5	10	6-6	65-0	STR.							12
J8	5	2 SETS OF 4 BARS	5-0 TO 14-0 @ 3'-0" INCREMENTS	76-0	STR.							12
J9	5	2 SETS OF 5 BARS	3-0 TO 13-0 @ 2'-6" INCREMENTS	80-0	STR.							12
J10	5	2 SETS OF 13 BARS	3-4 TO 4-4 @ 1" INCREMENTS	99-8	STR.							12
J11	5	2 SETS OF 7 BARS	3-6 TO 5-9 @ 4 1/2" INCREMENTS	64-9	STR.							12
J12	4	2 SETS OF 7 BARS	1-9 TO 19-9 @ 3'-0" INCREMENTS	150-6	STR.							12
J13	4	2 SETS OF 5 BARS	3-0 TO 13-0 @ 2'-6" INCREMENTS	80-0	STR.							12
J14	6	2 SETS OF 13 BARS	3-4 TO 4-4 @ 1" INCREMENTS	99-8	STR.							12
J15	6	2 SETS OF 7 BARS	3-6 TO 5-9 @ 4 1/2" INCREMENTS	64-9	STR.							12
J16	5	4	20-6	82-0	19	14-0	6-6		6-1 3/4		2-5	-
J17	8	52	13-4	693-4	2	4-1	9-3					12
J18	8	8	14-6	116-0	2	5-3	9-3					12
J19	4	16	20-3	324-0	FIELD BEND							12
J20	5	16	20-3	324-0	FIELD BEND							12
J21	6	20	15-6	310-0	STR.							12
J22	5	40	3-4	133-4	STR.							12
J23	5	2 SETS OF 3 BARS	4-0 TO 10-0 @ 3'-0" INCREMENTS	42-0	STR.							12
J24	5	2	15-6	31-0	STR.							-
J25	5	2	19-6	39-0	STR.							-
J26	5	2 SETS OF 7 BARS	3-4 TO 18-4 @ 2'-6" INCREMENTS	151-8	STR.							12
J27	5	2 SETS OF 9 BARS	5-3 TO 7-3 @ 3" INCREMENTS	112-6	STR.							12
J28	5	2 SETS OF 11 BARS	4-3 TO 5-1 @ 1" INCREMENTS	102-8	STR.							12
J29	4	2 SETS OF 4 BARS	2-0 TO 11-0 @ 3'-0" INCREMENTS	52-0	STR.							12
J30	4	4	19-6	78-0	STR.							12
J31	4	2 SETS OF 7 BARS	3-4 TO 18-4 @ 2'-6" INCREMENTS	151-8	STR.							12
J32	6	2 SETS OF 9 BARS	5-3 TO 7-3 @ 3" INCREMENTS	112-6	STR.							12
J33	6	2 SETS OF 11 BARS	4-3 TO 5-1 @ 1" INCREMENTS	102-8	STR.							12
J34	5	4	21-0	84-0	STR.							-

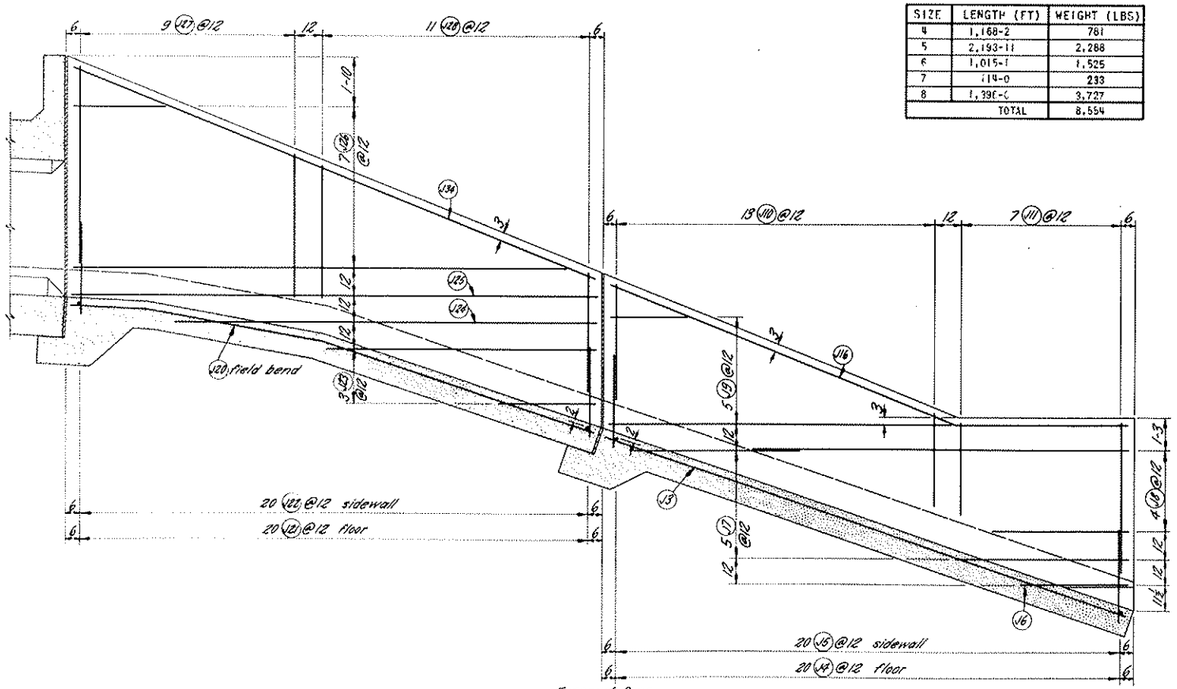
* PLAIN DOWEL BAR NO. 4 BAR = 1/2" DIA. NO. 5 BAR = 5/8" DIA. NO. 6 BAR = 3/4" DIA.
NO. 7 BAR = 7/8" DIA. NO. 8 BAR = 1" DIA.



HALF PLAN

BAR TOTALS

SIZE	LENGTH (FT)	WEIGHT (LBS)
4	1,168-2	761
5	2,193-11	2,288
6	1,015-1	1,525
7	114-0	233
8	1,39E-6	3,727
	TOTAL	8,554



SECTION L-L

NOTES:

1. PREFIX "B" ON BARS IN EXPANSION JOINTS.
   PREFIX "J" ON BARS FOR CHUTE SECTIONS BETWEEN E.J. 17 AND E.J. 19
   E.J. = EXPANSION JOINT
2. ALL DIMENSIONS SHOWING THE DISTANCE FROM FACE OF CONCRETE TO REINFORCING BARS DESIGNATE THE CLEAR DISTANCE.
3. MARK (83) PLAIN DOWEL BARS TO BE COATED ON THE UPSTREAM END TO PREVENT BOND. PROVIDE DOWEL SLEEVE WITH CLOSED END AND 3/4" EXPANSION CHAMBER AT UPSTREAM END OF DOWEL.
4. RADIUS OF BENDS OF REINFORCING BARS EQUALS THREE (3) TIMES THE DIAMETER OF THE BAR.
5. ALL DIMENSIONS ARE OUT TO OUT OF BAR.
6. THE STRUCTURE IS SYMMETRICAL ABOUT ITS CENTERLINE EXCEPT FOR ONE 6" DIA. ASBESTOS CEMENT PIPE ENTERING THROUGH THE RIGHT SIDEWALL ONLY.

"AS BUILT"

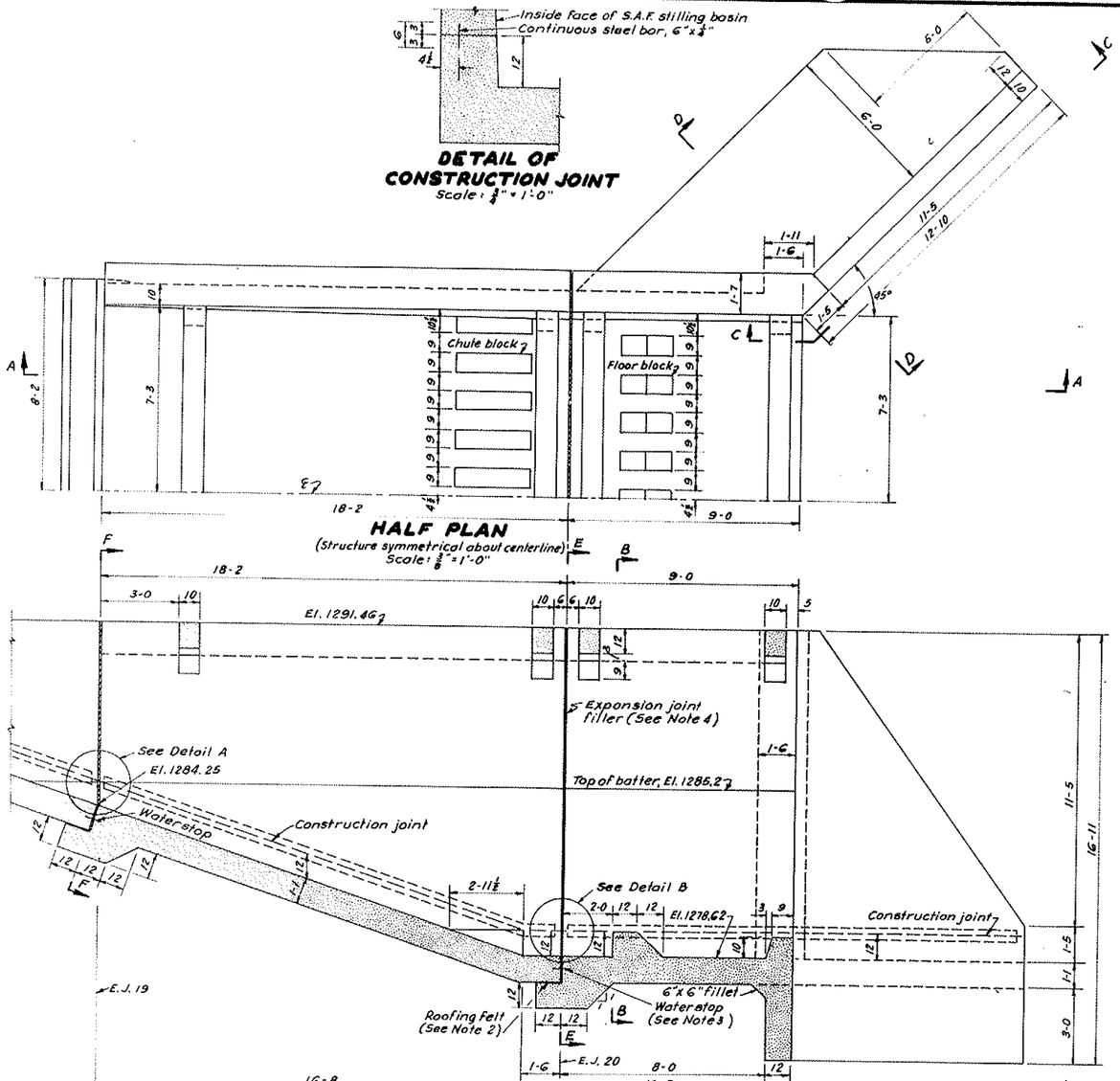
Scale: 3/4"=1'-0"

PRINCIPAL SPILLWAY CHUTE SECTIONS E.J. 17 TO E.J. 19 REINFORCING STEEL DETAILS

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date		
Designed D.E.M.	Approved by	
Drawn G.E.M.	Title	
Traced	Title	
Checked R.W.B., W.R.E.	Sheet No. 30 of 35	Drawing No. S,E-20,230



ITEM	UNIT	QUANTITY
CONCRETE (CLASS A)	CU.YD.	64.35
REINFORCING STEEL	LBS.	13,606

TABLE OF QUANTITIES

NOTES:

1. E.J. = EXPANSION JOINT.
2. PLACE TWO LAYERS OF HEAVY, SMOOTH SURFACE, ROOFING FELT BETWEEN BOTTOM OF STRUCTURE AND EXPANSION JOINT, AND BETWEEN SEAMS AND SUPPORTS.
3. USE POLYVINYLCHLORIDE WATERSTOP (SIMILAR AND EQUAL TO SEALTIGHT DUO-PVC TYPE NO. 6160D) 6" WIDE AT EXPANSION JOINTS, PER DETAILS.
4. SECURE PREMOLDED EXPANSION JOINT FILLER TO CONCRETE FACE OF THE SECTION LAST PLACED WITH 3" COPPER NAILS @ 12" C-C. COUNTERSINK NAILS 1/8".

PRINCIPAL SPILLWAY
DETAILS OF S.A.F. STILLING BASIN

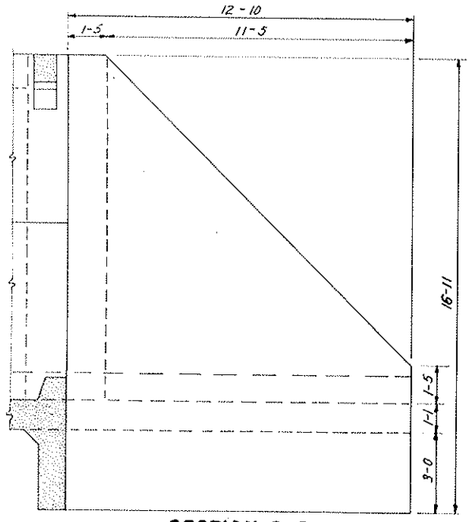
FLOOD RETARDING-FISH AND WILDLIFE DAM No.1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

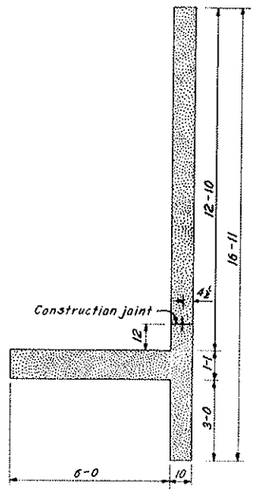
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

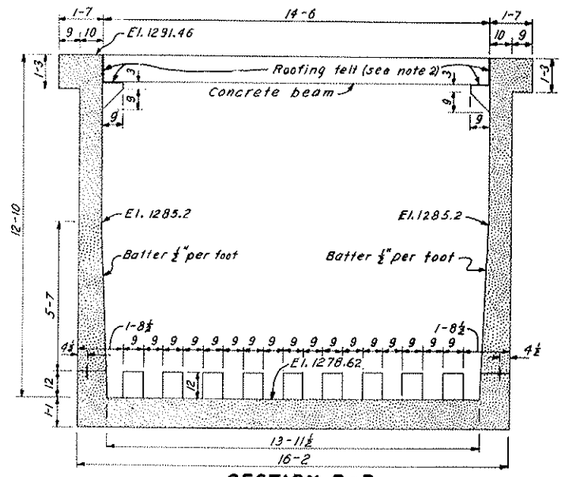
Designed W.R.E. D.E.M.	Date	Approved by	
Drawn		Title	
Traced		Title	
Checked RWB., WRC		Sheet No. 31 of 35	Drawing No. 5,E-20,230



SECTION C-C
Scale: $\frac{3}{8}$" = 1'-0"



SECTION D-D
Scale: $\frac{3}{8}$" = 1'-0"



SECTION B-B
(Concrete beam superimposed)
Scale: $\frac{3}{8}$" = 1'-0"

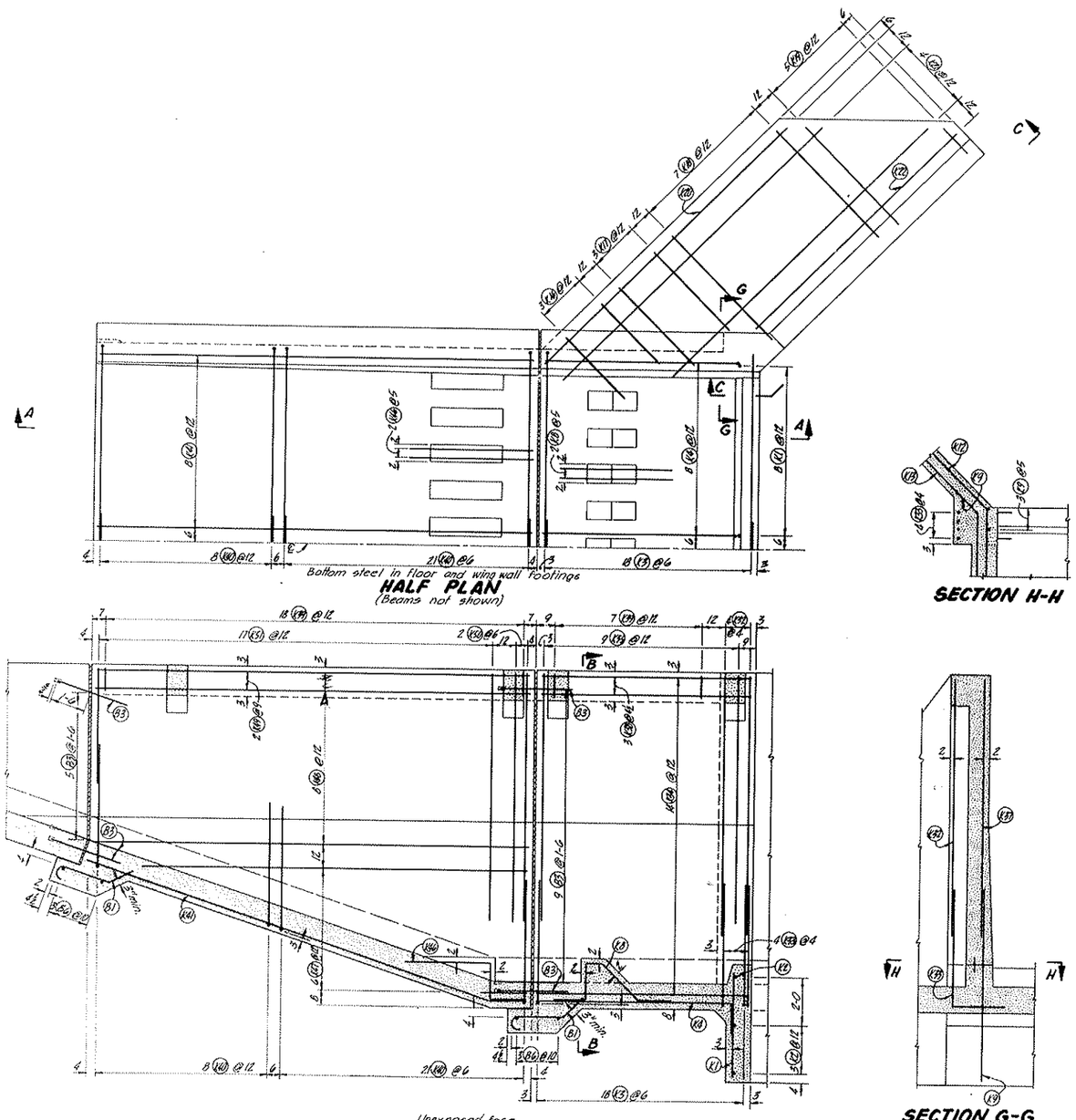
"AS BUILT"

PRINCIPAL SPILLWAY
DETAILS OF S.A.F. STILLING BASIN

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed D.E.M.		Approved by	
Drawn D.E.M.		Title	
Traced		Title	
Checked R.W.B., W.P.F.	5-64	Sheet No. 32 of 35	Drawing No. 5,E-20,230

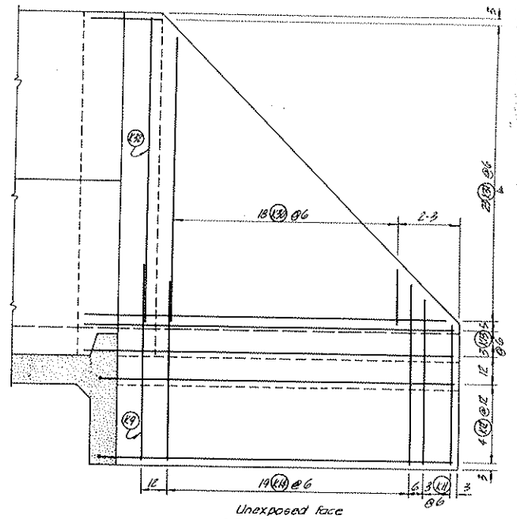


HALF PLAN
(Beams not shown)

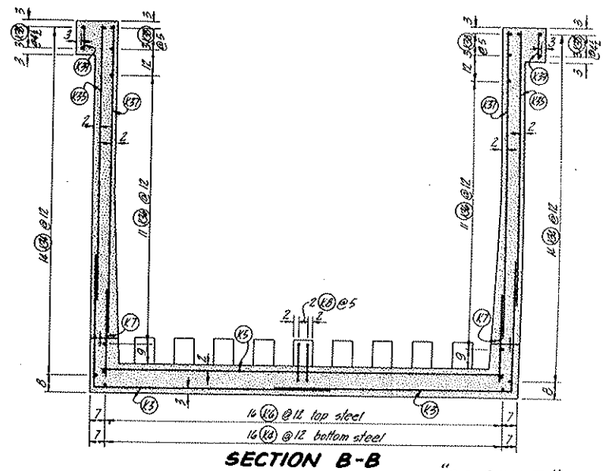
Unexposed face
SECTION A-A

SECTION H-H

SECTION G-G
(Sidewall steel not shown)



Unexposed face
SECTION C-C
(Steel in footing not shown)



SECTION B-B

"AS BUILT"

Scale: 3/8" = 1'-0"

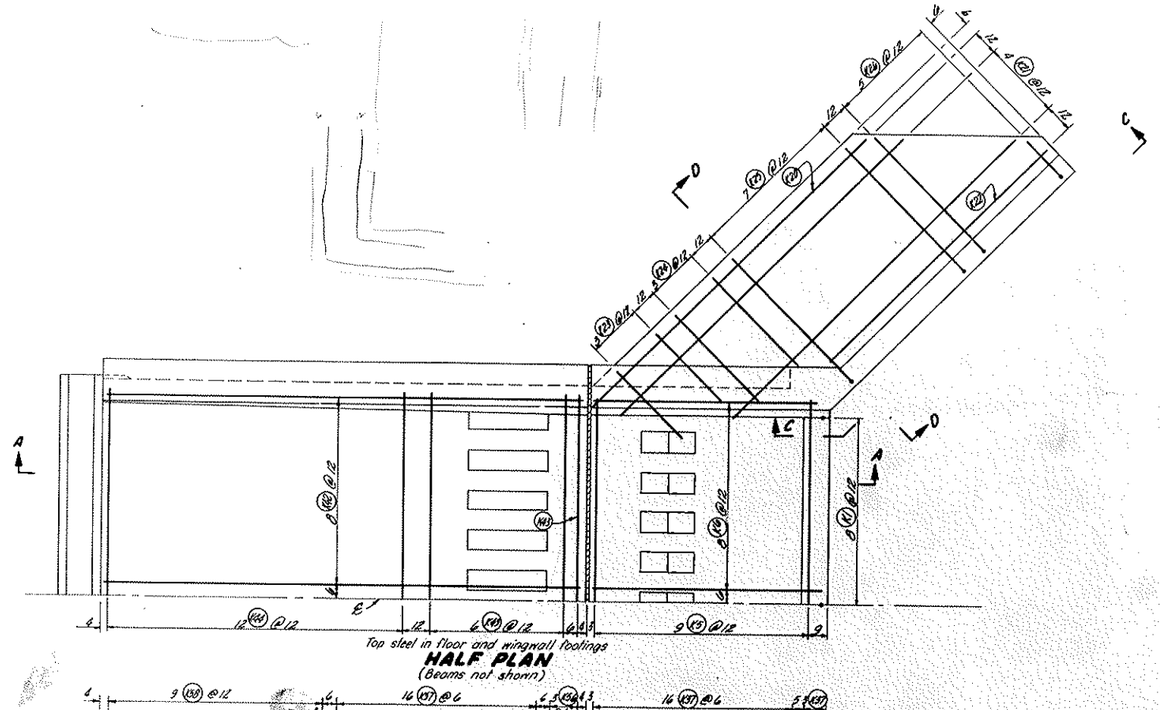
PRINCIPAL SPILLWAY S.A.F. STILLING BASIN REINFORCING STEEL DETAILS

FLOOD RETARDING - FISH AND WILDLIFE DAM No. 1

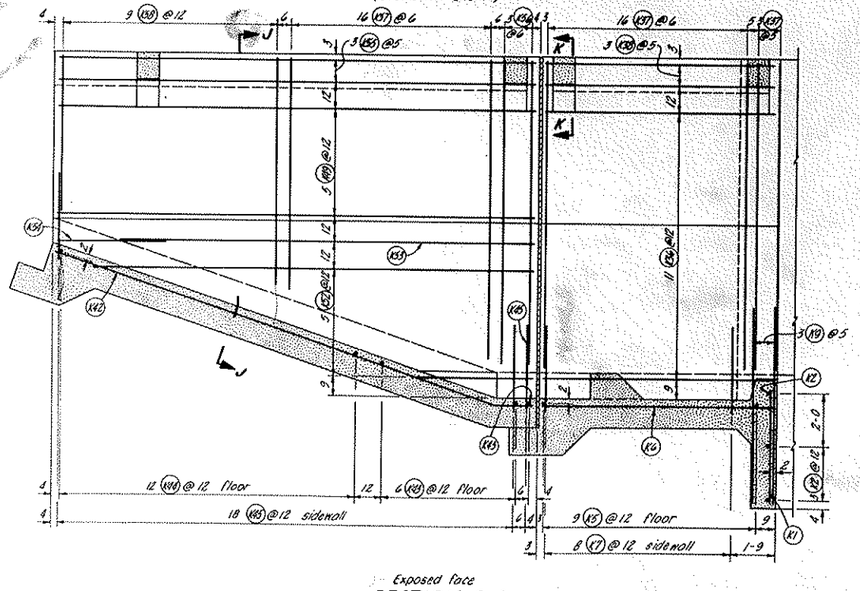
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

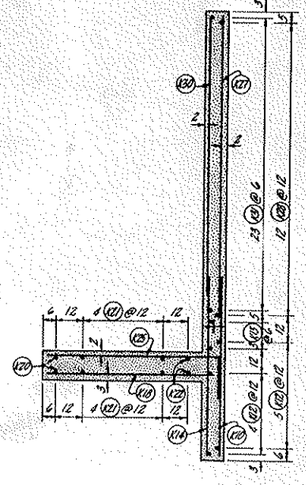
Date		Approved by:	
Designed D.E.M.		Title	
Drawn D.E.M., C.E.M.		Title	
Traced		Sheet No. 33 of 35	Drawing No. 5-E-20,230
Checked R.W.S., W.P.E.			



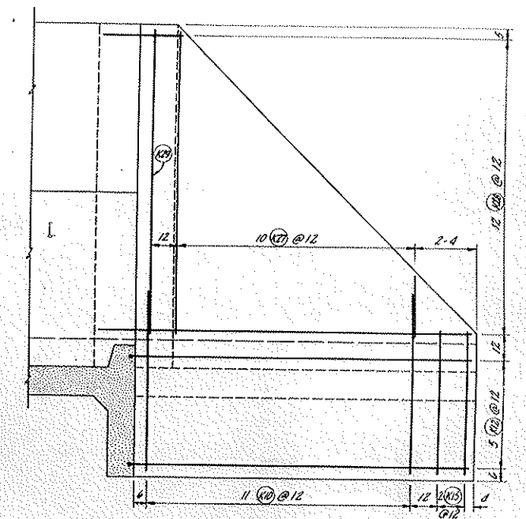
HALF PLAN
(Beams not shown)



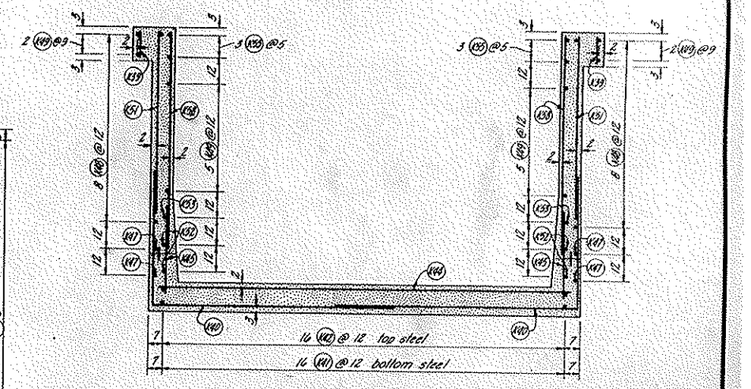
Exposed face
SECTION A-A



SECTION D-D



Exposed face
SECTION C-C
(Steel in footing not shown)



SECTION J-J

"AS BUILT"

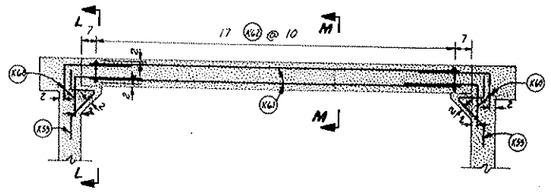
Scale: 1"=1'-0"

PRINCIPAL SPILLWAY S.A.F. STILLING BASIN REINFORCING STEEL DETAILS

FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1
MIDDLE SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

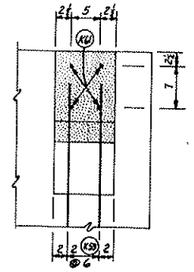
Designed D.E.M.	Date	Approved by	
Drawn D.E.M., C.E.M.		Title	
Traced		Title	
Checked R.W.B., W.R.E.		Sheet No. 34 of 35	Drawing No. 5,E-20,230



SECTION K-K

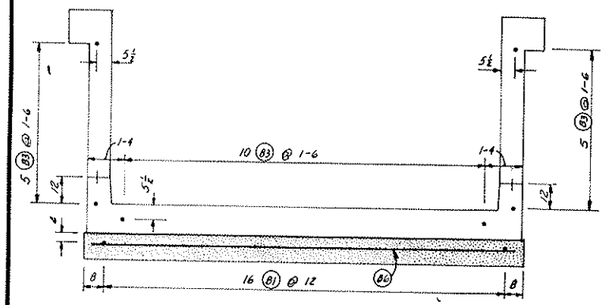
(Sidewall steel not shown)

Scale: $\frac{3}{8}$" = 1'-0"



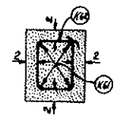
SECTION L-L

Scale: $\frac{3}{8}$" = 1'-0"



DETAILS OF EXPANSION JOINT 19

Scale: $\frac{3}{8}$" = 1'-0"

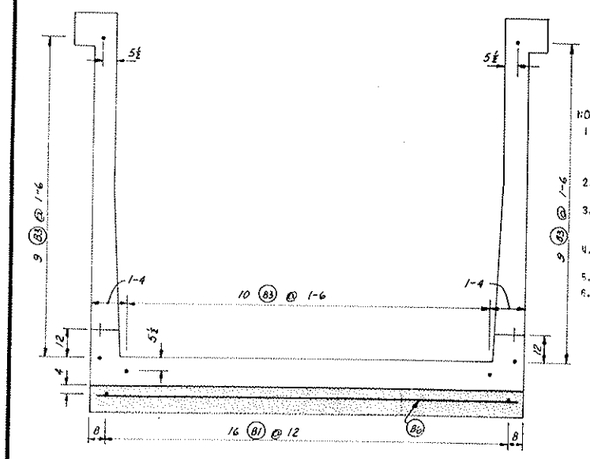


SECTION M-M

Scale: $\frac{3}{8}$" = 1'-0"

BAR TOTALS

SIZE	LENGTH (FT.)	WEIGHT (LBS.)
2	204-0	34
4	1,365-0	912
5	3,923-11	4,093
6	1,242-4	1,866
7	3,139-3	6,417
8	106-6	284
	TOTAL	13,606



DETAILS OF EXPANSION JOINT 20

Scale: $\frac{3}{8}$" = 1'-0"

NOTES:

1. PREFIX "B" ON BARS IN EXPANSION JOINTS. PREFIX "K" ON BARS IN S.A.F. STILLING BASIN FROM E.J. 19 TO OUTLET. E.J. = EXPANSION JOINT
2. ALL DIMENSIONS SHOWING DISTANCE FROM FACE OF CONCRETE TO REINFORCING BARS DESIGNATE THE CLEAR DISTANCE.
3. MARK (B3) PLAIN DOWEL BARS TO BE COATED ON THE UPSTREAM END TO PREVENT BOND. PROVIDE DOWEL SLEEVE WITH CLOSED END AND 3/4" EXPANSION CHAMBER AT UPSTREAM END OF DOWEL.
4. RADIUS OF BENDS OF REINFORCING BARS EQUALS THREE (3) TIMES THE DIAMETER OF THE BAR.
5. ALL BAR DIMENSIONS ARE OUT TO OUT OF BAR.
6. THE STRUCTURE IS SYMMETRICAL ABOUT ITS CENTERLINE.

BAR SCHEDULE

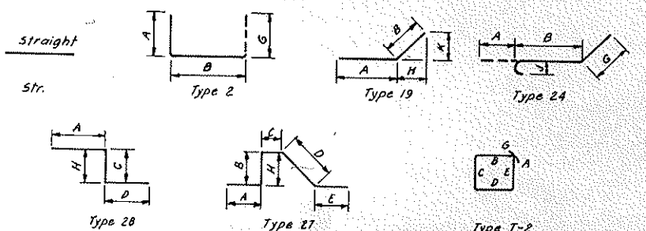
MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	A	B	C	D	E	G	H	J	K	SPACING IN INCHES
B1	5	32	4-3	136-0	24	0-9	2-1				1-5		0-5		12
B3	7	48	3-0	144-0	STR.										18
B6	5	6	15-6	93-0	STR.										10
K1	5	31	4-3	131-9	STR.										
K2	5	8	15-3	122-0	STR.										12
K3	7	36	14-0	504-0	2	5-0	9-0								12 & 24
K4	4	16	9-3	148-0	2	1-3	8-0								6
K5	7	9	15-3	137-3	STR.										12
K6	5	16	8-9	140-0	STR.										12
K7	5	16	3-3	52-0	STR.										12
K8	5	18	7-6	135-0	27	1-7	1-6	0-9	2-1	1-7		1-6			12
K9	7	8	7-4	58-8	STR.										5
K10	6	22	7-0	154-0	STR.										5
K11	7	2 SETS OF 3 BARS	5-4 TO 6-4 @ 6" INCREMENTS	35-0	STR.										12
K12	5	18	14-7	262-6	19	13-0	1-7					1-1 1/2		1-1 1/2	6
K13	7	6	14-0	84-0	19	12-5	1-7					1-1 1/2		1-1 1/2	12
K14	7	38	7-8	294-6	STR.										6
K15	5	4	5-4	21-4	STR.										6
K16	4	6	3-6	21-0	STR.										12
K17	4	6	4-6	27-0	STR.										12
K18	4	14	6-3	87-6	STR.										12
K19	4	2 SETS OF 5 BARS	1-6 TO 5-6 @ 1'-0" INCREMENTS	35-0	STR.										12
K20	5	4	14-0	56-0	STR.										
K21	5	16	14-9	236-0	STR.										12
K22	5	4	11-6	46-0	STR.										
K23	7	6	3-6	21-0	STR.										12
K24	7	6	4-6	27-0	STR.										12
K25	7	14	8-0	112-0	2	6-5	1-7								12
K26	7	2 SETS OF 5 BARS	3-6 TO 7-6 @ 1'-0" INCREMENTS	55-0	2	1-11 TO 5-11 @ 1'-0" INCREMENTS	1-7								12
K27	5	2 SETS OF 10 BARS	2-4 TO 11-4 @ 1'-0" INCREMENTS	136-8	STR.										12
K28	5	2 SETS OF 12 BARS	3-0 TO 14-0 @ 1'-0" INCREMENTS	204-0	19	1-5 TO 12-5 @ 1'-0" INCREMENTS	1-7					1-1 1/2		1-1 1/2	12
K29	5	2	11-4	22-8	STR.										
K30	7	2 SETS OF 18 BARS	2-0 TO 10-6 @ 6" INCREMENTS	226-0	STR.										6
K31	7	2 SETS OF 23 BARS	2-3 TO 13-3 @ 6" INCREMENTS	356-6	19	1-0 TO 12-0 @ 6" INCREMENTS	1-3 ERROR								
K32	7	10	10-9	107-6	STR.							0-10 1/2		0-10 1/2	6
K33	7	8	7-2	57-4	2	5-0	2-2								4
K34	4	28	8-9	245-0	STR.										4
K35	5	18	10-3	184-6	STR.										4
K36	5	22	8-9	192-6	STR.										12
K37	6	38	11-6	437-0	STR.										12
K38	6	12	8-9	105-0	STR.										12
K39	4	50	1-0	50-0	STR.										6
K40	7	58	14-0	812-0	2	5-0	9-0								4 1/2, 9
K41	4	16	18-9	300-0	19	17-3	1-6								12
K42	5	16	18-9	300-0	19	17-3	1-6					1-5	0-5 3/4		5, 12
K43	7	7	15-6	108-6	STR.							1-5	0-5 3/4		12
K44	6	12	15-6	186-0	STR.										12
K45	5	38	3-3	123-6	STR.										12
K46	5	20	6-6	130-0	28	3-6	1-6	1-6				1-6			12
K47	4	2 SETS OF 6 BARS	1-9 TO 15-6 @ 2'-9" INCREMENTS	103-6	STR.										5
K48	4	16	17-9	284-0	STR.										12
K49	5	16	17-9	284-6	STR.										12
K50	5	4	10-3	41-0	STR.										9, 12
K51	5	2 SETS OF 17 BARS	4-10 TO 10-2 @ 4" INCREMENTS	255-0	STR.										6
K52	5	2 SETS OF 5 BARS	4-6 TO 16-6 @ 3'-0" INCREMENTS	105-0	STR.										12
K53	5	2	15-6	31-0	STR.										
K54	5	2	4-0	8-0	STR.										12
K55	8	6	17-9	106-6	STR.										
K56	6	6	11-4	68-0	STR.										6
K57	6	2 SETS OF 16 BARS	8-8 TO 11-2 @ 2" INCREMENTS	317-4	STR.										6
K58	6	2 SETS OF 9 BARS	5-10 TO 8-6 @ 4" INCREMENTS	129-0	STR.										6
K59	4	16	4-0	64-0	27	0-9	1-11	0-3	1-4	0-9		0-11			12
K60	5	32	4-3	136-0	2	1-6	2-9								6
K61	5	16	13-9	220-0	STR.										5
K62	2	68	3-0	204-0	Y-2	0-4	0-6	0-8	0-6	0-8	0-4				10

* PLAIN DOWEL BAR

SIZE 2 BAR = 1/4" DIA. SIZE 4 BAR = 1/2" DIA. SIZE 5 BAR = 5/8" DIA.
SIZE 6 BAR = 3/4" DIA. SIZE 7 BAR = 7/8" DIA. SIZE 8 BAR = 1" DIA.

"AS BUILT"

BAR TYPES



PRINCIPAL SPILLWAY S.A.F STILLING BASIN REINFORCING STEEL DETAILS

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed D.E.M.	Date	Approved by	
Drawn		Title	
Traced		Title	
Checked R.W.A., W.B.E. 5-64		Sheet No. 35 of 35	Drawing No. 5,E-20,230

WATERSHED CHARACTERISTICS AND WEIGHTED INDEX NO.

1 % Area	2 Cover and Practice	3 Condition or rotation	4 Soil Gr.	5 Index No. Moisture II	Weighted Index No. 1 X 5
100				Total	

For moisture condition other than II convert total weighted index by use of table 3.10-1

Moisture Condition _____; Converted weighted index No _____

DRAINAGE AREA DATA

Drainage Area (A) = 1.24 sq. miles (1,936 acres)

Length Main waterway _____ Ft.; Average grade _____ %

Relief, Average slope of Drainage Area _____ %

Time of concentration (Tc) = _____ * 12.0 Hours; D = _____

Tp = D/2 + .6 Tc = _____ = _____ Hours

Tb = 2.67 Tp = _____ = _____ Hours

qp = 483 A Q / Tp = _____ = _____ Q c.f.s.

V-15 Point Rainfall = _____ in.

V-15 Area rainfall = _____ = _____ inches

PEAK COMPUTATIONS

Time Hours	Ratio to amount at sixth hour	Accum. Rainfall inches	Accum. Runoff inches	Increment of Runoff inches	Peak Rate = _____ Q c.f.s.

STORAGE

ELEV.	ACRES	STORAGE Ac. Ft. Flood Pool	STORAGE Ac. Ft. Silt and Cons. Pool
1310.0	0		0
1320.0	11.83		58.35
1325.0	24.44		153.33
1326.26	28.21		192.20
1330.0	56.36		346.02
1332.0	69.28		440.66
1334.0	100.00		634.98
1335.0	115.51		744.95
1334.8	134.81	0	2794.67
1335.0	135.51	27.03	
1340.0	184.67	752.56	
1345.0	177.66	1583.44	
1350.0	200.19	2539.56	
1364.2	221.68	3916.78	
1362.0	225.65	3575.65	
1360.0	248.17	4754.14	
1360.2	252.76	4980.97	
1365.0	276.95	6073.03	

SPILLWAY DISCHARGE

SPILLWAY C		c.f.s.
Principal	Emerg.	Total
0		0
115.0		115.0
166.0		166.0
203.4		203.4
230.0		230.0
652.0		652.0
666.0	0	666.0

Sediment rate = .014 inches

Silt Storage req'd. = 1/12 = 333 Ac.ft.

Detention Storage req'd. = 2.24x459.440 = 1029.4 Ac.ft.

SPILLWAY DISCHARGE TABLE

Pipe: Size 24" Ft. Length 250 Ft; _____ Pipe: Size _____ Length

Equivalent Length _____ Pipe = _____ Ft.

Emergency Spillway: Bottom width 32 Ft.; Crest Length 60

Side slopes 3:1

W.S. Elev	Weir or Orifice Flow h_2 Ft.	Weir or Orifice Flow Q_2 c.f.s.	Full Pipe Flow h_1 Ft.	Full Pipe Flow Q_1 c.f.s.	Emergency Spillway h_4 Ft.	Emergency Spillway Q_4 c.f.s.
1327.2	0	0				
1328.0	1.0	58.0				
1329.0	2.0	276				
1330.0	3.0	508				
1331.0	4.0	740				

WATERSHED CHARACTERISTICS AND WEIGHTE

1 % Area	2 Cover and Practice	3 Condition or rotation	Soil	5 Index No. Moisture II	Weighted index No. 1 X 5
100				Total	

For moisture condition other than II convert total weighted index by use of table 3 10-1

Moisture Condition ____; Converted weighted index No ____

DRAINAGE AREA DATA

Drainage Area (A) ____ sq. miles (____)

Length Main waterway ____ Ft.; Average grade ____%

Relief, Average slope of Drainage Area ____%

Time of concentration (Tc) = $\frac{48 \times 12}{3000}$ = ____ Hours, Or ____

Tp = $\frac{D}{2}$ + .6 Tc = ____ + ____ = ____ Hours

Tb = 2.67 Tp = ____ = ____ Hours

q = $\frac{484\ A\ Q}{Tp}$ = ____ = ____ Q c.f.s.

V-15 Point Rainfall = ____ in.

V-15 Area rainfall = ____ = 7.1" inches

PEAK COMPUTATIONS

Time Hours	Ratio to amount at sixth hour	Accum. Rainfall inches	Accum. Runoff inches	Increment of Runoff inches	Peak Rate = ____ Q c.f.s.

STORAGE

ELEV.	ACRES	STORAGE Ac. Ft. Flood Pool	STORAGE Ac. Ft. Silt and Cons. Pool	SPILLWAY Principal	SPILLWAY Emergency	E c.f.s. Total
1290.0	0		0			
1328.6	11.20		58.60			
1336.6	34.61		178.85			
1344.6	80.66		424.84			
1352.6	134.61		814.96			
1354.2	134.61	0	2144.64	0		0
1356.0	140.91	814.3		115.0		115.0
1340.6	164.69	1554.56		165.0		165.0
1345.6	177.66	1969.44		203.4		203.4
1354.2	221.66	3416.12		230.0		230.0
1360.6	259.69	4699.65				
1362.0	268.13	4980.19		652.0		652.0
1366.8	282.78	5493.03		656.0	0	656.0
1369.6	2.18.75	6093.03				

Sediment rate = 0.14 inches

Silt Storage req'd. = $\frac{X}{12}$ = 333 Ac. ft.

Detention Storage req'd. = $\frac{2.24 \times 1771 \times 5.90}{12}$ = 4,324 Ac. ft.

SPILLWAY DISCHARGE TABLE

Weir ~~Pipe~~ Conc. Length 500 Ft; ____ Pipe: Size ____ Leng

Equivalent Length ____ Pipes ____ Ft.

Emergency Spillway: Bottom width 375 Ft.; Crest Length 50 Ft.

Side slopes 3:1

W.S. Elev.	Weir or Orifice Flow h_2 Ft	Weir or Orifice Flow Q_2 c.f.s.	Weir or Pipe Flow h_1 Ft.	Weir or Pipe Flow Q_1 c.f.s.	Emergency Spillway h_3 Ft.	Emergency Spillway Q_3 c.f.s.
1334.8	0	0				
1336.3	1.0	53.0				
1337.0	1.7	81.2				
1338.0	2.7	81.2				
1342.2	12.9	230.0	0	0		
1344.1	14.4	283.5	0.5	49.5		
1345.2	14.9	236.5	1.0	127.0		
1345.1	20.0	237.0	1.5	238.0		
1346.2	13.9	190.0	2.0	359.0		
1346.7	4.0	106.0	2.5	502.0		
1347.2			55.12	636.0		
1348.0			55.92	640.0		
1349.0			56.92	646.0		
1360.8			58.92	656.0	0	0
1361.8			59.76	662.0	1	508.1
1362.8			60.76	667.0	2	1907.9
1363.8			61.75	672.0	3	3946.8
1364.8			62.75	678.0	4	6480.4
1365.8			63.76	680.0	5	9577.6
1366.8			64.22	686.0	5.5	11356.2

EMERGENCY SPILLWAY DATA FROM ROUTING

Rainfall frequency and W.S. Elevation at start of routing	Depth water in reservoir above spillway elevation Ft.	Max. spillway discharge c.f.s.	Spillway velocity f. s.
0.75 x 321 W.S. 2.5 x 1351.2	2.5	2370	$V_2 = 6.5$ $V_1 = 11.2$

Normal Release rate ____ c.f.s

Time to empty reservoir = ____ = ____ hrs

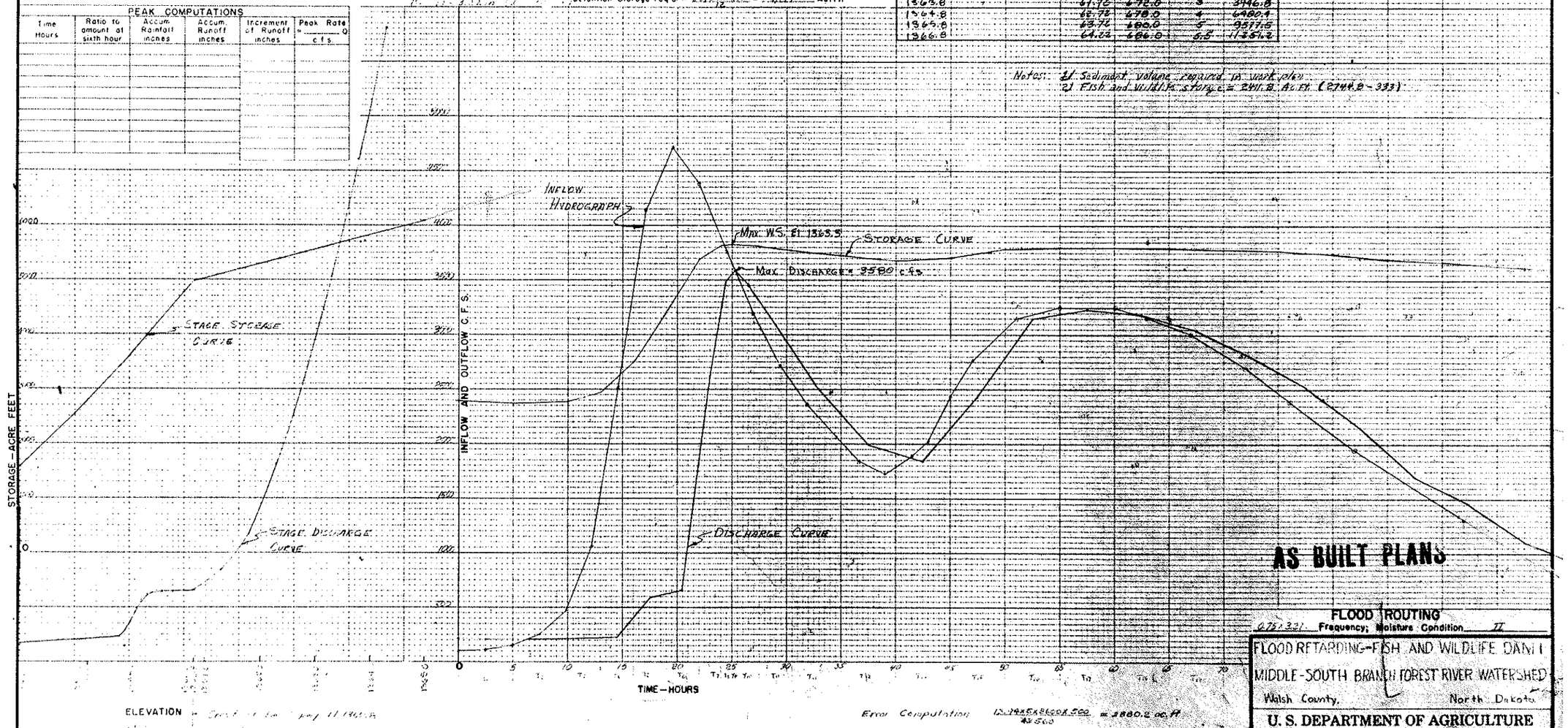
= ____ days

Reed's drawdown time k 5 x 1355.3 = 2647 hrs

Short Cut Method:

Conversion factor = $\frac{A \times Q}{6}$ = $\frac{\quad}{6}$ = ____

Notes: 1) Sediment volume required in work plan
2) Fish and Wildlife storage = 2911.8 Ac. Ft. (2744.8 - 333)



Error Computation $\frac{(5.94 \times 5.60) \times 500}{43560}$ = 3880.2 ac. ft

% error $\frac{2880.2 - 2865}{2865}$ x 100 = 0.53 % error

5650 − 2785 = 2865

T = 726 X $\frac{1000}{500}$ = 1452 MIN. = 24.2 HOURS → C $\frac{in}{hr}$ = 4.43"

AS BUILT PLANS

FLOOD ROUTING

0.75 x 321 Frequency; Moisture Condition II

FLOOD RETARDING--FISH AND WILDLIFE DAM I
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R.H.L. Date
Drawn RAV
Traced
J.M.K., R.R.E.
Approved by
Title
Sheet No. 2 of 4 Sheets
Drawing No. 5E-20,230-E

WATERSHED CHARACTERISTICS AND WEIGHTE

1 % Area	2 Cover and Practice	3 Condition or rotation	Soil Gr.	5 Index No. Moisture II	Weighted Index No. 1 X 5
100				Total	

FF INDEX NO.

For moisture condition other than II convert total weighted index by use of table 3.10-1

Moisture Condition II; Converted weighted index No. 75

DRAINAGE AREA DATA

Drainage Area (A) 45.7 sq. miles (Uncontrolled)

Length Main waterway _____ Ft.; Average grade _____ %

Relief, Average slope of Drainage Area _____ %

Time of concentration (Tc) = 42+12 = 54 Hours; D= _____

K=3600

Tp = D/2 + .6l Tc = _____ = _____ Hours

Tb = 2.67 Tp = _____ = _____ Hours

q = 483 A Q / Tp = _____ = _____ Q c.f.s

V-15 Point Rainfall = _____ In.

V-15 Area rainfall = _____ = 12.24 inches

Runoff = 6.81 in. (Uncontrolled)

PEAK COMPUTATIONS

Time Hours	Ratio to amount at sixth hour	Accum. Rainfall inches	Accum. Runoff inches	Increment of Runoff inches	Peak Rate = Y Q c.f.s.

STORAGE

ELEV.	ACRES	STORAGE Ac. Ft. Flood Pool	Silt and Cons. Pool	SPILLWAY Principal	Emergency	E c.f.s. Total
1290.0	0		0			
1298.0	11.60		18.96			
1306.0	34.80		107.84			
1314.0	84.00		328.28			
1318.0	120.80		466.76			
1322.0	161.20		626.92			
1326.0	201.60		1187.84			
1330.0	246.00		1419.68			
1334.8	334.81	0	2744.64	0		0
1335.0	338.61	27.03				
1340.0	450.59	752.56		115.0		115.0
1345.0	477.60	1588.44		165.0		165.0
1350.0	509.79	2529.56		203.4		203.4
1354.2	541.66	3416.73		230.0		230.0
1355.0	225.65	3595.65				
1360.0	548.19	4780.19		652.0		652.0
1360.8	552.78	4980.57		656.0	0	656.0
1365.0	276.45	6093.03				

Sediment rate = 0.1% inches

Silt Storage req'd. = 1/4 = 933 Ac.ft.

Detention Storage req'd = 5221.65 x 10 = 4974 Ac.ft.

SPILLWAY DISCHARGE TABLE

42"Ø Pipe Size Coated Length 286 Ft, ____ Pipe Size ____ Length

Equivalent Length ____ Pipe = ____ Ft.

Emergency Spillway: Bottom width 274 Ft.; Crest Length 50 Ft.

Side slopes 3:1

W.S. Elev.	Weir or Orifice Flow h_2 Ft.	Q_2 c.f.s.	Weir or Pipe Flow h_1 Ft.	Q_1 c.f.s.	Emergency Spillway h_e Ft.	Q_e c.f.s.
1334.8	0	0				
1336.3	1.0	58.0				
1337.0	1.7	69.2				
1338.0	2.7	87.2				
1354.2	18.9	230.0	0	0		
1354.7	19.4	233.5	0.8	49.5		
1355.2	19.9	236.6	1.0	137.0		
1355.7	20.0	237.0	1.5	238.0		
1356.2	20.0	190.0	2.0	349.0		
1356.7	20.0	196.0	2.5	502.0		
1357.2			3.0	676.0		
1358.0			3.8	956.0		
1359.0			4.8	1356.0		
1360.0			5.8	1809.0	0	0
1360.8			6.6	2221.0	0.8	656.0
1361.0			6.8	2329.0	1.0	1008.0
1362.0			7.8	2879.0	2	2907.9
1363.0			8.8	3472.0	3	5340.6
1364.0			9.8	4098.0	4	8486.4
1364.8			10.6	4600.0	5	12377.5
1365.9			11.7	5286.0	6.1	17,251.2

EMERGENCY SPILLWAY DATA FROM ROUTING

Rainfall frequency and W.S Elevation at start of routing	Depth water in reservoir above spillway elevation Ft.	Max. spillway discharge c.f.s.	Spillway velocity f. p. s.
1.25 / 3.27 W.S Elev. 1351.2	5.0	9840	19.2

Normal Release rate _____ c.f.s.

Time to empty reservoir = _____ = _____ hrs.

= _____ days.

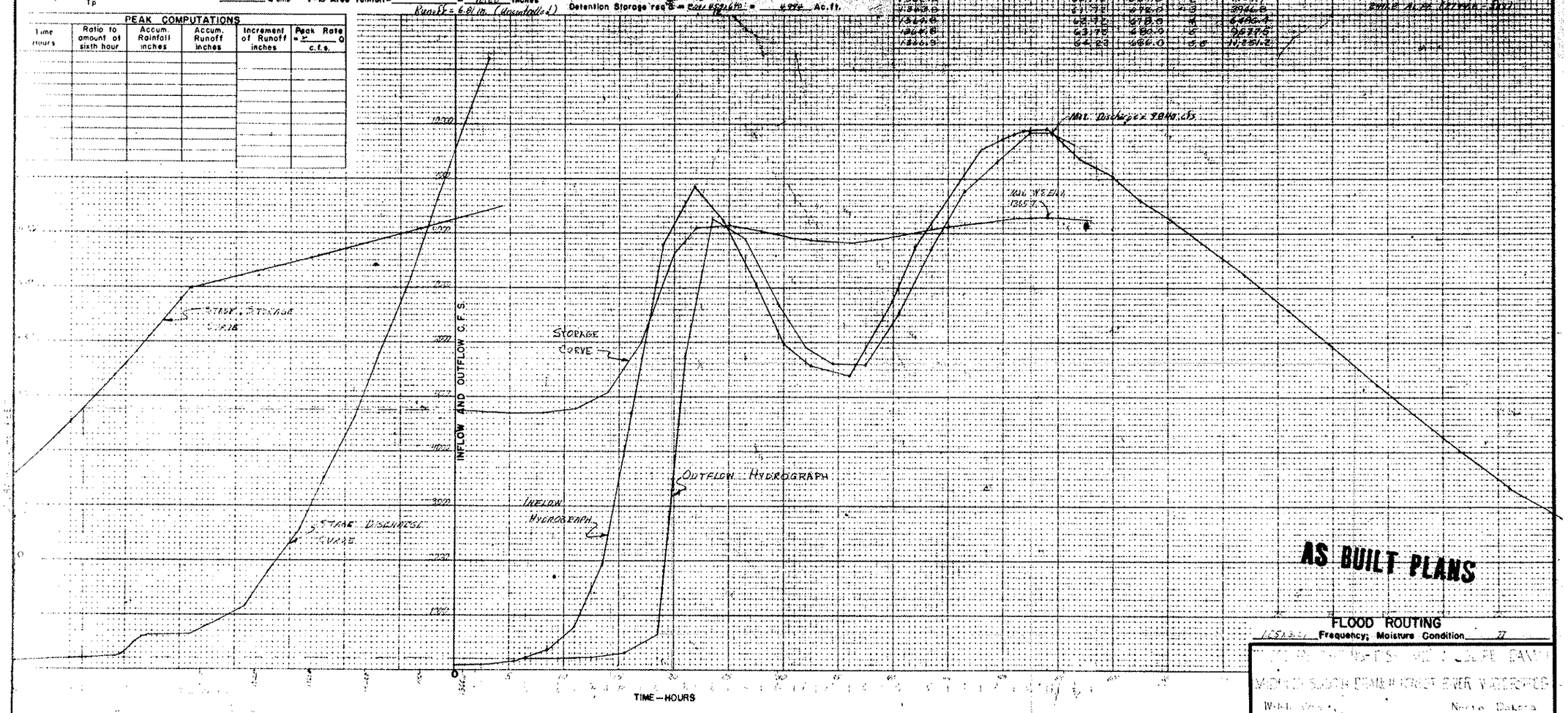
Revised drawdown time to El. 1335.0 = 275 days

Short Cut Method:

Conversion factor = A X Q / ____ = _____ = _____

Max. Discharge 9840 c.f.s.

Max. W.S Elev. 1365.9



T = 726 X ____ = _____ MIN. = _____ HOURS = 2.4 Hr.

AS BUILT PLANS

FLOOD ROUTING

1.25 / 3.27 Frequency; Moisture Condition II

[illegible] W.P.S. No. 1 [illegible] DAM

WORTH SOUTH DAKOTA RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed [illegible] Date

Drawn [illegible]

Traced

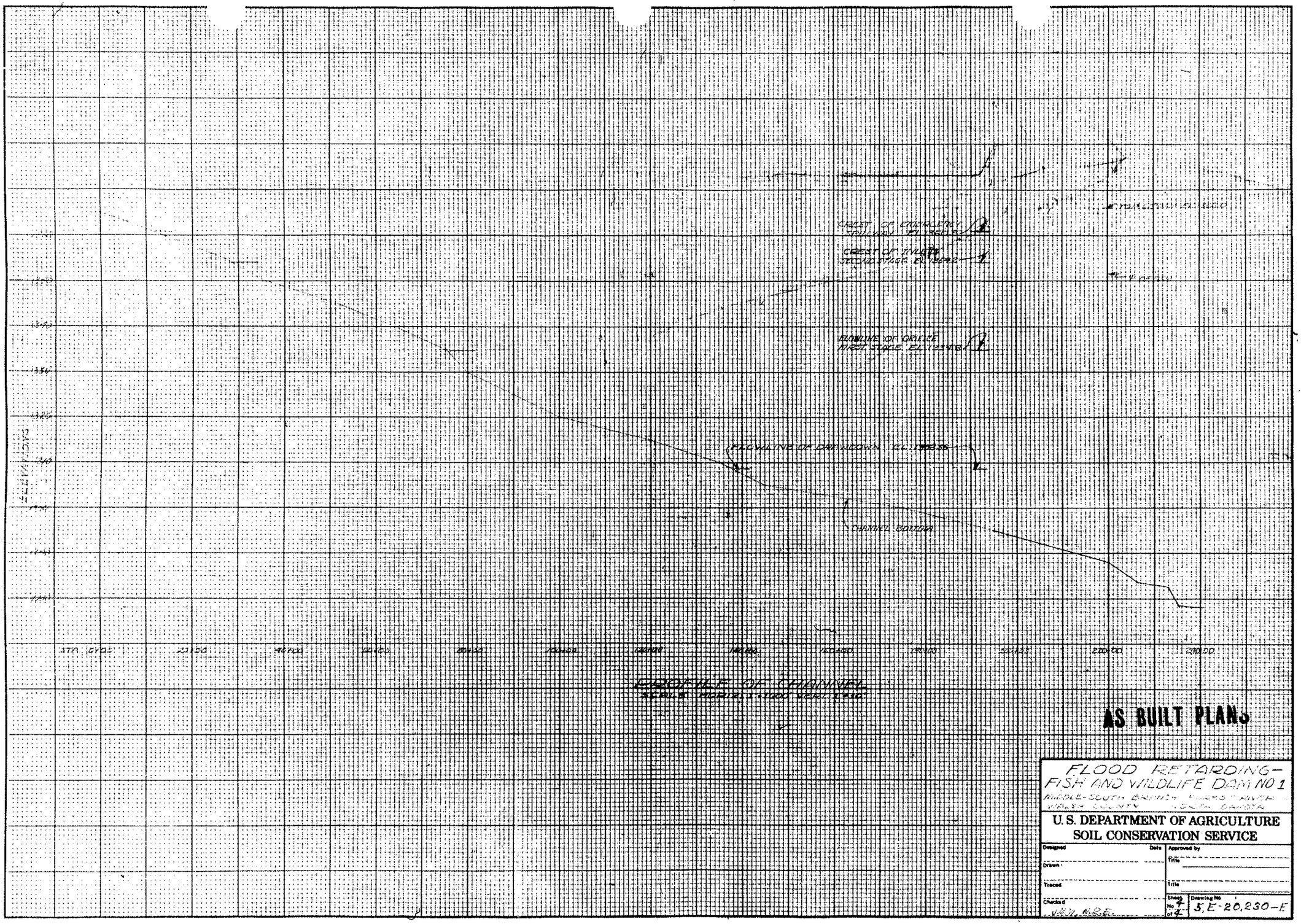
Checked [illegible]

Approved by [illegible]

Title [illegible]

Sheet No. 3 of 4

Drawing No. 5-E-20,230-E



AS BUILT PLANS

FLOOD RETARDING-
FISH AND WILDLIFE DAM NO 1
RIBBLE-SOUTH BRANCH TURKEY WATER
WALSH COUNTY NORTH DAKOTA

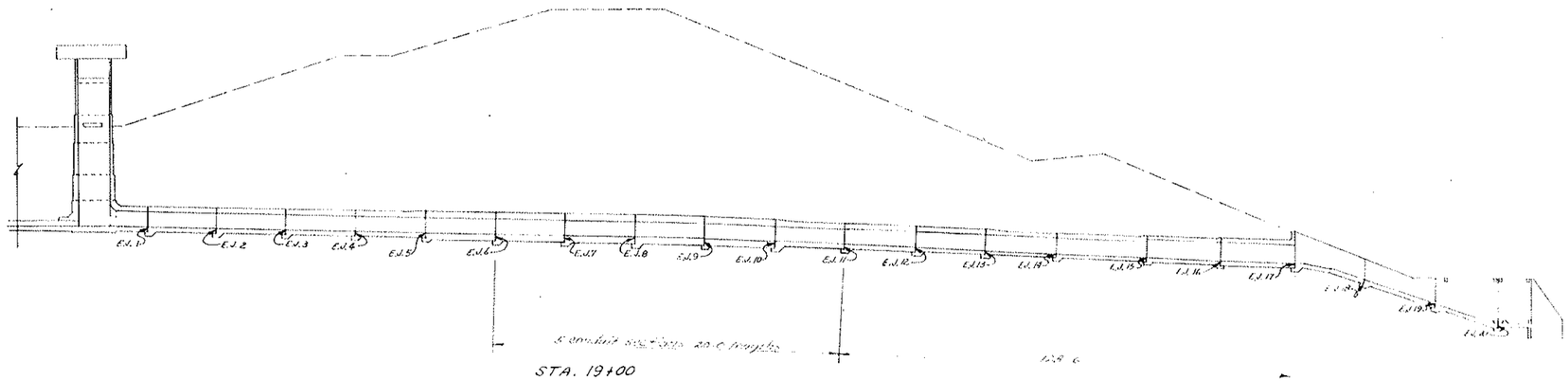
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
Drawn		Title
Traced		Title
Checked JAN, NDE		Sheet No 7 of 9 — Drawing No. 5, E-20,230-E

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

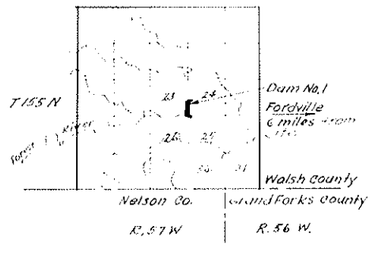
WALSH COUNTY. NORTH DAKOTA



STA. 19+00

CROSS SECTION OF DAM ALONG ℄ OF PRINCIPAL SPILLWAY

Scale: 1"= 20'



LOCATION MAP

TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
Impalpable Item	lb.	5.25
[illegible]	[illegible]	1167.5

Started Feb 1, 1967
Completed Feb 27, 1967
Contractor Wm. Clairmont Inc.
Bismark, N. Dak.

Proj Eng- Willis J. Damke
Proj Insp. - Elmer Bittner

AS BUILT

INSTALLATION OF COPPER WATERSTOP

AS BUILT

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

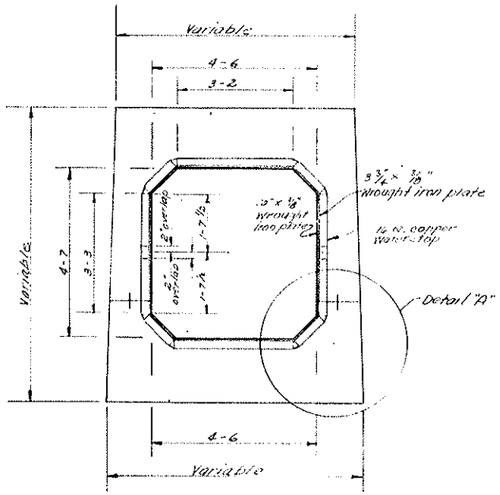
		Date
Designed	[illegible]	4-66
Drawn	J.R.O	8/66
Traced		
Checked	W.J.D	

Approved by: Area Engineer, Fortyhead - S.C.S. [illegible] 9/8/66

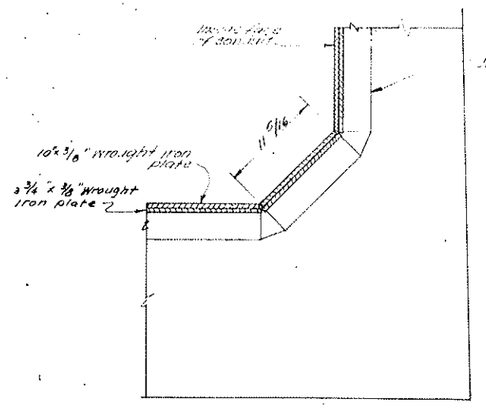
Title Sheet No. 1 of 7

Drawing No. 5, E-23,644

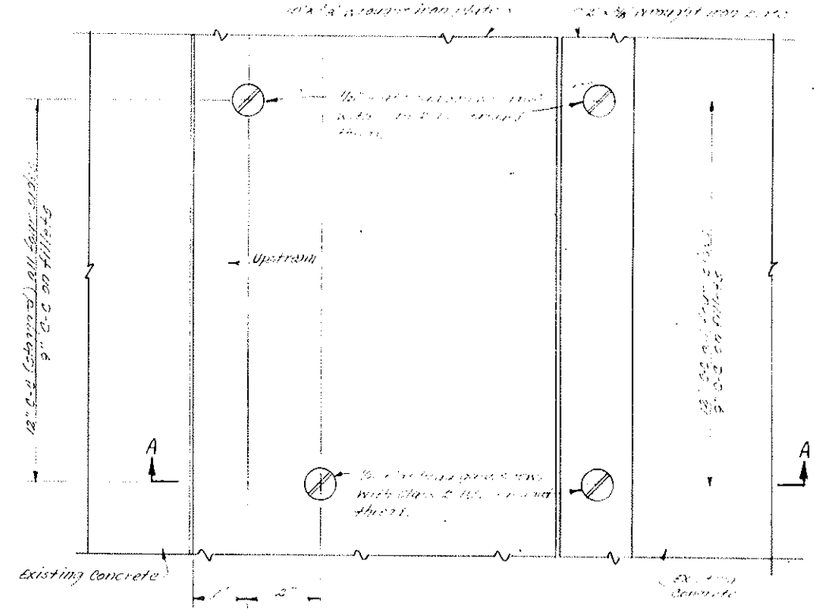
SCS-313 (9-64)



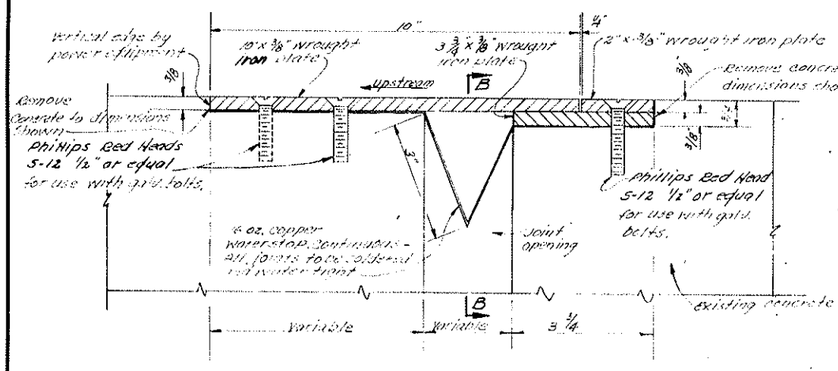
SECTION B-B
CROSS SECTION OF JOINT 6,7,8,9,&10
Scale ½" = 1'-0"



DETAIL "A"
Scale 1½" = 1'-0"

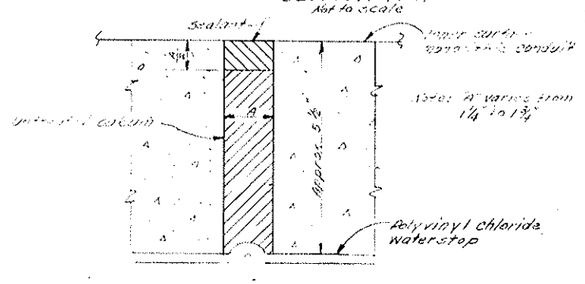


PLAN
Not to scale



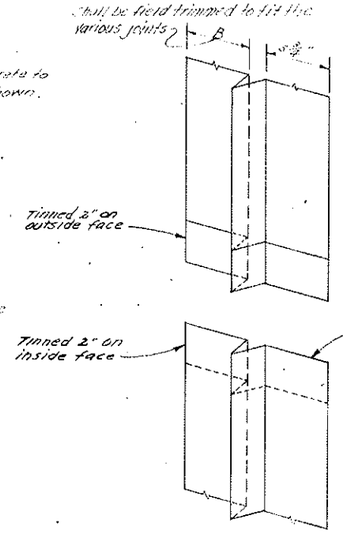
DETAILS OF REPAIR OF EXPANSION JOINTS

SECTION A-A
Not to scale



JOINT 11
Not to scale

Note: The copper waterstop shall be fabricated with dimension "B" equal to seven and one-half (7.5") inches and shall be field trimmed to fit the various joints.



Note: Ends of joint sections to be tinned a minimum of 2" in shop and sweated together in field.

VIEW OF WATERSTOP
CONNECTION AT SIDE OF CONSTRUCTION JOINT

NOTES:

1. All joints shall be cleaned of debris and water.
2. Joint #11 shall be chipped back for the depth of the sealant plus ½", exposing concrete that is free of bituminous expansion joint material. The joint shall be clean and dry. Untreated oakum shall be tamped loosely into the joint before installation of sealant.
3. Joints in copper waterstop shall be watertight. Corner joints shall be shop fabricated. The contractor shall furnish the engineer with drawings of the proposed corner joints for his approval. The copper waterstop shall be furnished in two sections and joined at the sides of the joint.
4. Sealant shall be placed:
   a. between concrete and copper waterstop.
   b. between copper waterstop and wrought iron plates.
   c. between wrought iron plates.
   d. over entire joint after completion of installation.
5. Sealant shall be gun grade white or colored.

WROUGHT IRON LIST

Size	Length	Quantity
⅜" x 2" x [illegible]		24
⅜" x [illegible] x 2'-4"		12
⅜" x 2" x 2'-5"		12
⅜" x [illegible] x 10⅜"		24
⅜" x [illegible]		24
⅜" x [illegible]		24
⅜" x [illegible]		24
⅜" x 3¾" x [illegible]		12
⅜" x [illegible]		12

AS BUILT

AS - BUILT

DETAIL OF INSTALLATION OF COPPER WATERSTOP - 5 JOINTS

FLOOD RETARDING - FISH AND WILDLIFE DAM No. 1
MIDDLE - SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

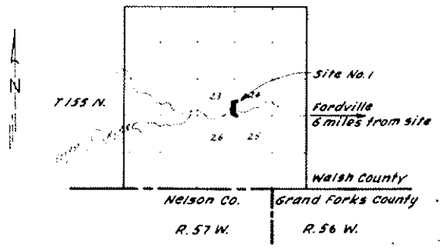
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Designed	ACW	9/66	Title	
Drawn	JCD	9/66		
Traced			Title	
Checked	ACW	9/9/66	Sheet No. 4 of	Drawing No. 5, E-23,644

SCS-313 (9-64)

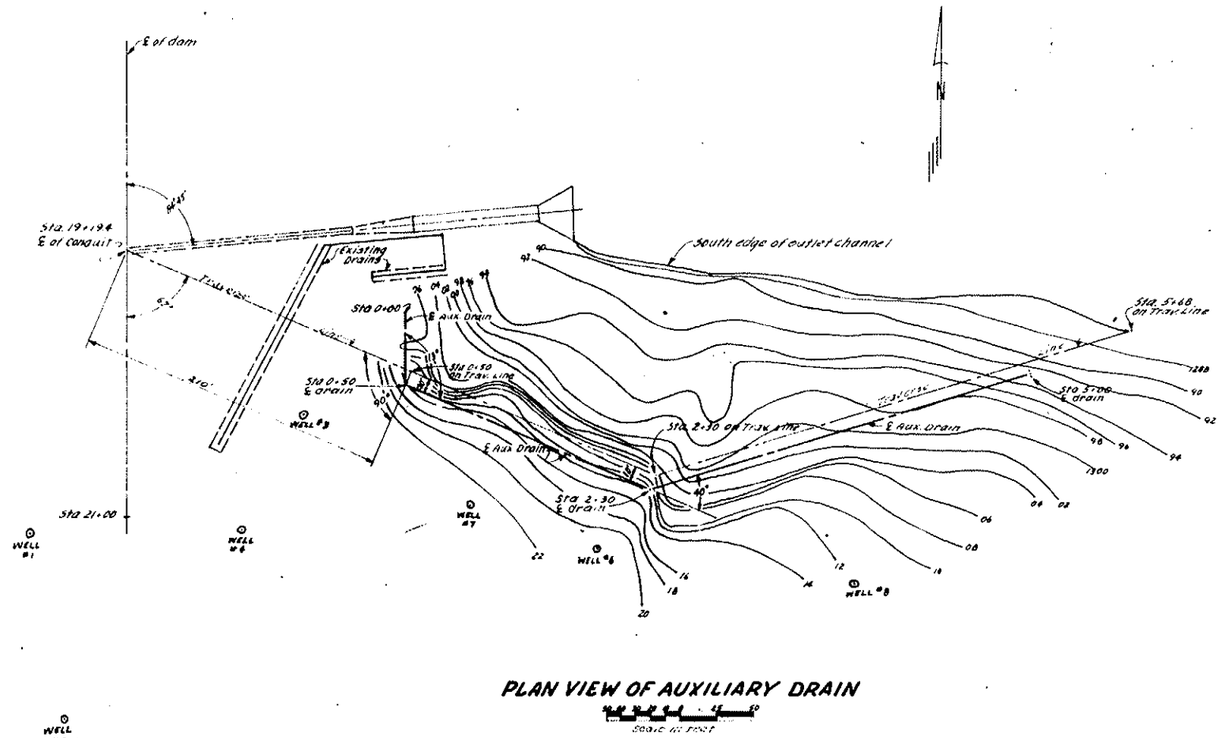
AUXILIARY DRAIN SITE NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

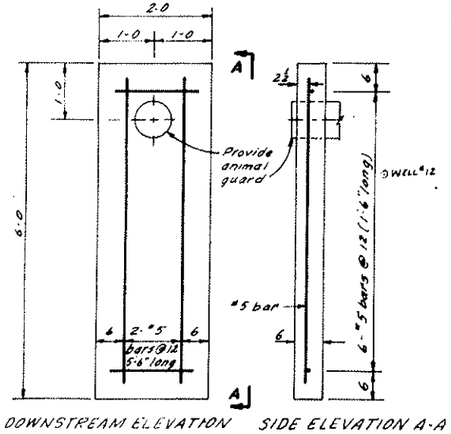
WALSH COUNTY NORTH DAKOTA



LOCATION MAP
Scale ½" = 1 mi.



PLAN VIEW OF AUXILIARY DRAIN
Scale in Feet



DOWNSTREAM ELEVATION SIDE ELEVATION A-A

DETAILS OF OUTLET DRAIN PIPE SUPPORT
Scale: ¾" 1'-0"

QUANTITIES FOR AUXILIARY DRAIN

ITEM	UNIT	QUANTITY	AS-BUILT QUANTITY
Excavation	Cu. Yd.	2591*	
Drain Fill	Cu. Yd.	1108	1054
Concrete (Class 4000 Air entrained)	Cu. Yd.	0.22	0.22
Steel Reinforcement	Lb.	21	21
8" dia. perforated asbestos cement pipe	Lin. Ft.	498	498
45° C.I. Bend Bell x Bell	Ea.	3	3
22½° C.I. Bend Bell x Spigot	Ea.	1	1
Loose rock riprap	Cu. Yd.	14	14

~~All quantities are estimated~~

* Estimated.

NOTES:

1. Provide end cap outlet end of pipe. For details of end cap see Std. Drwg. No. 5, R-10,000.56
2. Plug upper end of pipe with 6" of concrete or prefabricated cap.
3. The drain material shall be a poorly graded gravel with all the material being retained on the #4 sieve and maximum size not to exceed 3".
4. The drain material shall extend at least 3' below the bottom of the bentonite layer. Therefore the depths indicated on the plans for the drain are approximate and the exact depths will be determined by the Engineer in the field.
5. Backfill drain a minimum of one foot or to existing ground line, which ever is larger.
6. The neat lines on the cross sections indicating excavation above the auxiliary drain are approximate. The contractor shall have the option of increasing or decreasing the slopes as he may deem necessary.
7. At Sta. 0+50 and Sta 2+30 the alignment of the pipe can be adjusted by taking up several degrees in the joints between the pipe and the bends.
8. Care shall be taken during construction to protect the observation wells from damage. They are located on the plan view of the Auxiliary Drain.

AUXILIARY DRAIN AS-BUILT

FLOOD RETARDING-FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
R.D.S.	6-69	Wayne D. Walker, State Cons. Engr.
J.H.D.	6-69	Elwin D. Butler, Head, E & WP Unit
Drawn	6-69	Sheet 2 of 2 — 5, E-27,338

APPENDIX C

Boring Logs and Rock Core Box Photos

Date Started: 2/15/19	**DRILLING LOG**		Hole Number: 2
Date Finished: 2/15/19	Gannett Fleming		Sheet: 1 of 3
Soil Drilling: 40.0 ft			Line & Station:
Rock Sampling: 19.5 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043		Offset:
Total Depth of Hole: 59.5 ft	Drilling Agency: Interstate Drilling Services, Inc.		N Coordinate: 17526583.0 ft
No. of Undist. Samples: 0	Driller: Jared Zak		E Coordinate: 1902580.0 ft
Total Number of Core Boxes: 2	Bit Size and Type: NQ3	Bulk Sampler: N/A	Elev. Top of Hole: +1361.6 ft
GROUNDWATER OBSERVATIONS Drilling mud (quick gel) in hole.	Casing Size: N/A	Spoon Size: 2.0 " OD	Direction of Hole
	Hollow Stem Auger: 3.25 " ID x 6.5 " OD	Hammer Wt.: 140 lb	Vertical ☒ Inclined ☐
	Drilling Fluid: Quick Gel	Hammer Drop: 30.0 "	Degrees from Vertical ---
	Drill Rig: Dietrich 50 Track Rig	Hammer Type: Automatic	Logged By: W. Roman

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.5						0.0'-2.5': Unsampled El. 1359.1	Began 15-Feb-2019 at 1218.
2.5 - 5.0	S-1	30-38-30-27-24	1.0	40		2.5'-7.5': Clayey Silty SAND (sc) (GLACIAL OUTWASH), 10% gravel, 50% sand, 40% fines. Gravel is subangular to rounded, soft, fine, max. particle size: <0.5"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Light brownish gray (2.5Y 6/2), Dry, strong HCl reaction, homogeneous, fine gravel and coarse sand consists of clasts of soft white chalky chert, soft gray shale, and trace pink granite; trace organics 5'-7.5': includes pieces of high plasticity gray clay El. 1354.1	
5.0 - 7.5	S-2	10-13-13-14-16	0.9	36			
7.5 - 10.0	S-3	8-11-18-25-27	1.8	72		7.5'-10.0': Clayey Silty SAND with gravel (sm) (GLACIAL OUTWASH), 15% gravel, 60% sand, 25% fines. Gravel is subangular to rounded, fine, max. particle size: <1"; Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Grayish brown (2.5Y 5/2), Dry to Moist, strong HCl reaction, homogeneous, fine gravel and coarse sand consists of clasts of soft white chalky chert, soft gray shale, and hard granodiorite 7.5'-10': Field dispersion test grade ranges from 1 (non-dispersive) to 3 (dispersive) El. 1351.6	P.P. = 3.6 to >4.5 tsf 2.5'-10': Overall fining-upward sequence
10.0 - 12.4	S-4	14-14-26-38-50	2.0	83			P.P. = >4.5 tsf
12.4 - 12.5							
12.5 - 13.8	S-5	14-32-50	1.2	92		10.0'-20.0': Sandy SILT (ML) (GLACIAL TILL), 10% gravel, 50% sand, 40% fines. Gravel is subangular to rounded, soft, fine, max. particle size: <0.5"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Grayish brown (2.5Y 5/2), Moist, strong HCl reaction, homogeneous, fine gravel and coarse sand consists of clasts of soft white chalky chert and gray shale; reddish-brown mottling 10.0'-20.0': Field classified as silty clayey SAND (sc) 15'-16.5': reddish-brown (hematite) staining on fractures in till 15'-16.5': Field dispersion test grade = 2 (intermediate) 17.5'-18.5': No recovery	P.P. = >4.5 tsf
13.8 - 15.0							
15.0 - 16.5	S-6	17-28-50	1.3	87			P.P. = >4.5 tsf
16.5 - 17.5							
17.5 - 18.5	S-7	45-50	0.0	0			
18.5 - 20.0						El. 1341.6	
20.0 - 21.5	S-8	18-39-50	1.1	73		20.0'-22.5': Clayey Silty SAND with gravel (sm) (GLACIAL TILL), 20% gravel, 35% sand, 45% fines. Gravel is angular to subrounded, Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Dark gray (5Y 4/1), Moist, strong HCl reaction, homogeneous, Gravel consists of clasts of tan dolomite and light gray quartzite, broken by sampling El. 1339.1	
21.5 - 22.5							
22.5 - 25.0	S-9	10-15-27-40-47	2.3	92			

Purpose: Sample auxiliary spillway materials
Drilling Method: Continous split spoon sampling using hollow stem auger, drilled dry to 47.5'; NQ3 coring with Quick Gel to 59.5'.
Termination: 10' of rock or total depth of 35'
Abandonment: Tremie grouted with cement-bentonite grout to full depth.
Additional Remarks: Drilled 6' east of staked location.

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 2
Driller: Jared Zak	Gannett Fleming	Sheet: 2 of 3
Inspector: W. Roman		Elev. Top of Hole: +1361.6 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
						22.5'-27.0': Clayey Sandy SILT (ml) (GLACIOLACUSTRINE), 45% sand, 55% fines. max. particle size: <3/16"; Sand is fine to coarse, subrounded to rounded; Fines: low plasticity, Very dark gray (GLEY 1 N3), Moist, weak HCl reaction, varved structure, alternating light and dark gray; sand is mostly very fine to fine-grained	
25.0 - 27.5	S-10	12-20-24-33-45	2.2	88		El. 1334.6 22.5'-25': Field dispersion test grade = 3 (dispersive)	P.P. = >4.5 (in till) tsf Collected two jars: S-10A with varved material from 26'-27'; S-10B with till material from bottom of S-10.
27.5 - 29.5	S-11	18-25-42-50	0.1	5		27.0'-37.5': Sandy SILT (ML) (GLACIAL TILL), 5% gravel, 50% sand, 45% fines. Gravel is subangular to rounded, soft, fine, max. particle size: <1/4"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Very dark gray (GLEY 1 N3), Moist, strong HCl reaction, homogeneous, Gravel consists of fine clasts of tan dolomite, pink quartzite, and gray shale	
29.5 - 30.0							
30.0 - 32.0	S-12	11-19-33-50	2.0	100			P.P. = >4.5 tsf
32.0 - 32.5						27.0'-37.5': Field classified as silty, clayey SAND (sc) Weak HCl reaction 30'-35'	
32.5 - 33.5	S-13	26-50	1.0	100		30'-32': Field dispersion test grade = 4 (highly dispersive)	P.P. = >4.5 tsf
33.5 - 35.0							
35.0 - 37.5	S-14	12-18-25-33-38	1.2	48			P.P. = 4 tsf
						El. 1324.1 37.5'-42.5': Clayey Sandy SILT (ml) (GLACIAL TILL), 5% gravel, 20% sand, 75% fines. Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Dark gray (GLEY 1 N4), Moist, weak HCl reaction, homogeneous, local shale till (possible ice-thrust rock block); includes broken fragments of light gray (2.5Y 7/1) dolomite; trace pyrite	P.P. = >4.5 tsf
37.5 - 40.0	S-15	11-23-36-50-50	1.4	56			
40.0 - 41.5	S-16	13-30-50	1.4	93		37.5'-40': Field dispersion test grade = 4 (highly dispersive)	P.P. = >4.5 tsf
41.5 - 42.5						Top of Rock @ 42.5 ft	
42.5 - 43.3	S-17	31-50	0.8	100		El. 1319.1 42.5'-47.5': Clayey SHALE, *[Pierre Fm.]* comprised of clay to silt sized particles, Dark gray, (GLEY 1 N4), very soft, Rock wafers easily broken with fingers and gouged with fingernail; no HCl reaction. Laboratory classified as Elastic SILT (MH).	
43.3 - 45.0							
45.0 - 45.9	S-18	29-50	0.9	100			
45.9 - 47.5						45'-47.5': Field dispersion test grade = 4 (highly dispersive)	
						El. 1314.1 47.5'-59.5': Clayey SHALE, *[Pierre Fm.]* comprised of clay to silt sized particles, Dark gray, (GLEY 1 N4), very soft, Core easily broken by hand and gouged with fingernail; no HCl reaction. Fractures are nearly horizontal, and most appear to be mechanical. Core develops horizontal hairline fractures.	47.5'-49.5': Gray drill water return (DWR); recovered 1.4'; 0.6' core missing.
47.5 - 49.5	R-1	0.8' / 40%	2.0	100			
49.5 - 51.5	R-2	1.6' / 80%	2.0	100		47.5'-54.7': interbedded clayey and silty shale 50.4'-54.7': scattered light gray calcareous nodules	49.5'-51.5': Gray DWR; recovered 2.3', picking up 0.3' missing core.
51.5 - 54.5	R-3	3.0' / 100%	3.0	100			51.5'-54.5': Gray DWR; recovered 3.3', picking up remaining missing core; all breaks mechanical.
54.5 - 59.5	R-4	2.9' / 58%	4.5	90		54.7'-57': mostly clay shale 57'-58.5': interbedded clayey and silty shale with scattered calcareous nodules	54.5'-59.5': Gray DWR; 0.5' core missing. NQ3 coring completed at 59.5' at 1710 15-Feb-2019. Boring grouted 1300 on 16-Feb-2019.

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 2
Driller: Jared Zak	Gannett Fleming	Sheet: 3 of 3
Inspector: W. Roman		Elev. Top of Hole: +1361.6 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
						58.5'-59': clayey shale El. 1302.1	

Bottom of Borehole at 59.5 feet.
Total Core Recovery: 96%
Total RQD: 69%


Matejcek Dam, Walsh County, ND
Boring No. 2
Box 1 of 2
From 47.5' to 56.7'
Run Depth Recovery (ft-%) RQD
1 47.5-49.5 2.0-100 0.8-40
2 49.5-51.5 2.0-100 1.6-80
3 51.5-54.5 3.0-100 3.0-100
4 54.5-59.5
51.5

Matejcek Dam, Walsh County, ND
Boring No. 2
Box ~~1~~ of 2 of 2
From ~~47.5' to~~ 56.7' to 59.5'

Run	Depth	Recovery (ft-%)	RQD
1	47.5-49.5	2.0-100	0.8-40
2	49.5-51.5	2.0-100	1.6-80
3	51.5-54.5	3.0-100	3.0-100
4	54.5-59.5	4.5-90	2.9-58



Date Started: 2/16/19	**DRILLING LOG**		Hole Number: 3
Date Finished: 2/16/19	Gannett Fleming		Sheet: 1 of 2
Soil Drilling: 43.5 ft			Line & Station:
Rock Sampling: 5.3 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043		Offset:
Total Depth of Hole: 48.8 ft	Drilling Agency: Interstate Drilling Services, Inc.		N Coordinate: 17526675.0 ft
No. of Undist. Samples: 0	Driller: Jared Zak		E Coordinate: 1902887.0 ft
Total Number of Core Boxes: 0	Bit Size and Type: N/A	Bulk Sampler: N/A	Elev. Top of Hole: +1362.0 ft
GROUNDWATER OBSERVATIONS Not recorded	Casing Size: N/A	Spoon Size: 2.0 " OD	Direction of Hole
	Hollow Stem Auger: 3.25 " ID x 6.5 " OD	Hammer Wt.: 140 lb	Vertical ☒ Inclined ☐
	Drilling Fluid: N/A	Hammer Drop: 30.0 "	Degrees from Vertical ---
	Drill Rig: Dietrich 50 Track Rig	Hammer Type: Automatic	Logged By: W. Roman

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.5						0.0'-2.5': Unsampled El. 1359.5	Began 16-Feb-2019 at 0833
2.5 - 5.0	S-1	6-6-8-10-14	1.2	48	SM	2.5'-10.5': Silty SAND (SM) (GLACIAL OUTWASH), 15% gravel, 60% sand, 25% fines. Gravel is subrounded to rounded, soft, fine, max. particle size: 1"; Sand is fine to coarse, subrounded to rounded; Fines: low plasticity, Light brownish gray (2.5Y 6/2), Dry, homogeneous, Gravel consists of clasts of soft gray shale and light gray chalky dolomite; trace organics; weak to no HCl reaction 2.5'-10.5': Field classified as silty sand with gravel (sm) 2.5'-5': Field dispersion test grade = 1 (non-dispersive)	
5.0 - 7.5	S-2	23-15-15-14-15	0.8	32			
7.5 - 10.0	S-3	7-10-11-9-10	0.5	20		El. 1351.5	P.P. = 2.3 tsf
10.0 - 12.5	S-4	--9-14-13-17	2.3	92	SC	10.5'-15.5': Clayey SAND with gravel (sc) (GLACIAL TILL), 15% gravel, 45% sand, 40% fines. Gravel is subrounded to rounded, soft, fine, max. particle size: 1"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Grayish brown (2.5Y 5/2), Moist, weak HCl reaction, Gravel consists of clasts of light gray dolomite and dark gray shale; some iron-oxide staining 12.5'-14.5': reddish-brown (hematite) staining on fractures in till 12.5'-15': Field dispersion test grade = 3 (dispersive)	P.P. = >4.5 tsf
12.5 - 14.5	S-5	6-10-11-50	2.0	100			
14.5 - 15.0						El. 1346.5	P.P. = >4.5 tsf
15.0 - 16.5	S-6	26-44-50	1.4	93	CL	15.5'-40.0': Silty Sandy CLAY (cl) (GLACIAL TILL), 5% gravel, 30% sand, 65% fines. Gravel is subrounded to rounded, soft, fine, max. particle size: 1"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Very dark gray (GLEY 1 N3), Moist, homogeneous, Gravel consists of clasts of light gray dolomite, dark gray shale, and red granite; weak to strong HCl reaction	
16.5 - 17.5							P.P. = >4.5 tsf
17.5 - 20.0	S-7	12-21-27-30-32	2.3	92			
20.0 - 21.9	S-8	9-23-40-50	1.8	95			P.P. = >4.5 tsf
21.9 - 22.5						22.5'-24': strong HCl reaction	
22.5 - 24.0	S-9	15-27-50	1.5	100		22.5'-24': Field dispersion test grade = 1 (non-dispersive)	P.P. = >4.5 tsf

Purpose: Sample auxiliary spillway materials
Drilling Method: Continous split spoon sampling using hollow stem auger; drilled dry.
Termination: 10' of rock or total depth of 35'
Abandonment: Tremie grouted with cement-bentonite grout to full depth.
Additional Remarks: Drilled 5' 215 degrees from staked location.

Log Checked By: EJB, 10/11/19

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 3
Driller: Jared Zak	Gannett Fleming	Sheet: 2 of 2
Inspector: W. Roman		Elev. Top of Hole: +1362.0 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
24.0 - 25.0							
25.0 - 25.3	S-10	50	0.0	0		25.0'-25.3': no recovery	
25.3 - 27.5							
27.5 - 30.0	S-11	16-21-31-40-50	2.4	96		27.5'-30': strong HCl reaction	P.P. = >4.5 tsf
30.0 - 32.0	S-12	8-20-28-50	1.5	75		30'-32': includes clasts of red granite; slightly more moist; stong HCl reaction	P.P. = >4.5 tsf
32.0 - 32.0							
32.5 - 34.5	S-13	12-28-36-50	2.0	100		32.5'-34.5': strong HCl reaction	P.P. = >4.5 tsf
34.5 - 35.0							
35.0 - 36.0	S-14	22-50	1.0	100		35'-36': strong HCl reaction	P.P. = >4.5 tsf
36.0 - 37.5							
37.5 - 39.5	S-15	14-23-34-50	0.0	0		37.5'-39.5': no recovery	
39.5 - 40.0						El. 1322.0	
40.0 - 41.9	S-16	11-23-46-50	1.9	100		40.0'-43.5': Silty Sandy CLAY (cl) (GLACIAL TILL), 5% gravel, 30% sand, 65% fines. Gravel is angular to subrounded, soft, fine, max. particle size: 1"; Sand is fine to medium, subrounded to rounded; Fines: medium to high plasticity, Very dark gray (GLEY 1 N3), Moist, no HCl reaction, homogeneous, Gravel consists of clasts of dark gray shale; shaley till	P.P. = >4.5 tsf
41.9 - 42.5							
42.5 - 44.3	S-17	20-32-41-50	1.5	83		El. 1318.5 40'-41.5': Field dispersion test grade = 4 (highly dispersive) Top of Rock @ 43.5 ft	P.P. = >4.5 tsf
44.3 - 44.5							
44.5 - 45.8	S-18	11-23-46-50	1.7	100		43.5'-48.8': Clayey SHALE, *[Pierre Fm.]* comprised of clay to silt sized particles, Very dark gray, (GLEY 1 N3), very soft, Rock wafers easily broken with fingers and gouged with fingernail; no HCl reaction. Laboratory classified as Elastic SILT (MH). 44.5'-45.8': specks of light gray dolomite 44.5'-45.8': Field dispersion test grade = 4 (highly dispersive)	P.P. = 1.5 to >4.5 tsf SPT completed 48.8' at 1050 16-Feb-2019. Boring grouted immediately after completion on 16-Feb-2019.
45.8 - 47.5							
47.5 - 48.8	S-19	20-25-50	1.3	100		El. 1313.2	P.P. = >4.5 tsf

Bottom of Borehole at 48.8 feet.

Date Started: 2/12/19	**DRILLING LOG**		Hole Number: 4
Date Finished: 2/13/19	Gannett Fleming		Sheet: 1 of 4
Soil Drilling: 104.3 ft			Line & Station:
Rock Sampling: 19.7 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043		Offset:
Total Depth of Hole: 124.0 ft	Drilling Agency: Interstate Drilling Services, Inc.		N Coordinate: 17526026.5 ft
No. of Undist. Samples: 0	Driller: Jared Zak		E Coordinate: 1902365.0 ft
Total Number of Core Boxes: 0	Bit Size and Type: N/A	Bulk Sampler: N/A	Elev. Top of Hole: +1368.3 ft
GROUNDWATER OBSERVATIONS Not recorded	Casing Size: N/A	Spoon Size: 2.0 " OD	Direction of Hole
	Hollow Stem Auger: 3.25 " ID x 6.5 " OD	Hammer Wt.: 140 lb	Vertical ☒ Inclined ☐
	Drilling Fluid: N/A	Hammer Drop: 30.0 "	Degrees from Vertical ---
	Drill Rig: Dietrich 50 Track Rig	Hammer Type: Automatic	Logged By: W. Roman

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.5						0.0'-2.5': Unsampled	Began 12-Feb-2019 at 1148
						El. 1365.8	
2.5 - 5.0	S-1	25-30-32-40-28	2.0	80		2.5'-5.0': Silty Clayey SAND with gravel (sc) (EMBANKMENT), 25% gravel, 40% sand, 35% fines. Gravel is subangular to subrounded, fine and coarse, max. particle size: >1.5"; Sand is fine to coarse, subangular to rounded; Fines: low to medium plasticity, Grayish brown (2.5Y 5/2), Moist, weak HCl reaction, homogeneous, mixed gravel of varying hardness, including white (2.5Y 8/1) dolomite, soft dark gray shale, and pink granite 2.5'-5': High dry strength	P.P. = 3 tsf
						El. 1363.3	
5.0 - 7.5	S-2	7-9-14-15-18	1.4	56		5.0'-94.5': Sandy SILT (ML) (EMBANKMENT), 10% gravel, 45% sand, 45% fines. Gravel is subangular to rounded, fine, max. particle size: 1"; Sand is fine to coarse, subangular to rounded; Fines: low to medium plasticity, Grayish brown (2.5Y 5/2), Moist, weak HCl reaction, color varies from grayish-brown (2.5Y 5/2 and gray (GLEY 1 N5) to very dark grayish-brown (2.5Y 3/2) and dark gray (GLEY 1 N4); mixed gravel of varying hardness, including white to light gray dolomite, soft dark gray shale, and pink granite 5.0'-94.5': Field classified as silty clayey sand (sc).	P.P. = 4 tsf
7.5 - 10.0	S-3	8-10-10-12-14	1.7	68			P.P. = 3.2 tsf
10.0 - 12.5	S-4	4-5-7-9-12	1.4	56			P.P. = 2.3 tsf
12.5 - 15.0	S-5	6-9-12-14-17	1.5	60			P.P. = 4.2 tsf
15.0 - 17.5	S-6	5-7-14-16-22	1.7	68			P.P. = 3.3 tsf
17.5 - 20.0	S-7	6-12-14-16-19	2.0	80			P.P. = 4.5 tsf
20.0 - 22.5	S-8	6-22-18-16-14	1.9	76		20'-22.5': little black fines	P.P. = 4.1 tsf
22.5 - 25.0	S-9	54-22-26-23-18	1.8	72		22.5'-25': strong HCl reaction	P.P. = 3.7 tsf

Purpose: Sample embankment materials and foundation soils
Drilling Method: Continous split spoon sampling using hollow stem auger; drilled dry.
Termination: 20' of rock or low permeability material
Abandonment: Two vibrating wire pressure transducers installed in cement-bentonite grout
Additional Remarks: Drilled between cartway of County Road 14 and guiderail, 7' west and 1.1' higher than staked location. Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900930 at 121.5', SN1900931 at 96'; connected to Geokon 8002-4-2 SN 1847930 data logger.

Log Checked By: EJB, 10/11/19

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 4
Driller: Jared Zak	Gannett Fleming	Sheet: 2 of 4
Inspector: W. Roman		Elev. Top of Hole: +1368.3 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
25.0 - 27.5	S-10	17-15-14-20-18	1.4	56			P.P. = 4.1 to >4.5 tsf
27.5 - 30.0	S-11	34-21-23-24-24	1.8	72		27.5'-30': includes clasts of red granite (till source)	P.P. = 4 tsf
30.0 - 32.5	S-12	84-53-19-18-22	1.1	44			P.P. = >4.5 tsf
32.5 - 35.0	S-13	19-10-13-17-20	1.6	64		32.5'-35': includes clasts of red granite (till source)	P.P. = >4.5 tsf
35.0 - 37.5	S-14	31-18-12-18-17	1.2	48			P.P. = >4.5 tsf
37.5 - 40.0	S-15	20-15-16-19-20	1.7	68			P.P. = >4.5 tsf
40.0 - 42.5	S-16	20-15-13-15-17	1.7	68		40'-42.5': Field dispersion test grade = 1 (non-dispersive)	P.P. = 4.3 tsf
42.5 - 45.0	S-17	12-9-10-15-20	1.7	68		42.5'-45': strong HCl reaction	P.P. = 4.3 tsf
45.0 - 47.5	S-18	9-15-16-17-26	1.5	60			P.P. = 3.3 tsf
47.5 - 50.0	S-19	10-10-14-20-22	0.0	0		47.5'-50': no recovery	
50.0 - 52.5	S-20	8-14-18-25-26	2.2	88			P.P. = >4.5 tsf
52.5 - 55.0	S-21	9-12-16-24-27	0.0	0		52.5'-55': no recovery	
55.0 - 57.5	S-22	5-9-15-18-24	1.0	40		55'-57.5': includes subangular clast of white to light gray dolomite 1"x1"x1"	P.P. = 4.2 tsf
57.5 - 60.0	S-23	9-14-16-19-29	2.5	100			P.P. = 3.8 tsf

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 4
Driller: Jared Zak	Gannett Fleming	Sheet: 3 of 4
Inspector: W. Roman		Elev. Top of Hole: +1368.3 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
60.0 - 62.5	S-24	17-20-24-23-19	2.3	92			P.P. = >4.5 tsf
62.5 - 65.0	S-25	8-9-13-18-21	2.0	80		62.5'-65': includes subangular clast of pinkish white (7.5YR 8/2) dolomite 1"x1"x2"	P.P. = >4.5 tsf
65.0 - 67.5	S-26	9-14-15-23-30	1.7	68			P.P. = too disturbed to measure tsf
67.5 - 70.0	S-27	5-12-17-20-25	2.2	88			P.P. = >4.5 tsf
70.0 - 72.5	S-28	5-8-13-17-24	2.5	100			P.P. = >4.5 tsf
72.5 - 75.0	S-29	15-15-20-22-24	2.4	96			P.P. = >4.5 tsf
75.0 - 77.5	S-30	7-10-16-19-19	2.5	100			P.P. = 4.5 tsf
77.5 - 80.0	S-31	14-15-20-22-25	0.2	8			End 12-Feb-2019 at 77.5' at 1720. P.P. = too disturbed to measure tsf Resume 13-Feb-2019 at 77.5' at 0840.
80.0 - 82.5	S-32	4-21-19-19-12	0.7	28		80'-87.5': mostly pale brown (10YR 6/3); trace subangular to subrounded quartzite pebbles	P.P. = 2 tsf
82.5 - 85.0	S-33	5-10-8-14-18	2.5	100		82.5'-85': Field dispersion test grade = 1 (non-dispersive)	P.P. = 2.2 tsf
85.0 - 87.5	S-34	4-7-12-18-17	2.3	92			P.P. = 3.3 tsf
87.5 - 90.0	S-35	7-14-20-27-39	0.7	28		87.5'-92.5': strong HCl reaction	P.P. = >4.5 tsf
90.0 - 92.5	S-36	5-12-20-27-29	0.6	24			P.P. = 3.2 tsf
92.5 - 95.0	S-37	7-11-17-21-25	2.5	100			P.P. = >4.5 tsf

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 4
Driller: Jared Zak	Gannett Fleming	Sheet: 4 of 4
Inspector: W. Roman		Elev. Top of Hole: +1368.3 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
						El. 1273.8	
95.0 - 97.5	S-38	4-8-8-10-7	2.3	92		94.5'-104.3': Silty Clayey SAND (sc) (GLACIAL TILL), 10% gravel, 45% sand, 45% fines. Gravel is subangular to rounded, fine, max. particle size: <0.5"; Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Grayish brown (10YR 5/2), Wet to Moist, weak HCl reaction, Gravel consists of white chalky dolomite, light gray dolomite, dark gray shale, and light gray quartzite	P.P. = 1.2 tsf
97.5 - 100.0	S-39	8-9-15-17-23	2.4	96		95'-96': wet 95'-97.5': high dry strength 97.5'-100': Field dispersion test grade = 2 (intermediate)	P.P. = 4 tsf
100.0 - 102.5	S-40	6-6-10-12-11	0.0	0		100'-102.5': no recovery	
102.5 - 105.0	S-41	4-5-8-10-13	2.5	100		Top of Rock @ 104.3 ft El. 1264.0	P.P. = 4.1 tsf
105.0 - 107.5	S-42	4-7-12-15-20	2.0	80		104.3'-124.0': Clayey SHALE, *[Pierre Shale]* comprised of clay to silt sized particles, Very dark gray, (GLEY1 N3), very slight to fresh, very soft, high plasticity, like a hard fat clay; specimens broken by hand and gouged by fingernail; also gray to greenish-gray; some hairline fractures develop parallel bedding, which is nearly flat; some burrows; none to weak HCl reaction. Laboratory classified as Fat CLAY (CH).	P.P. = >4.5 tsf
107.5 - 110.0	S-43	9-13-16-22-31	2.5	100		105'-107.5': no HCl reaction 107.5'-112.5': weak HCl reaction	P.P. = >4.5 tsf
110.0 - 112.5	S-44	7-11-18-24-32	2.5	100			P.P. = >4.5 tsf
112.5 - 115.0	S-45	9-16-21-25-40	2.5	100		112.5'-124': no HCl reaction 112.5'-115': Field dispersion test grade = 4 (highly dispersive)	P.P. = >4.5 tsf
115.0 - 117.5	S-46	7-9-17-24-30	2.5	100			P.P. = >4.5 tsf
117.5 - 120.0	S-47	11-15-24-35-41	2.5	100			P.P. = >4.5 tsf
120.0 - 122.5	S-48	12-18-27-36-40	2.5	100			P.P. = >4.5 tsf SPT completed at 124' at 1430 13-Feb-2019.
122.5 - 124.0	S-49	12-18-25	1.5	100		122.5'-124': trace angular white specks, possibly authigenic dolomite El. 1244.3	P.P. = >4.5 tsf
						Bottom of Borehole at 124.0 feet.	

Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900930 at 121.5', SN1900931 at 96'; connected to Geokon 8002-4-2 SN 1847930 data logger.

Date Started: 2/14/19	**DRILLING LOG**		Hole Number: 5
Date Finished: 2/15/19	Gannett Fleming		Sheet: 1 of 3
Soil Drilling: 51.5 ft			Line & Station:
Rock Sampling: 13.5 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043		Offset:
Total Depth of Hole: 65.0 ft	Drilling Agency: Interstate Drilling Services, Inc.		N Coordinate: 17526027.6 ft
No. of Undist. Samples: 0	Driller: Jared Zak		E Coordinate: 1902500.0 ft
Total Number of Core Boxes: 0	Bit Size and Type: N/A	Bulk Sampler: N/A	Elev. Top of Hole: +1327.1 ft
GROUNDWATER OBSERVATIONS Not recorded	Casing Size: N/A	Spoon Size: 2.0 " OD	Direction of Hole
	Hollow Stem Auger: 3.25 " ID x 6.5 " OD	Hammer Wt.: 140 lb	Vertical ☒ Inclined ☐
	Drilling Fluid: N/A	Hammer Drop: 30.0 "	Degrees from Vertical ---
	Drill Rig: Dietrich 50 Track Rig	Hammer Type: Automatic	Logged By: W. Roman

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.5						0.0'-2.5': Unsampled El. 1324.6	Began 14-Feb-2019 at 0250
2.5 - 5.0	S-1	8-13-18-24-27	1.8	72		2.5'-37.5': Sandy Elastic SILT (MH) (EMBANKMENT), 5% gravel, 55% sand, 40% fines. Gravel is subrounded to rounded, fine to coarse, Sand is medium to coarse, subrounded to rounded; Fines: low to medium plasticity, Grayish brown (10YR 5/2), Moist, weak HCl reaction, homogeneous, Color varies to very dark gray (10YR 3/1); gravel and coarse sand includes clasts of soft dark gray shale, pinkish-white dolomite, chalky white dolomite, and hard quartzite 2.5'-37.5': Field classified as silty clayey sand (sc). 5'-7.5': Field dispersion test grade = 1 (non-dispersive)	P.P. = too disturbed to measure tsf
5.0 - 7.5	S-2	8-13-18-21-27	2.0	80			P.P. = >4.5 tsf
7.5 - 10.0	S-3	13-15-17-18-18	0.1	4			P.P. = too disturbed to measure tsf
10.0 - 12.5	S-4	6-9-10-16-17	0.9	36			P.P. = 4.4 tsf
12.5 - 15.0	S-5	6-7-8-10-11	1.2	48			P.P. = >4.5 tsf
15.0 - 17.5	S-6	7-11-12-14-15	1.2	48		15'-17.5': includes subangular clast of white, to light gray and dolomite 1"x1.25"x1.5", broken by drillng	P.P. = 2.2 tsf
17.5 - 20.0	S-7	6-6-12-11-15	0.9	36			P.P. = too disturbed to measure tsf
20.0 - 22.5	S-8	6-10-12-11-13	0.0	0		20'-22.5': no recovery	
22.5 - 25.0	S-9	9-9-13-16-21	1.2	48		22.5'-25': includes subangular clast of pinkish-white dolomite 0.75"x1.25"x1.25", broken by drilling	P.P. = 4 tsf

Purpose: Sample embankment materials and foundation soils
Drilling Method: Continous split spoon sampling using hollow stem auger; drilled dry.
Termination: 20' of rock or low permeability material
Abandonment: Two vibrating wire pressure transducers installed in cement-bentonite grout
Additional Remarks: Drilled 5' east of stake on bench. Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900933 at 45', SN1900932 at 64'; connected to Geokon 8002-4-2 SN 1847932 data logger.

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 5
Driller: Jared Zak	Gannett Fleming	Sheet: 2 of 3
Inspector: W. Roman		Elev. Top of Hole: +1327.1 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
25.0 - 27.5	S-10	5-8-11-13-15	1.7	68			P.P. = 4.4 tsf
27.5 - 30.0	S-11	9-9-11-16-20	1.1	44			P.P. = 3.9 tsf
30.0 - 32.5	S-12	6-7-12-14-18	1.7	68		30'-32.5': Field dispersion test grade = 1 (non-dispersive)	P.P. = >4.5 tsf
32.5 - 35.0	S-13	10-11-11-12-13	1.2	48			P.P. = >4.5 tsf
35.0 - 37.5	S-14	6-6-8-16-17	0.0	0		35'-37.5': no recovery El. 1289.6	
37.5 - 40.0	S-15	6-5-7-12-11	1.6	64		37.5'-51.5': Sandy SILT (ML) (GLACIAL TILL), 10% gravel, 45% sand, 45% fines. Gravel is subangular to rounded, fine, max. particle size: <1"; Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Grayish brown (10YR 5/2), Moist, weak HCl reaction, Gravel consists of white chalky dolomite, light gray dolomite, dark gray shale, and light gray quartzite 37.5'-51.5': Field classified as silty, clayey sand (sc).	P.P. = 3 tsf
40.0 - 42.5	S-16	5-6-9-12-15	1.6	64			P.P. = 3.4 tsf
42.5 - 45.0	S-17	5-7-10-9-7	1.8	72		42.5'-45': Field dispersion test grade = 1 (non-dispersive)	P.P. = 2.4 tsf
45.0 - 47.5	S-18	2-3-8-8-11	1.7	68			P.P. = 2.7 tsf
47.5 - 50.0	S-19	5-6-6-8-8	2.0	80			P.P. = 2.5 tsf
50.0 - 52.5	S-20	3-5-7-11-7	2.5	100		Top of Rock @ 51.5 ft El. 1275.6	P.P. = 2.6 above rock; >4.5 in rock tsf End 14-Feb-2019 at 52.5' at 1715.
52.5 - 55.0	S-21	5-5-5-7-11	2.5	100		51.5'-65.0': Clayey SHALE, *[Pierre Shale]* comprised of clay to silt sized particles, Very dark gray, (GLEY 1 N3), very slight to fresh, very soft, high plasticity, like a very stiff to hard fat clay; none to strong HCl reaction; specimens broken by hand and gouged by fingernail; also gray to greenish-gray; some hairline fractures develop parallel bedding; trace white angular specks, possible authigenic dolomite 51.5'-52.5': strong HCl reaction in light gray material 52.5'-65': no HCl reaction 52.5'-55': high dry strength	P.P. = 2.7 tsf Resume 15-Feb-2019 at 52.5' at 0830. Measured water level at 41.5' after sampling to 55'.
55.0 - 57.5	S-22	4-4-7-9-10	2.5	100			P.P. = 2.5 tsf
57.5 - 60.0	S-23	5-7-9-11-12	2.5	100		57.5'-60': Field dispersion test grade = 4 (highly dispersive)	P.P. = 3.3 tsf

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 5
Driller: Jared Zak	Gannett Fleming	Sheet: 3 of 3
Inspector: W. Roman		Elev. Top of Hole: +1327.1 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
60.0 - 62.5	S-24	4-7-8-14-22	2.5	100			P.P. = 4 tsf SPT completed at 65 at 0930 15-Feb-2019.
62.5 - 65.0	S-25	6-8-12-14-17	2.5	100		El. 1262.1	P.P. = 3.9 tsf
						Bottom of Borehole at 65.0 feet.	Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900933 at 45', SN1900932 at 64'; connected to Geokon 8002-4-2 SN 1847932 data logger.

Date Started: 2/14/19	**DRILLING LOG**		Hole Number: 6
Date Finished: 2/14/19			Sheet: 1 of 2
Soil Drilling: 31.5 ft	Gannett Fleming		Line & Station:
Rock Sampling: 16.0 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043		Offset:
Total Depth of Hole: 47.5 ft	Drilling Agency: Interstate Drilling Services, Inc.		N Coordinate: 17525853.0 ft
No. of Undist. Samples: 0	Driller: Jared Zak		E Coordinate: 1902500.0 ft
Total Number of Core Boxes: 0	Bit Size and Type: N/A	Bulk Sampler: N/A	Elev. Top of Hole: +1326.3 ft
GROUNDWATER OBSERVATIONS Not recorded	Casing Size: N/A	Spoon Size: 2.0 " OD	Direction of Hole
	Hollow Stem Auger: 3.25 " ID x 6.5 " OD	Hammer Wt.: 140 lb	Vertical ☒ Inclined ☐
	Drilling Fluid: N/A	Hammer Drop: 30.0 "	Degrees from Vertical ---
	Drill Rig: Dietrich 50 Track Rig	Hammer Type: Automatic	Logged By: W. Roman

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.5						0.0'-2.5': Unsampled El. 1323.8	Began 14-Feb-2019 at 0940
2.5 - 5.0	S-1	9-9-13-15-18	1.7	68		2.5'-7.5': Silty Clayey SAND (sc) (EMBANKMENT), 2% gravel, 53% sand, 45% fines. Gravel is subrounded to rounded, fine to coarse, Sand is medium to coarse, subrounded to rounded; Fines: low to medium plasticity, Grayish brown (10YR 5/2), Moist, weak HCl reaction, homogeneous, Color varies to very dark gray (10YR 3/1); gravel and coarse sand includes clasts of soft dark gray shale, pinkish-white dolomite, chalky white dolomite, and hard quartzite 2.5'-5': Field dispersion test grade = 1 (non-dispersive)	P.P. = >4.5 tsf
5.0 - 7.5	S-2	5-10-15-16-12	1.0	40		El. 1318.8	P.P. = too disturbed to measure tsf
7.5 - 10.0	S-3	6-6-6-10-13	2.0	80		7.5'-31.5': SILT with sand (ML) (COLLUVIAL/RESIDUAL), 2% gravel, 45% sand, 53% fines. Gravel is subangular to rounded, fine to coarse, Sand is fine, subrounded to rounded; Fines: low to medium plasticity, Gray (GLEY1 N5), Moist, homogeneous, weak to strong HCl reaction; trace fine rounded white dolomite pebbles and gravel 7.5'-31.5': Field classified as sandy silt (ml) 10'-12.5': strong HCl reaction	P.P. = 4.2 tsf
10.0 - 12.5	S-4	5-10-10-11-13	1.2	48			P.P. = 3.7 tsf
12.5 - 15.0	S-5	6-9-12-14-16	2.0	80		12.5'-15': subangular clast of white dolomite 0.75"x1"x1.5", partially broken by drilling 12.5'-15': high dry strength	P.P. = >4.5 tsf
15.0 - 17.5	S-6	4-7-10-11-10	1.8	72		15'-17.5': Field dispersion test grade = 1 (non-dispersive)	P.P. = 4 tsf
17.5 - 20.0	S-7	7-9-10-12-16	0.1	4			
20.0 - 22.5	S-8	5-6-6-10-11	0.0	0		20'-22.5': no recovery	
22.5 - 25.0	S-9	6-8-11-13-14	0.2	8			

Purpose: Sample embankment materials and foundation soils
Drilling Method: Continous split spoon sampling using hollow stem auger; drilled dry.
Termination: 20' of rock or low permeability material
Abandonment: Two vibrating wire pressure transducers installed in cement-bentonite grout
Additional Remarks: Drilled on bench about 35' west of stake on slope. Drilled location about 12' higher than stake. Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900935 at 28', SN1900934 at 38'; connected to Geokon 8002-4-2 SN 1847931 data logger.

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 6
Driller: Jared Zak	Gannett Fleming	Sheet: 2 of 2
Inspector: W. Roman		Elev. Top of Hole: +1326.3 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
25.0 - 27.5						25'-27.5': augered through interval in attempt to push aside obstruction causing poor recovery	
27.5 - 30.0	S-10	12-13-16-16-16	1.2	48		27.5'-32.5': moist, becoming wet; more clayey fines	P.P. = >4.5 tsf
30.0 - 32.5	S-11	8-15-19-26-30	2.5	100		Top of Rock @ 31.5 ft El. 1294.8	P.P. = >4.5 tsf
32.5 - 35.0	S-12	11-26-33-38-50	2.2	88		31.5'-47.5': Clayey SHALE, *[Pierre Shale]* comprised of clay to silt sized particles, Very dark gray, (GLEY1 N3), very slight to fresh, very soft, interbedded with whitish bentonite clay; specimens broken by hand and gouged by fingernail 32.5'-35.5': mostly whitish bentonite	P.P. = >4.5 tsf
35.0 - 37.5	S-13	10-14-23-27-31	2.0	80			P.P. = 3.2 tsf
37.5 - 40.0	S-14	16-27-36-39-38	1.9	76			P.P. = >4.5 tsf
40.0 - 42.5	S-15	7-11-17-26-33	2.0	80		40'-40.8': mostly whitish bentonite 40'-42.5': Field dispersion test grade = 1 (non-dispersive)	P.P. = >4.5 tsf
42.5 - 45.0	S-16	18-19-30-27-32	1.1	44		42.5-45': mostly whitish bentonite	P.P. = >4.5 tsf SPT completed at 47.5' at 1220 14-Feb-2019.
45.0 - 47.5	S-17	10-15-23-24-24	2.5	100		45'-47.5': Field dispersion test grade = 3 (dispersive) El. 1278.8	P.P. = >4.5 tsf
						Bottom of Borehole at 47.5 feet.	

Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900935 at 28', SN1900934 at 38'; connected to Geokon 8002-4-2 SN 1847931 data logger.

APPENDIX D

Piezometer Construction Logs and Data

Project No.:	064799	**PIEZOMETER CONSTRUCTION LOG**	**Hole Number:** 4
Date Started:	2/12/19	Gannett Fleming	Piezometer ID: 4U & 4D
Date Finished:	2/13/19		Line & Station:
Elev. Top of Hole:	+1368.3 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043	Offset:
Total Depth of Hole:	124.0 ft	Drilling Agency: Interstate Drilling Services, Inc.	N Coordinate: 17526026.5 ft
Borehole Diameter:	6.5 "	Driller: Jared Zak	E Coordinate: 1902365.0 ft
Logged By:	W. Roman	Equilibrated Piezometric Head: 4U: 32.7 ft bgs, El. 1335.55 4D: 34.8 ft bgs, El. 1333.45	

Strata		Piezometer Construction				
Description	USCS	Piezometer Materials	Piezometer Construction Details			Elev.
				Stick Up	Diameter	Material
			Protective Casing	2.5 ft	8 in	Steel
0.0'-2.5'						1370.8
El. 1365.8						
2.5'-5.0': Silty Clayey SAND with gravel (sc)						
El. 1363.3						
5.0'-94.5': Sandy SILT (ML)						
El. 1273.8						
94.5'-104.3': Silty Clayey SAND (sc)			96.0': VW Transducer Tip, Geokon 4500 S350 kpa SN 1900931			1272.2
Top of Rock @ 104.3 ft						
El. 1264.0						
104.3'-124.0': Clayey SHALE						
El. 1244.3			121.5': VW Transducer Tip, Geokon 4500 S350 kpa SN 1900930			1246.7
			124.0': Bottom of Borehole			1244.3

Remarks: Backfilled with grout

Project No.:	064799	**PIEZOMETER CONSTRUCTION LOG**	**Hole Number:** 5
Date Started:	2/14/19	Gannett Fleming	Piezometer ID: 5U & 5D
Date Finished:	2/15/19		Line & Station:
Elev. Top of Hole:	+1327.1 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043	Offset:
Total Depth of Hole:	65.0 ft	Drilling Agency: Interstate Drilling Services, Inc.	N Coordinate: 17526027.6 ft
Borehole Diameter:	6.5 "	Driller: Jared Zak	E Coordinate: 1902500.0 ft
Logged By:	W. Roman	Equilibrated Piezometric Head: 5U: 32.7 ft bgs, El. 1294.39	5D: 35.0 ft bgs, El. 1292.09

Strata		Piezometer Construction		
Description	USCS	Piezometer Materials	Piezometer Construction Details	Elev.
			Stick Up / Diameter / Material	
			Protective Casing 3.0 ft 8 in Steel	1330.1
0.0'-2.5'				
El. 1324.6				
2.5'-37.5': Sandy Elastic SILT (MH)				
El. 1289.6				
37.5'-51.5': Sandy SILT (ML)				
			45.0': VW Transducer Tip, Geokon 4500 S350 kpa SN 1900933	1282.1
Top of Rock @ 51.5 ft				
El. 1275.6				
51.5'-65.0': Clayey SHALE				
El. 1262.1				
			64.0': VW Transducer Tip, Geokon 4500 S350 kpa SN 1900932	1263.1
			65.0': Bottom of Borehole	1262.1

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70

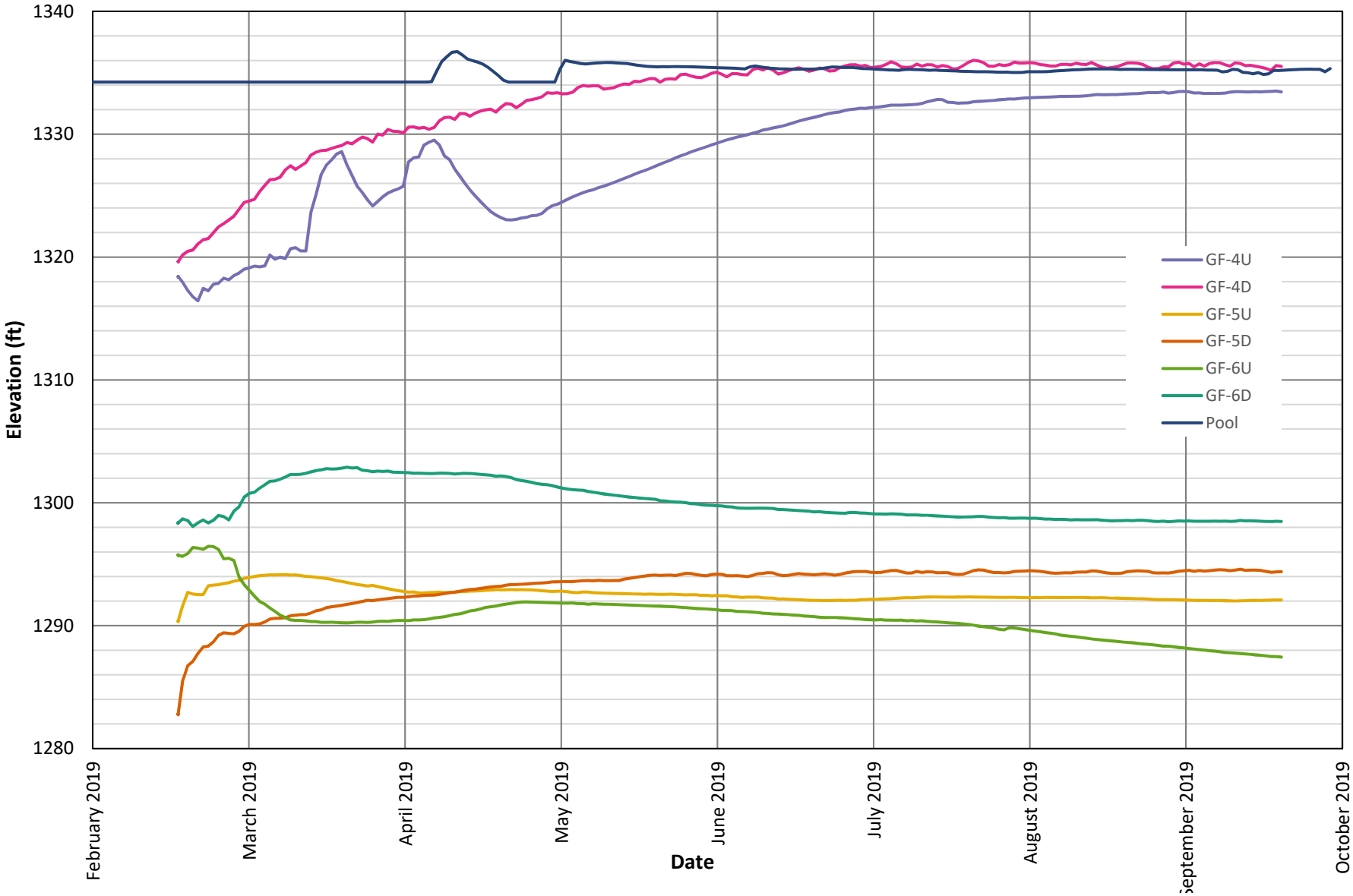
Remarks: Backfilled with grout

Project No.:	064799	**PIEZOMETER CONSTRUCTION LOG**	**Hole Number:** 6
Date Started:	2/14/19	Gannett Fleming	Piezometer ID: 6U & 6D
Date Finished:	2/14/19		Line & Station:
Elev. Top of Hole:	+1326.3 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043	Offset:
Total Depth of Hole:	47.5 ft	Drilling Agency: Interstate Drilling Services, Inc.	N Coordinate: 17525853.0 ft
Borehole Diameter:	6.5 "	Driller: Jared Zak	E Coordinate: 1902500.0 ft
Logged By:	W. Roman	Equilibrated Piezometric Head: 6U: 27.8 ft bgs, El. 1298.45	6D: 38.8 ft bgs, El. 1287.45

Strata		Piezometer Construction		
Description	USCS	Piezometer Materials	Piezometer Construction Details	Elev.
			Stick Up / Diameter / Material	
			Protective Casing 3.3 ft 8 in Steel	1329.6
0.0'-2.5'				
El. 1323.8				
2.5'-7.5': Silty Clayey SAND (sc)				
El. 1318.8				
7.5'-31.5': SILT with sand (ML)				
			28.0': VW Transducer Tip, Geokon 4500 S350 kpa SN 1900935	1298.2
Top of Rock @ 31.5 ft				
El. 1294.8				
31.5'-47.5': Clayey SHALE				
			38.0': VW Transducer Tip, Geokon 4500 S350 kpa SN 1900934	1288.2
El. 1278.8				
			47.5': Bottom of Borehole	1278.8

Remarks: Backfilled with grout

Matejcek Dam, Walsh County, ND
Piezometer Data



APPENDIX E

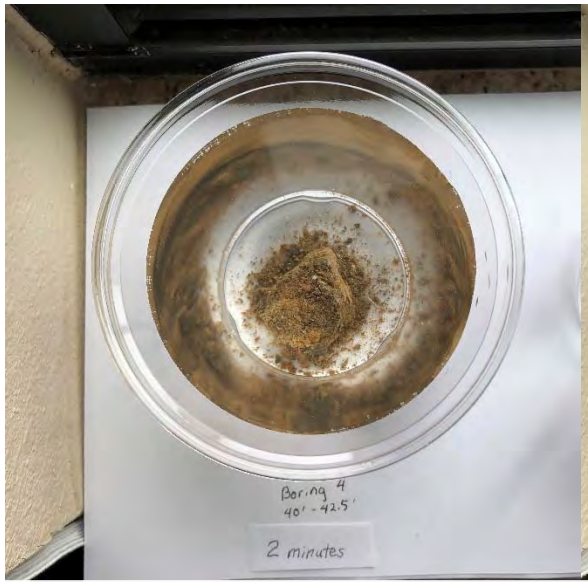
Field Crumb Dispersion Test Reports

FIELD CRUMB DISPERSION TEST RESULTS

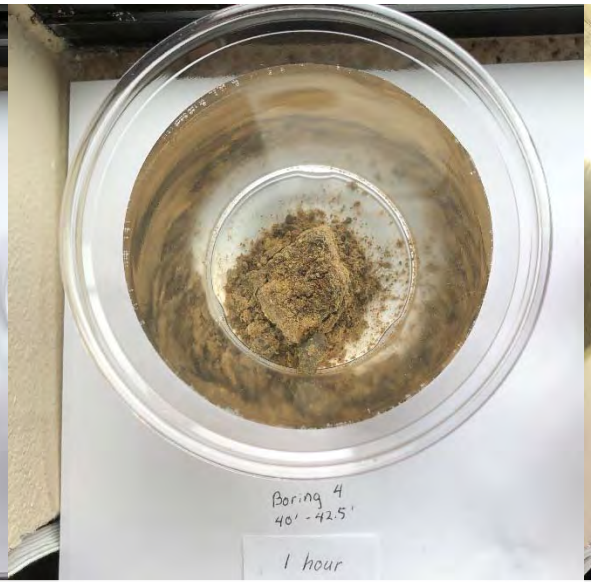
(ASTM D 6572)

	Layer	Boring	Layer Depth (ft)		Sample Depth (ft)		GRADE			
			Top	Bottom	Top	Bottom	2 minutes	1 hour	6 hours	Average
DAM AND RIGHT ABUTMENT	Embankment	4	2.5	94.5	40	42.5	1	1	1	1
					82.5	85	1	1	1	
		5	2.5	37.5	5	7.5	2	1	1	
					30	32.5	1	1	1	
		6	2.5	7.5	2.5	5	3	1	1	
	Till	4	94.5	104.3	97.5	100	1	2	2	1.5
		5	37.5	51.5	42.5	45	1	1	1	
	Colluvium/Residuum	6	7.5	31.5	15	17.5	2	1	1	1
	Clay/Shale	4	104.3	124	112.5	115	2	4	4	3
		5	51.5	65	57.5	60	2	4	4	
		6	31.5	47.5	40	42.5	1	1	1	
					45	47.5	1	3	3	
AUXILIARY SPILLWAY	Outwash	2	2.5	10	7.5	10	4	3	3	1.8
					7.5	10	1	1	1	
					7.5	10	2	1	2	
		3	2.5	10.5	2.5	5	1	1	1	
	Brown Oxidized Till	2	10	20	15	16.5	2	2	2	3
		3	10.5	15.5	12.5	15	3	3	3	
	Upper Gray Reduced Till	2	20	37.5	30	32	2	4	4	
		3	15.5	40	22.5	24	1	1	1	
	Gray Melt-out Till	*2*	*22.5*	*27*	*22.5*	*25*	2	2	3	
	Lower Gray Reduced Till	2	37.5	42.5	37.5	40	2	4	4	
		3	40	43.5	40	41.5	2	4	4	
	Clay/Shale	2	42.5	59.5	45	47.5	2	4	4	4
		3	43.5	48.3	44.5	45.8	2	4	4	

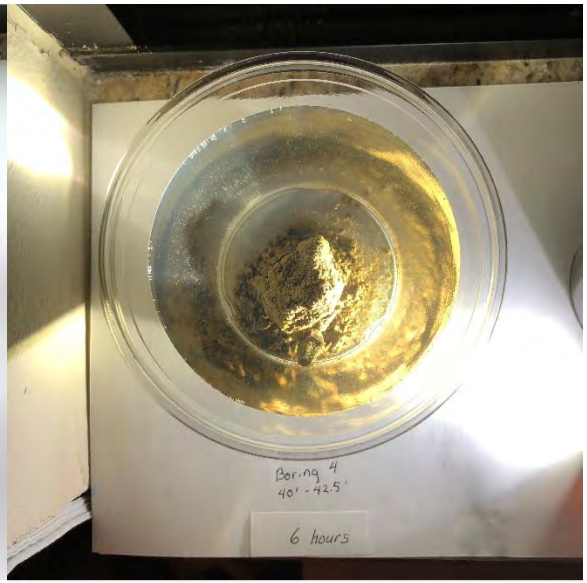
GF-4 40’ - 42.5’ Embankment



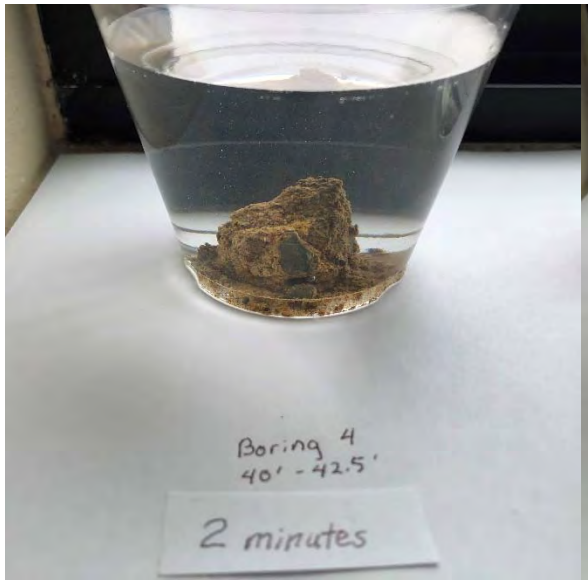
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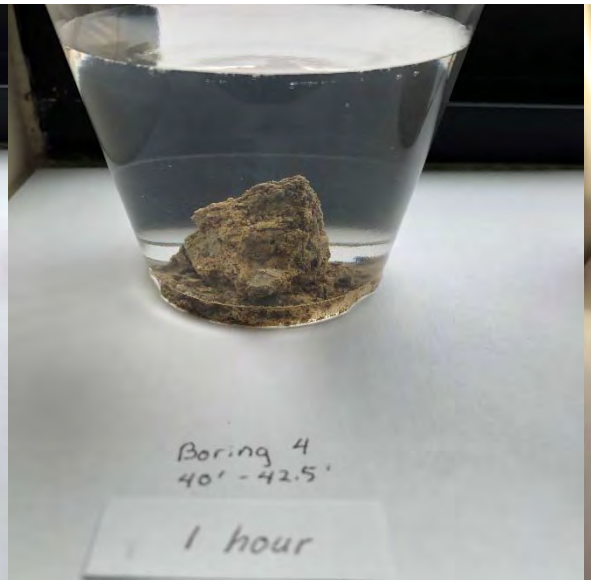


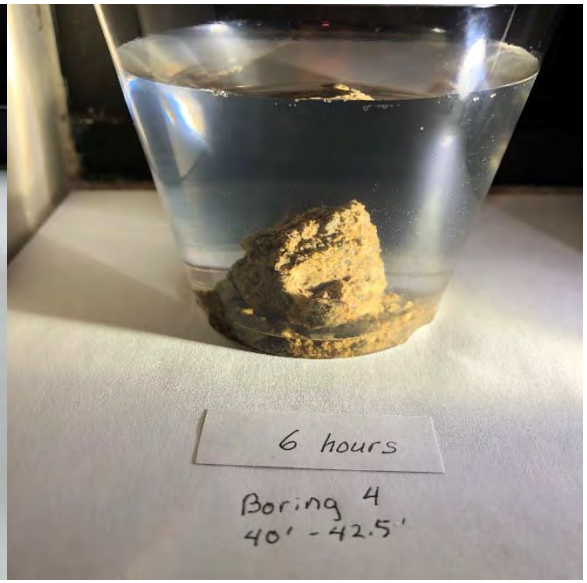
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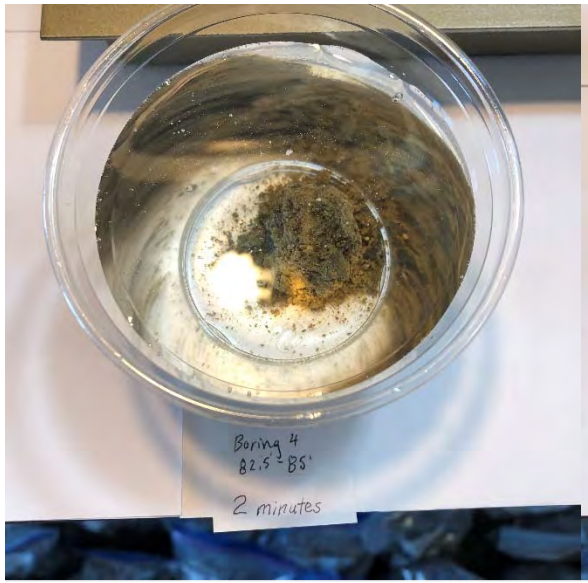
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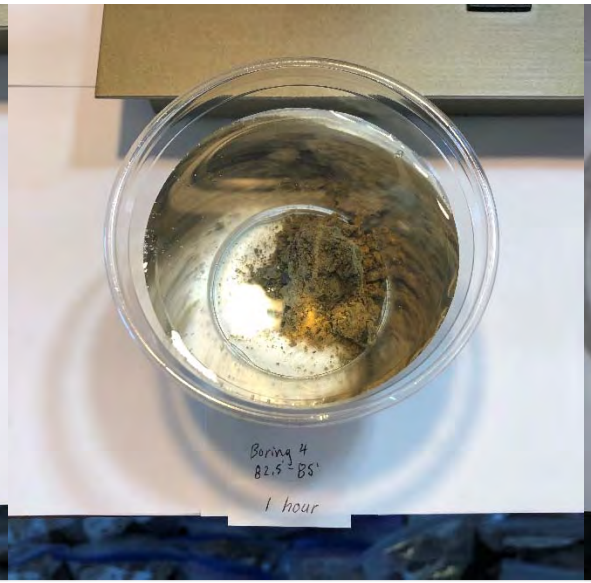




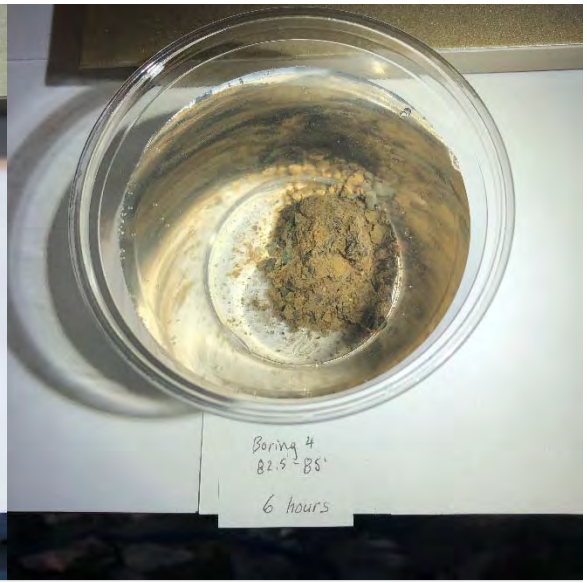
GF-4 82.5' - 85' Embankment



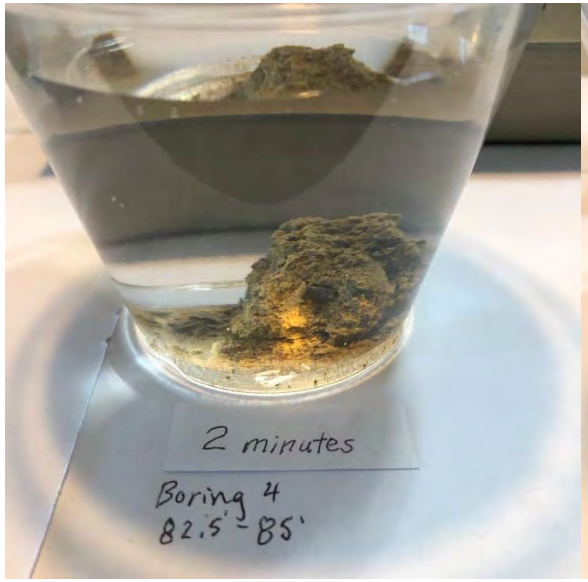
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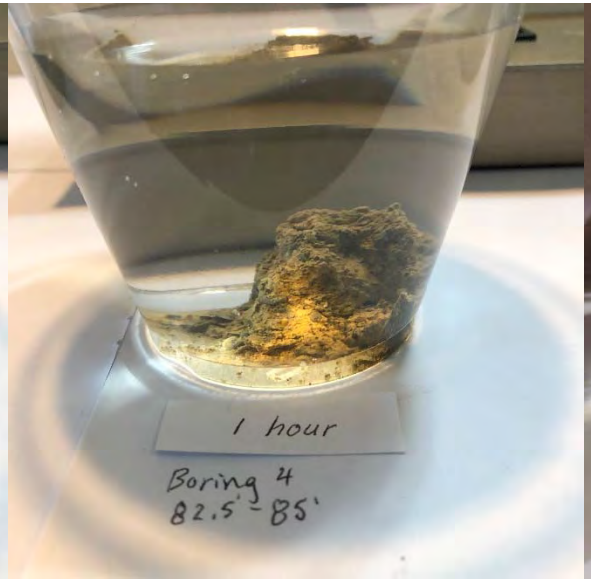


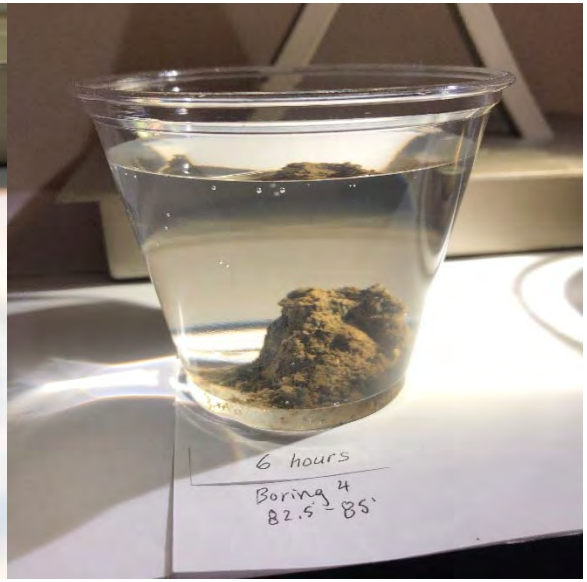
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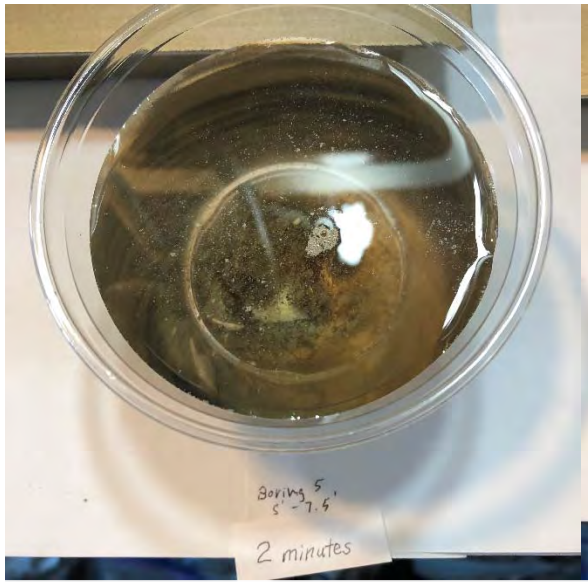
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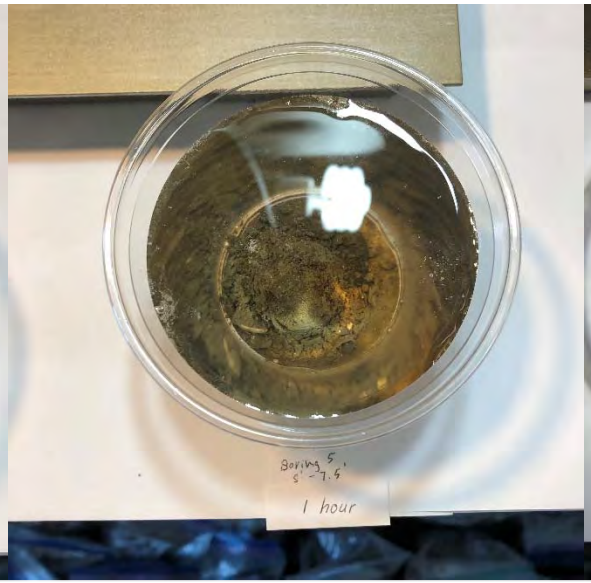




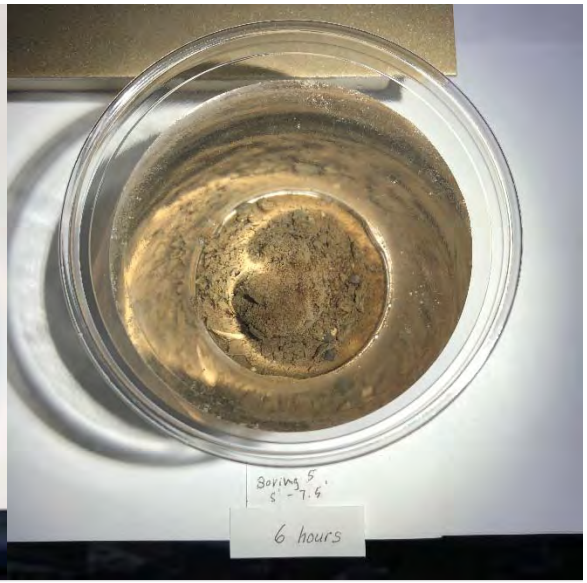
GF-5 5' - 7.5' Embankment



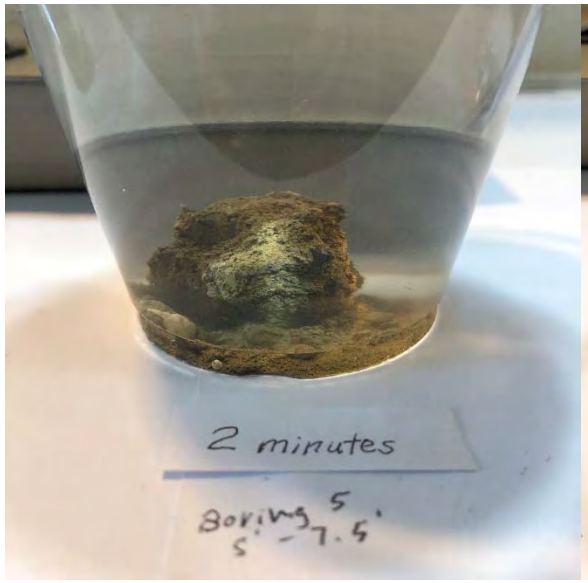
Time = 2 minutes Grade = 2

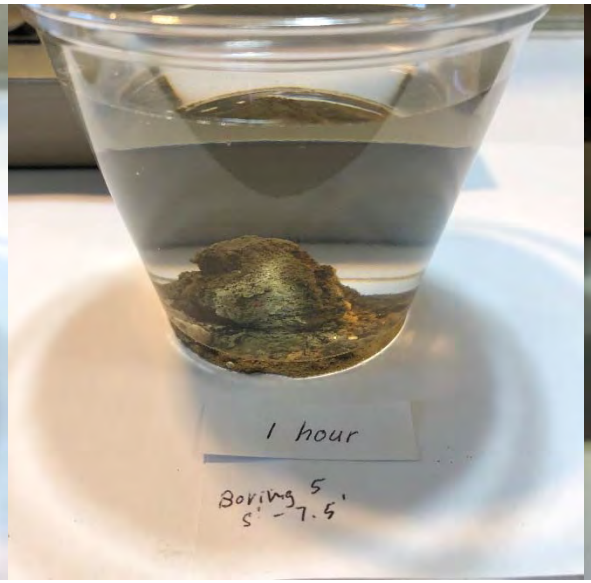


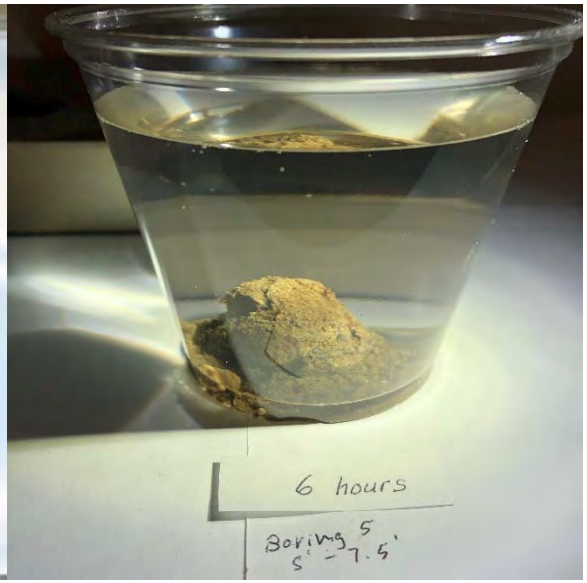
Time = 1 hour Grade = 1



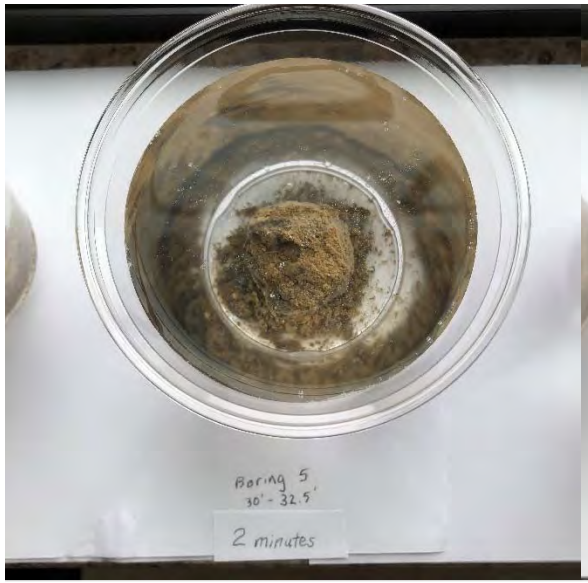
Time = 6 hours Grade = 1



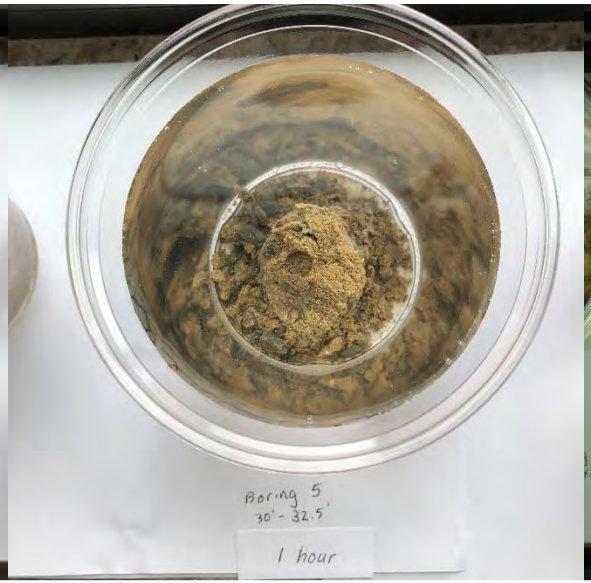




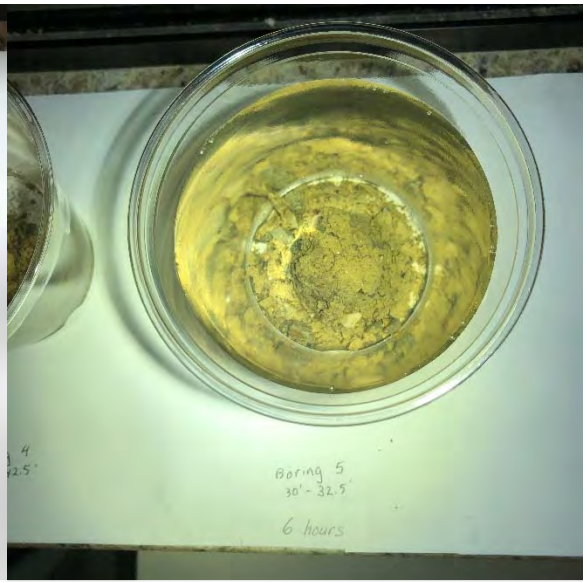
GF-5 30' - 32.5' Embankment



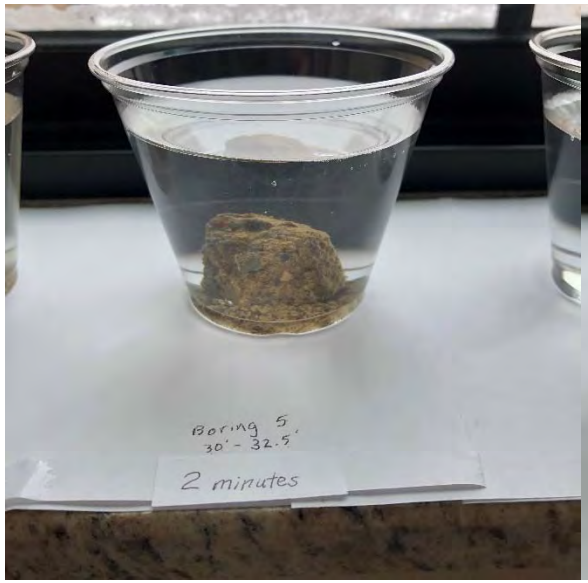
Time = 2 minutes Grade = 1

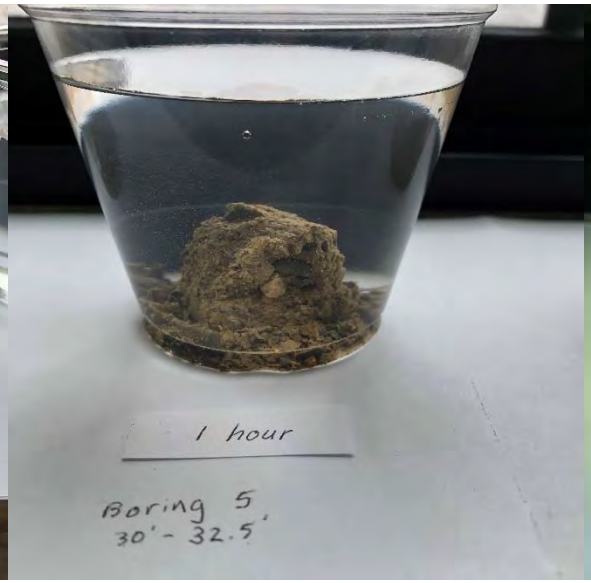


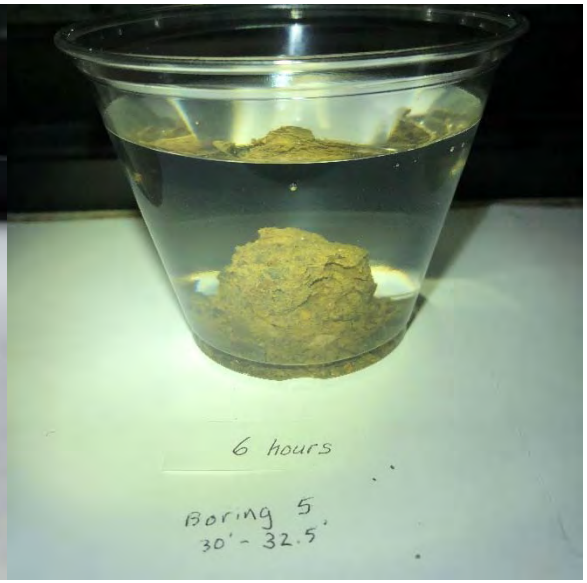
Time = 1 hour Grade = 1



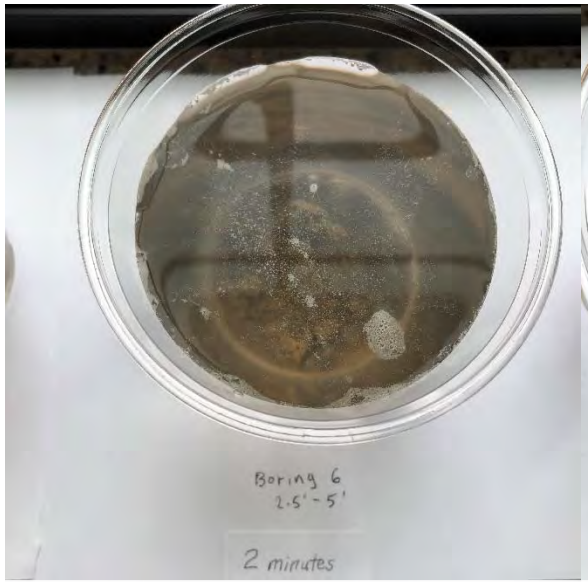
Time = 6 hours Grade = 1



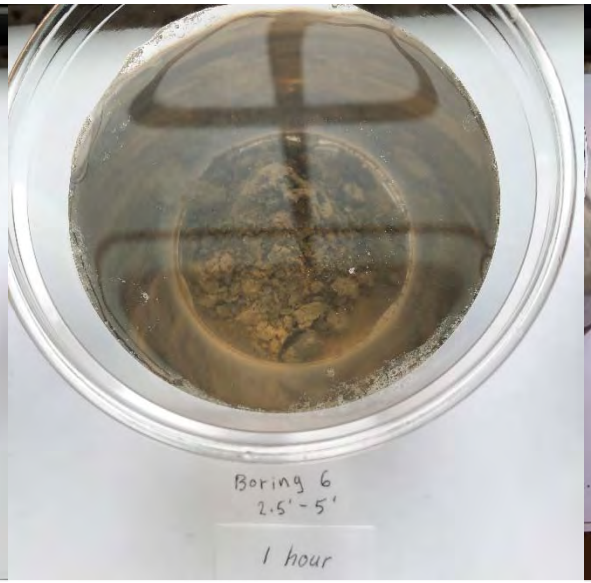




GF-6 2.5' - 5' Embankment



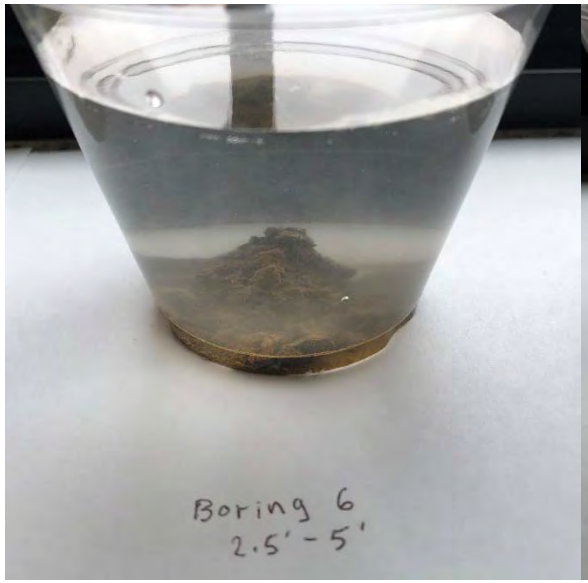
Time = 2 minutes Grade = 3

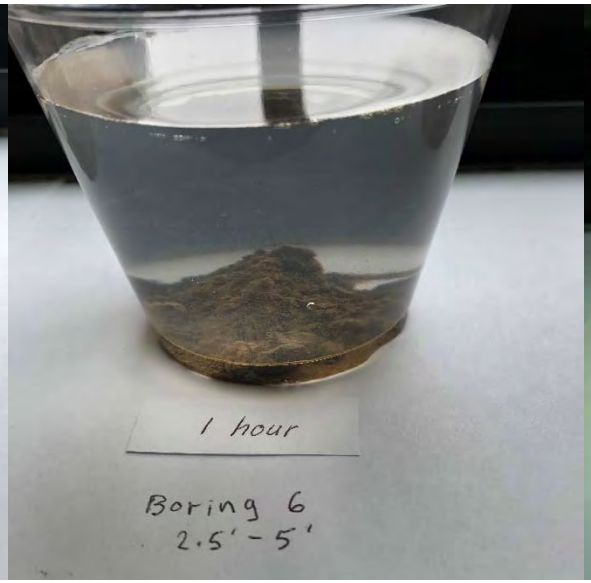


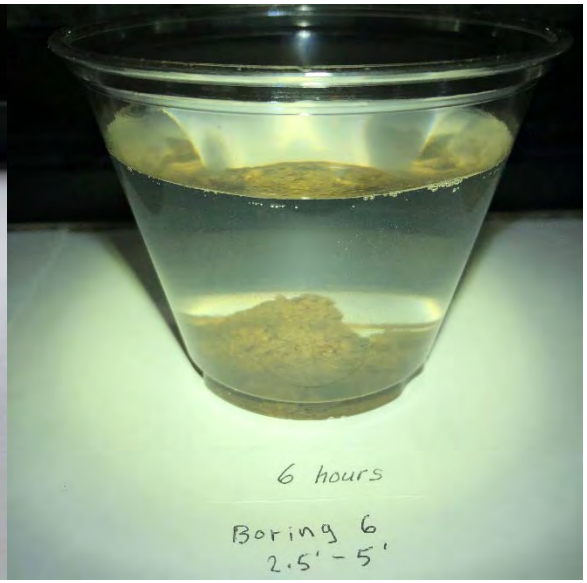
Time = 1 hour Grade = 1



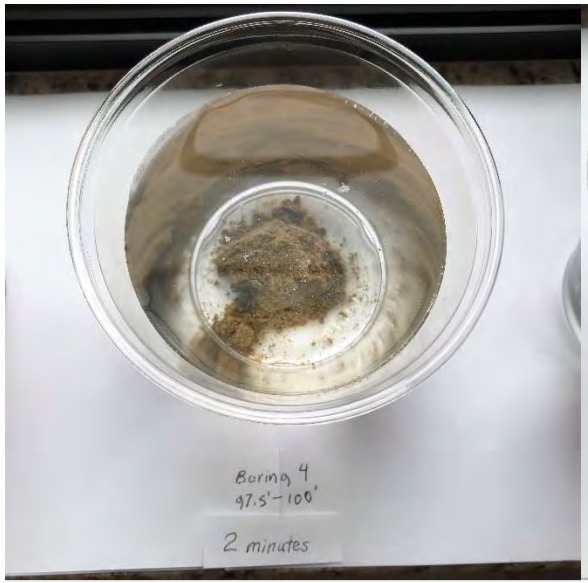
Time = 6 hours Grade = 1



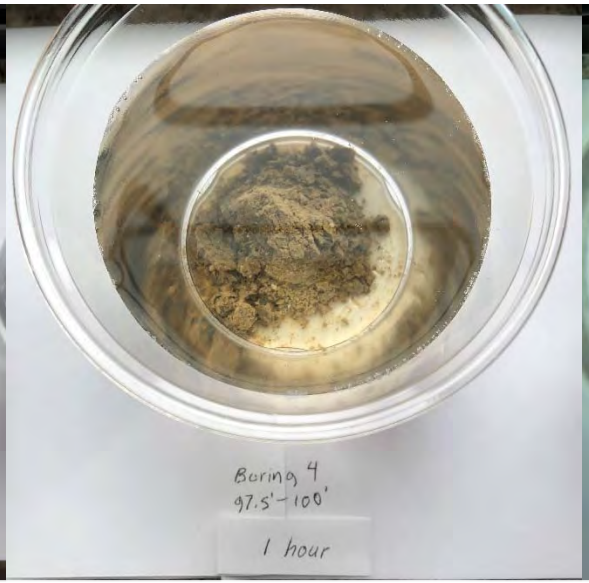




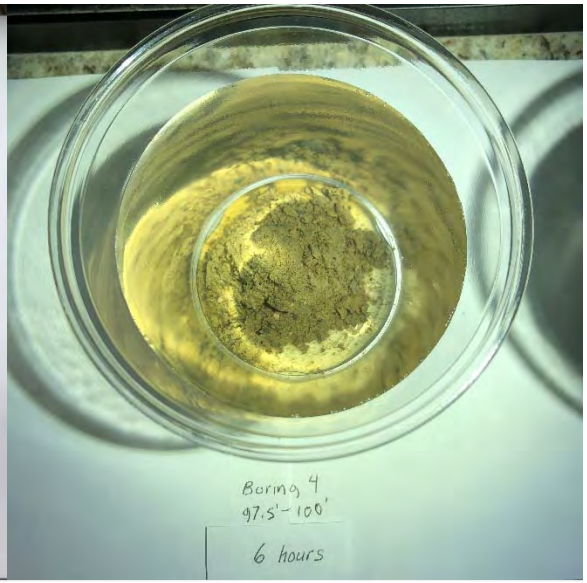
GF-4 97.5' - 100' Till



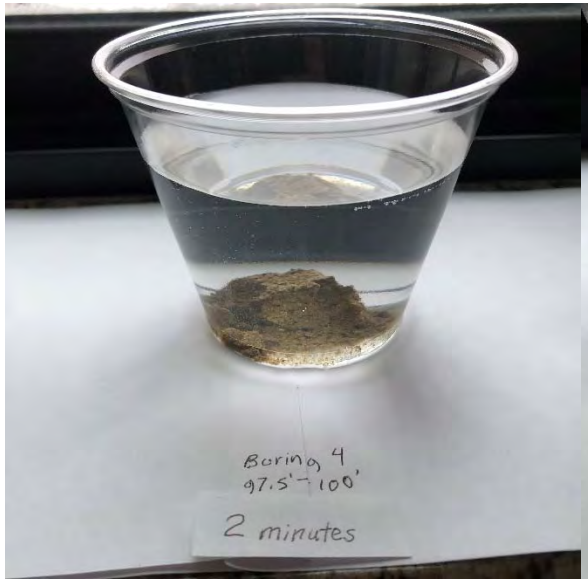
Time = 2 minutes Grade = 1

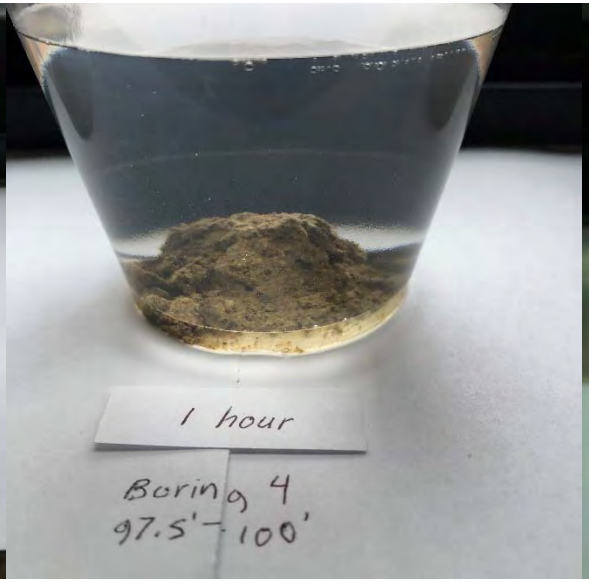


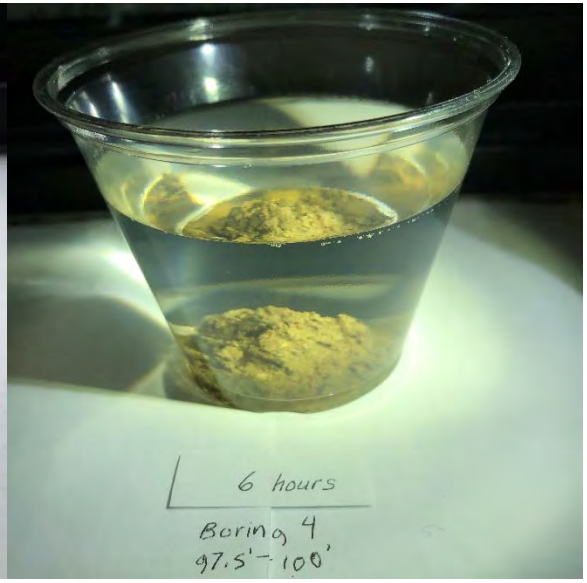
Time = 1 hour Grade = 2



Time = 6 hours Grade = 2



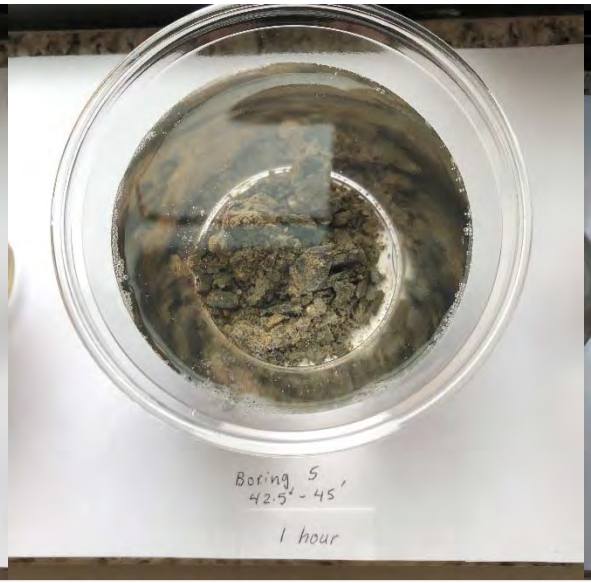




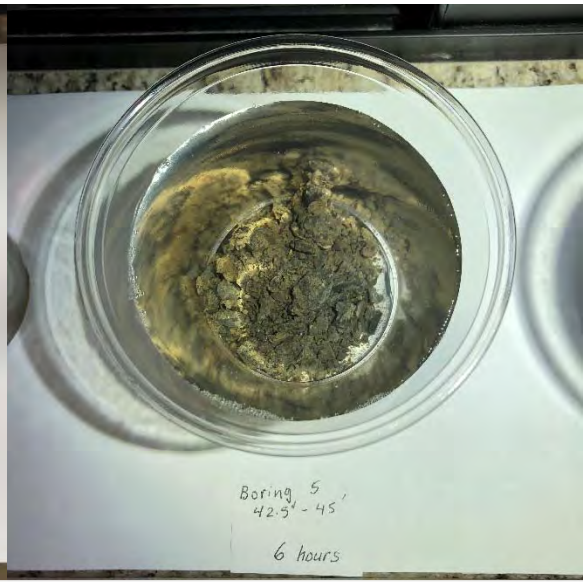
GF-5 42.5' - 45' Till



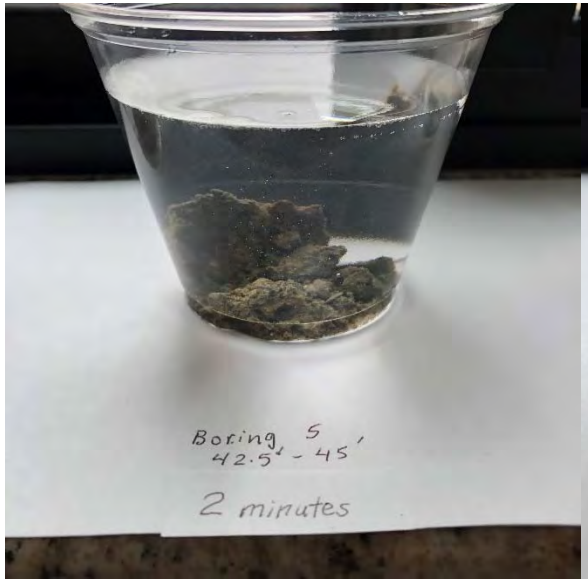
Time = 2 minutes Grade = 1

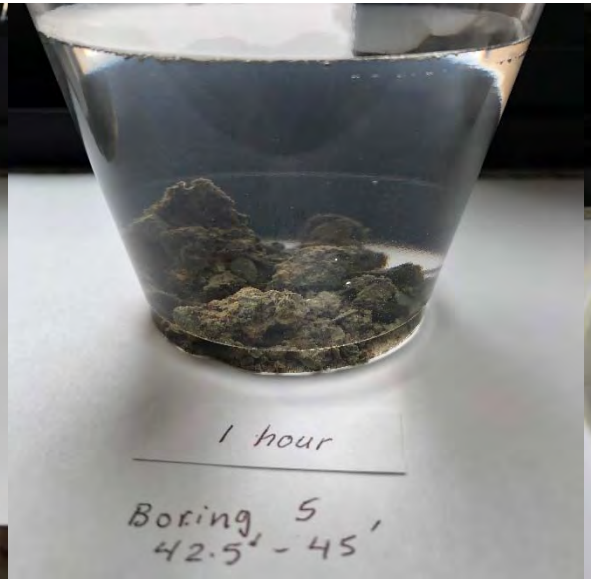


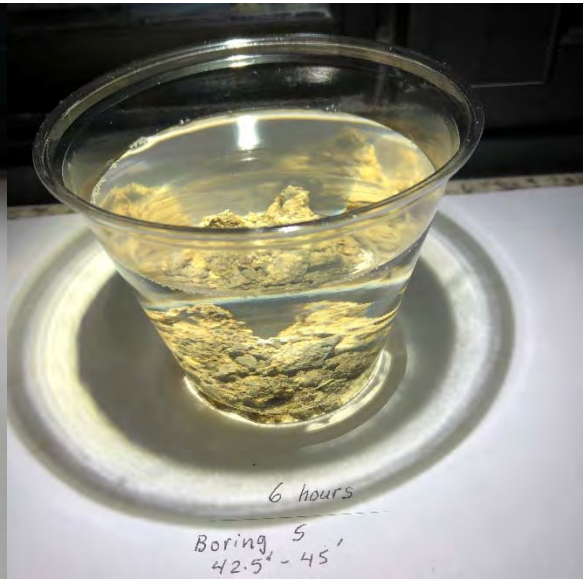
Time = 1 hour Grade = 1



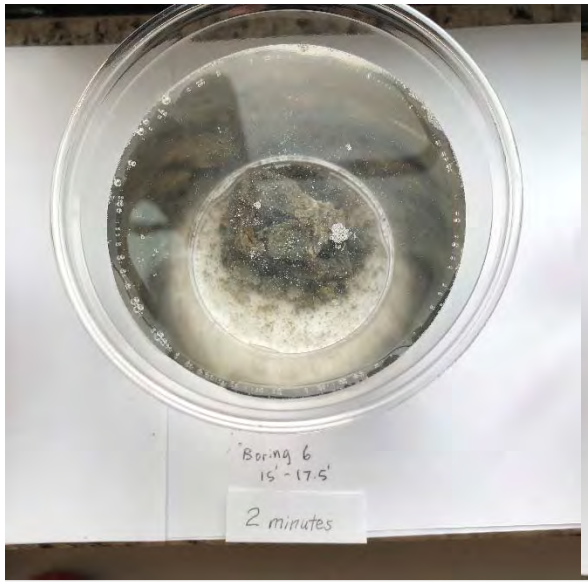
Time = 6 hours Grade = 1







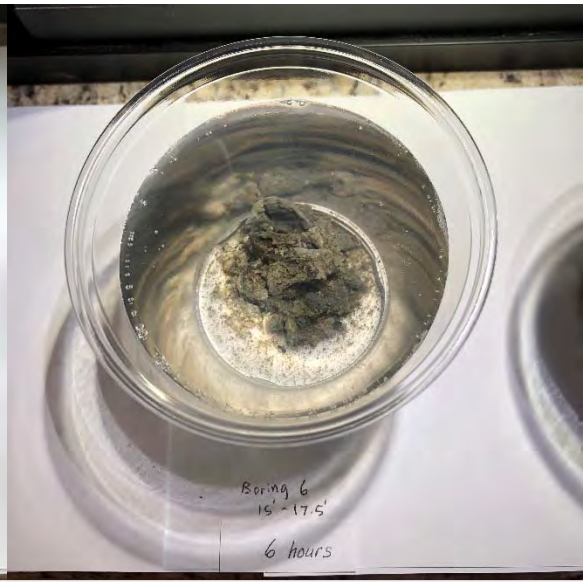
GF-6 15’ - 17.5’ Colluvium/Residual



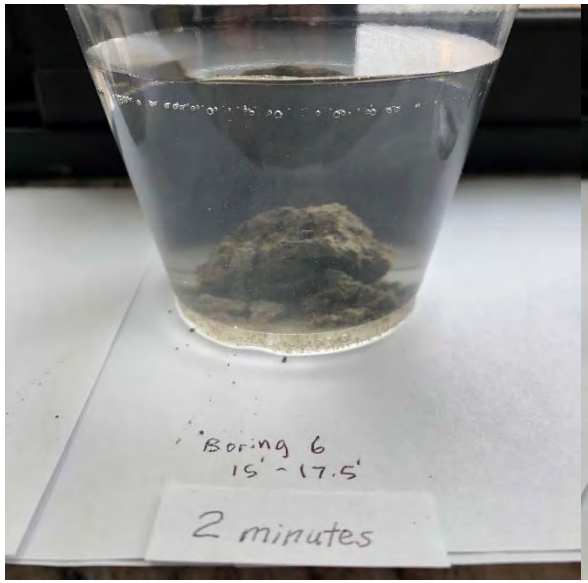
Time = 2 minutes Grade = 2

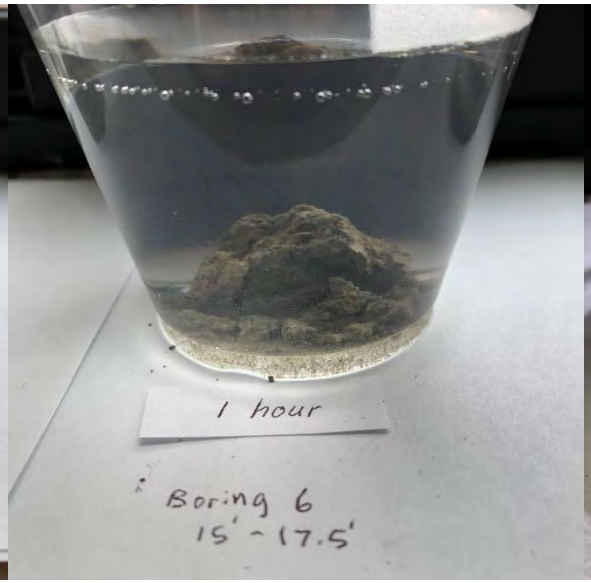


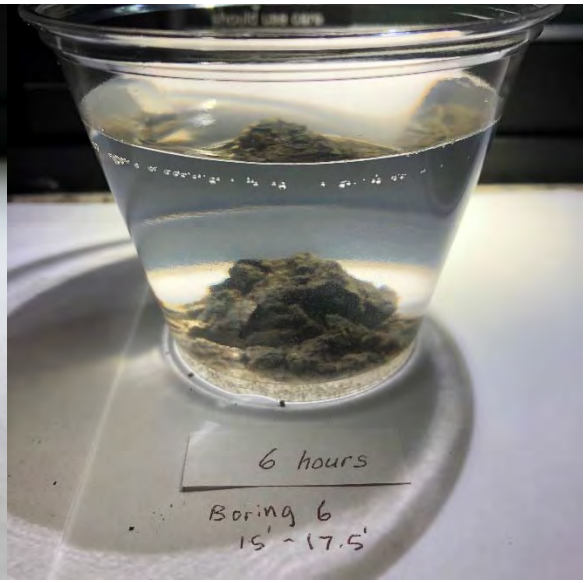
Time = 1 hour Grade = 1



Time = 6 hours Grade = 1



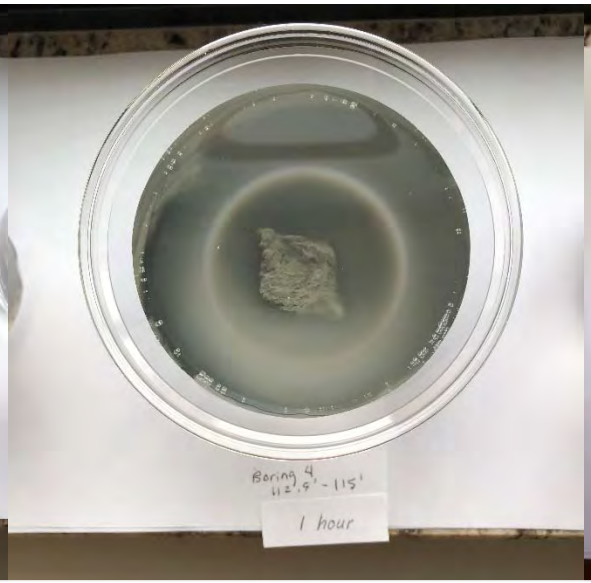




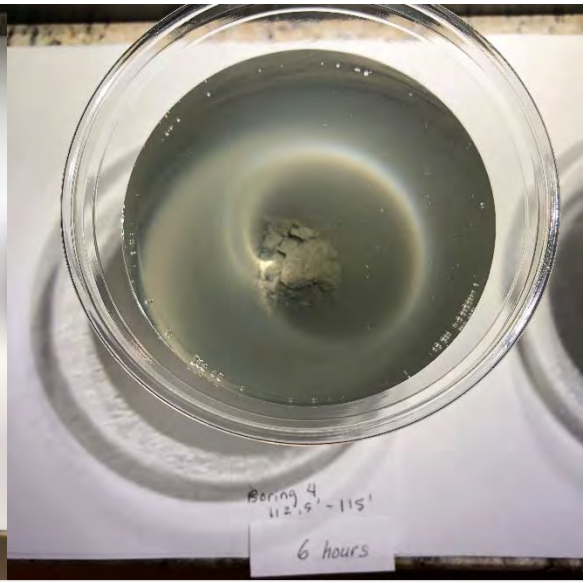
GF-4 112.5' - 115' Clay/Shale



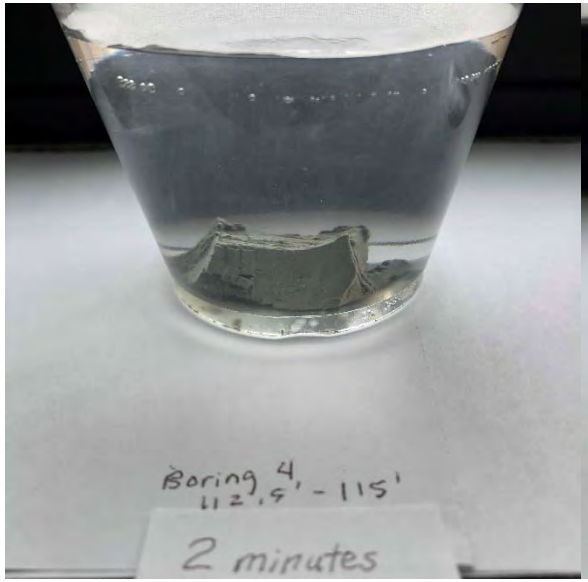
Time = 2 minutes Grade = 2

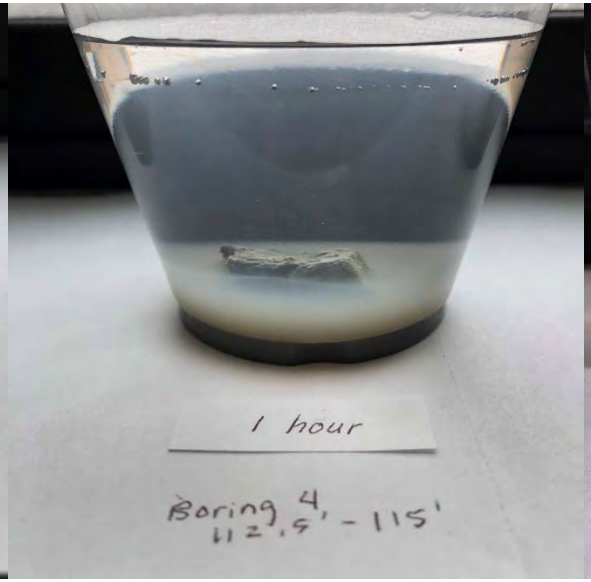


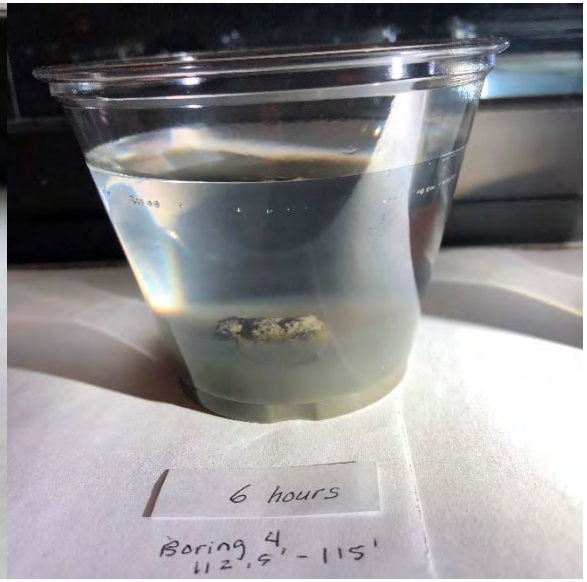
Time = 1 hour Grade = 4



Time = 6 hours Grade = 4







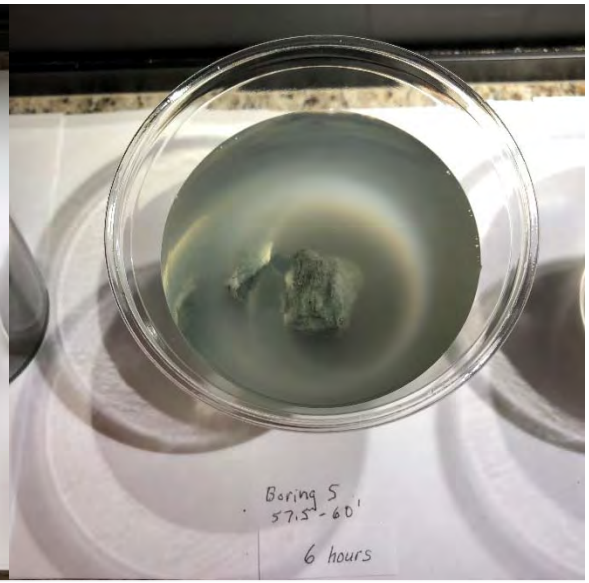
GF-5 57.5’ - 60’ Clay/Shale



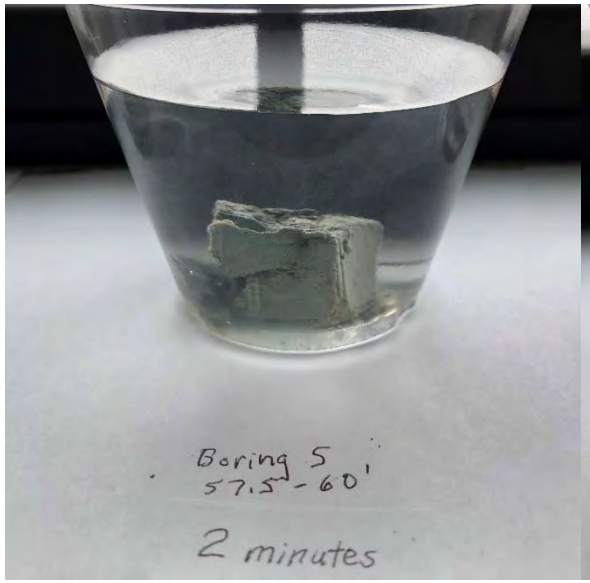
Time = 2 minutes Grade = 2

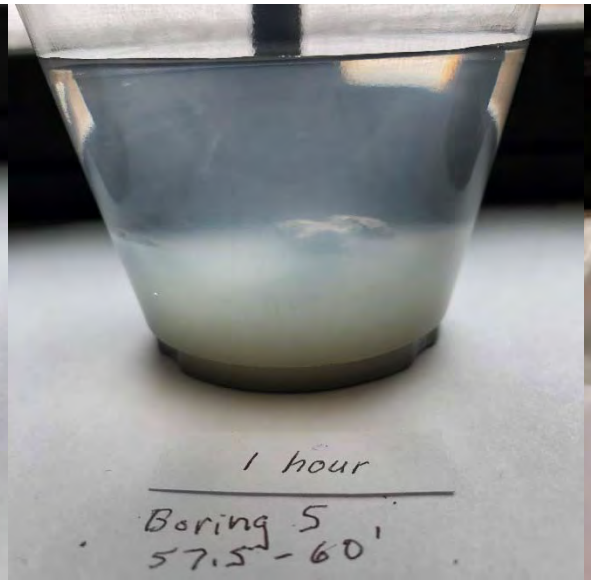


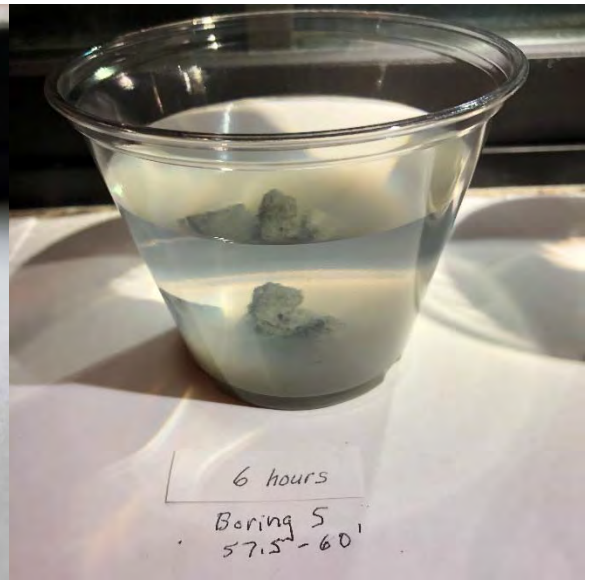
Time = 1 hour Grade = 4



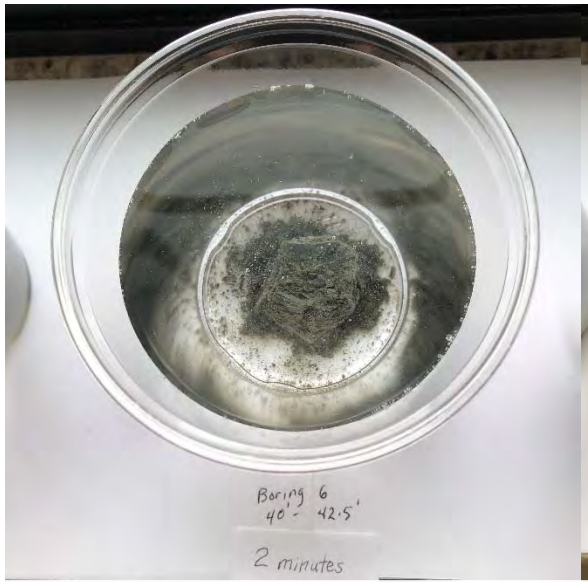
Time = 6 hours Grade = 4







GF-6 40' - 42.5' Clay/Shale



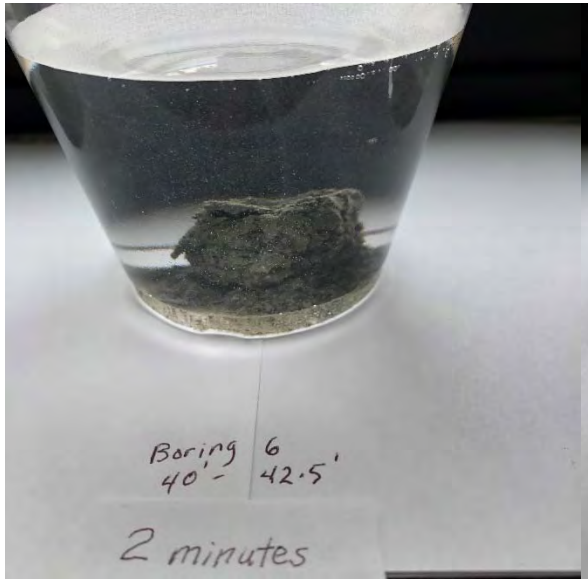
Time = 2 minutes Grade = 1

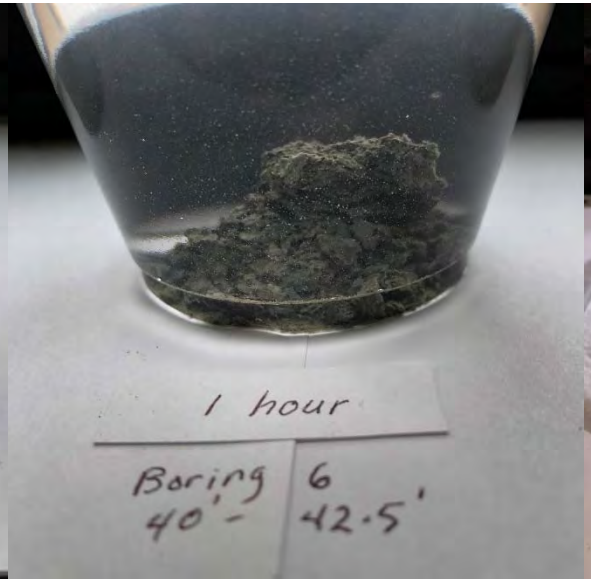


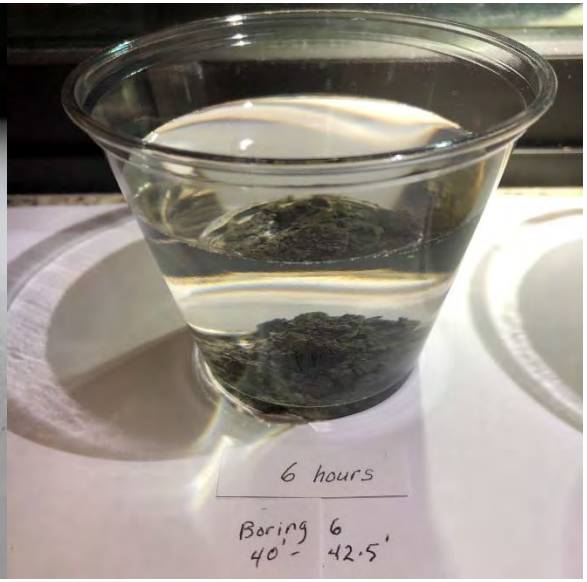
Time = 1 hour Grade = 1



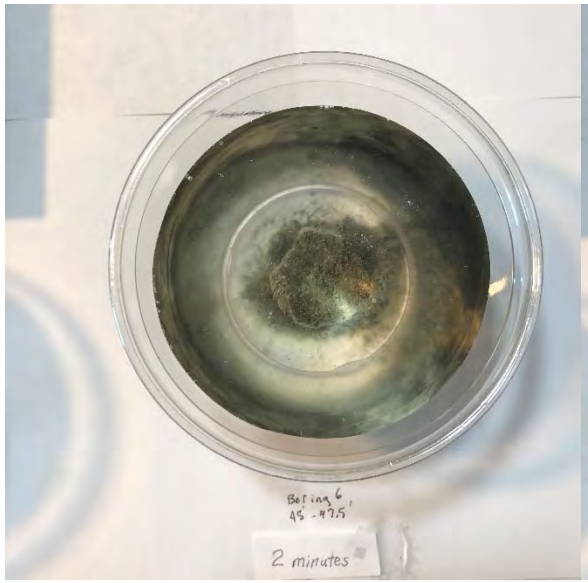
Time = 6 hours Grade = 1



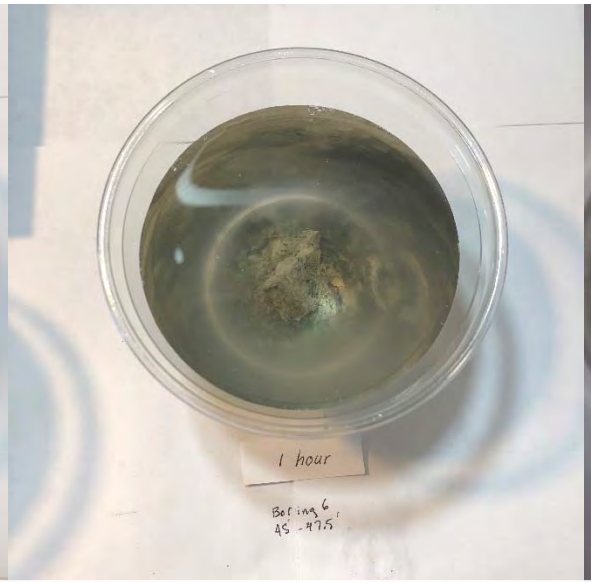




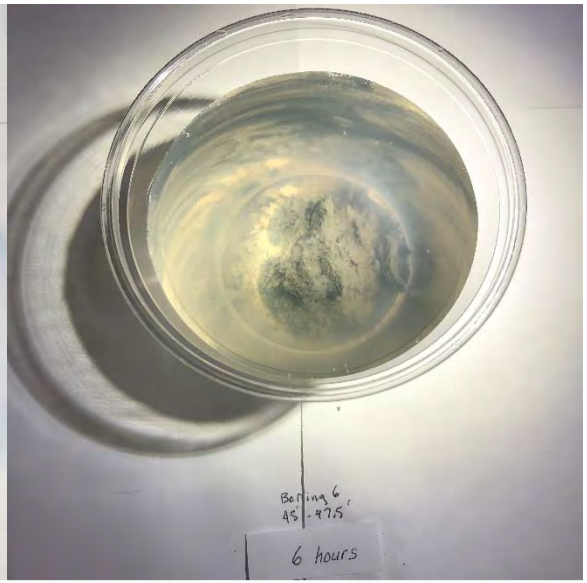
GF-6 45' - 47.5' Clay/Shale



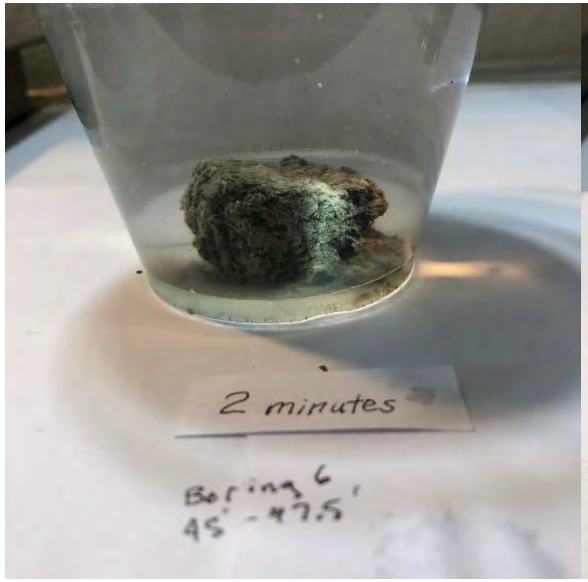
Time = 2 minutes Grade = 1

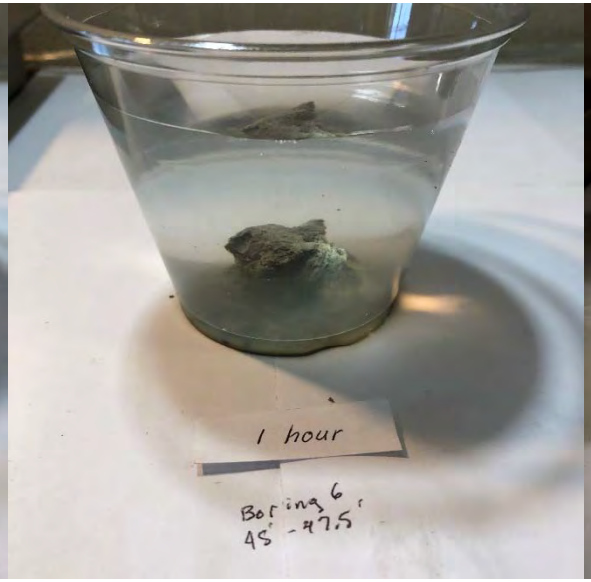


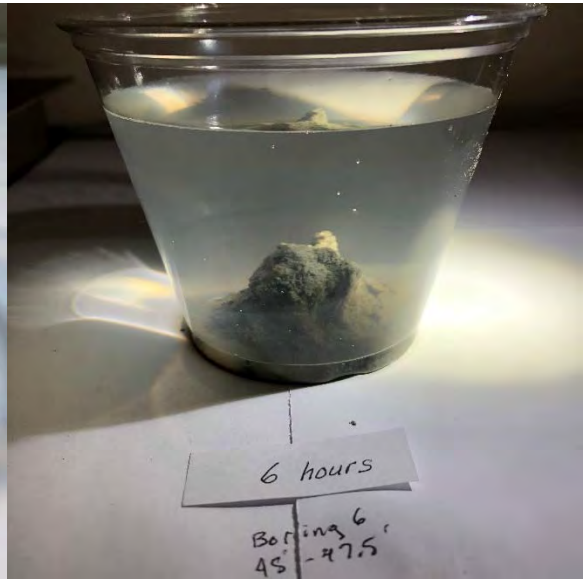
Time = 1 hour Grade = 3



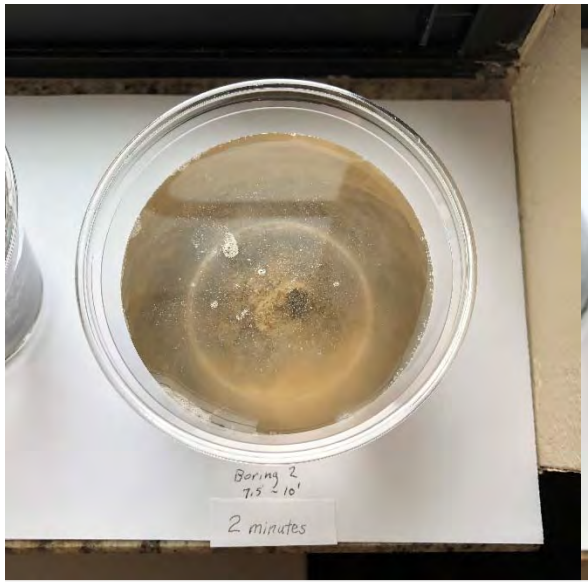
Time = 6 hours Grade = 3



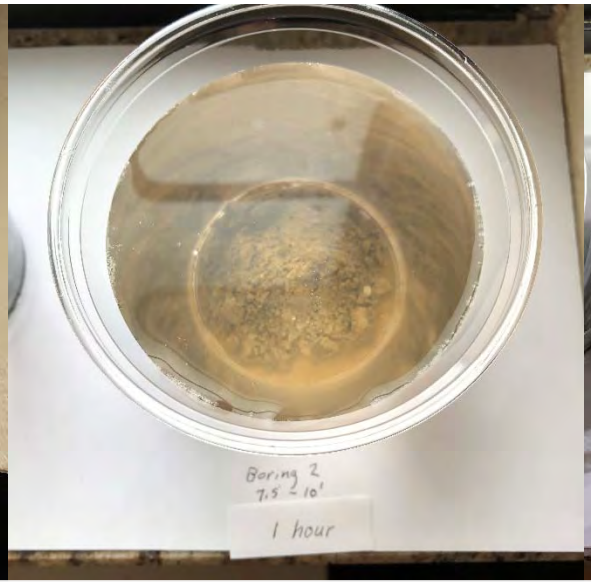




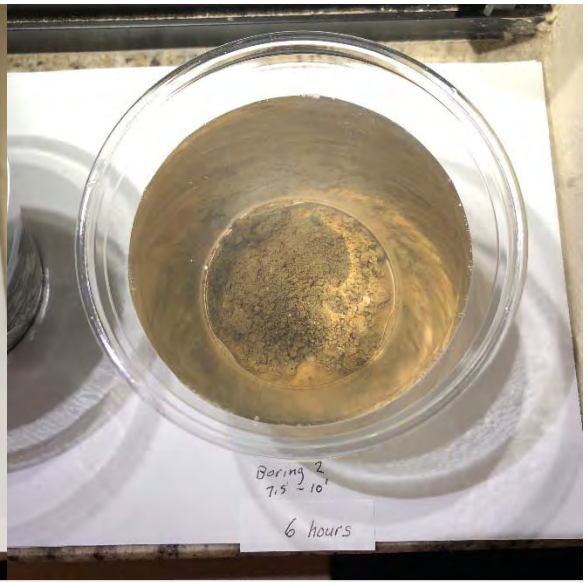
GF-2 7.5’ - 10’ (1) Outwash



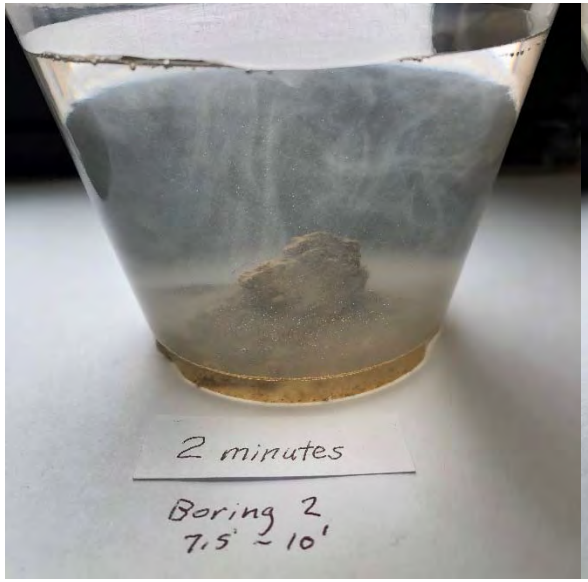
Time = 2 minutes Grade = 4

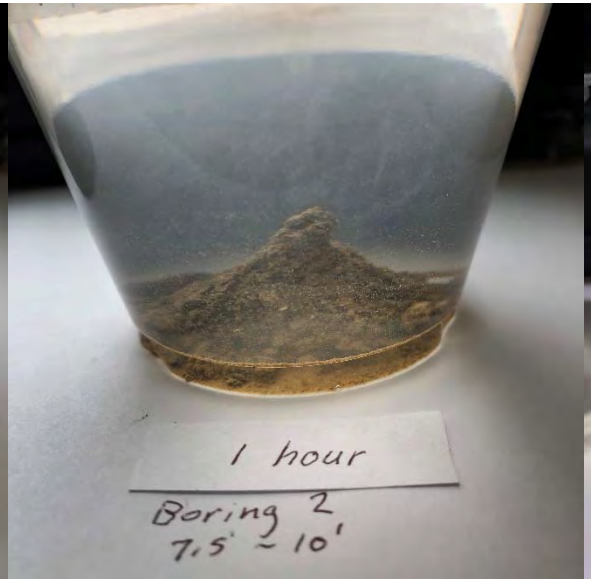


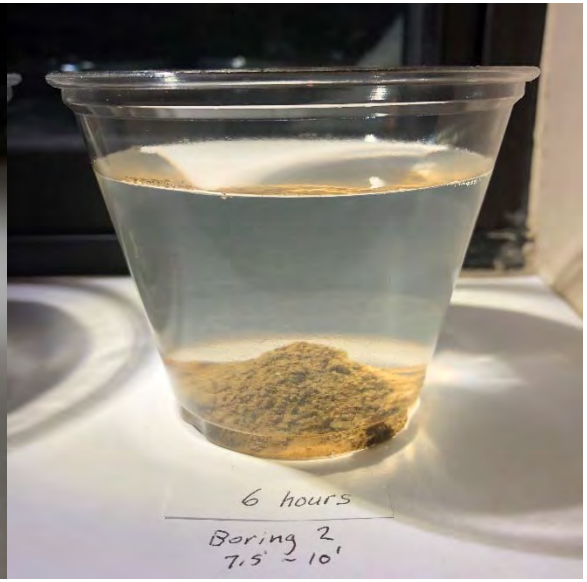
Time = 1 hour Grade = 3



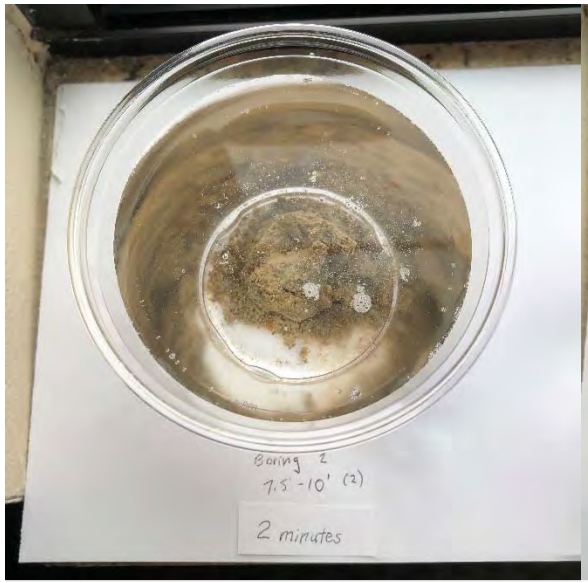
Time = 6 hours Grade = 3



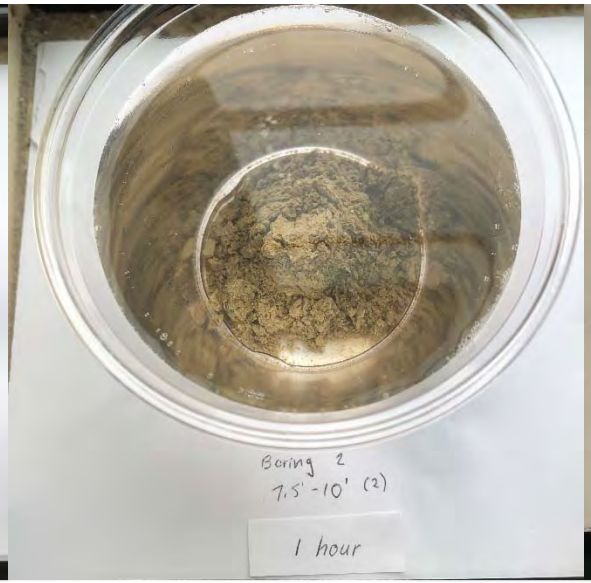




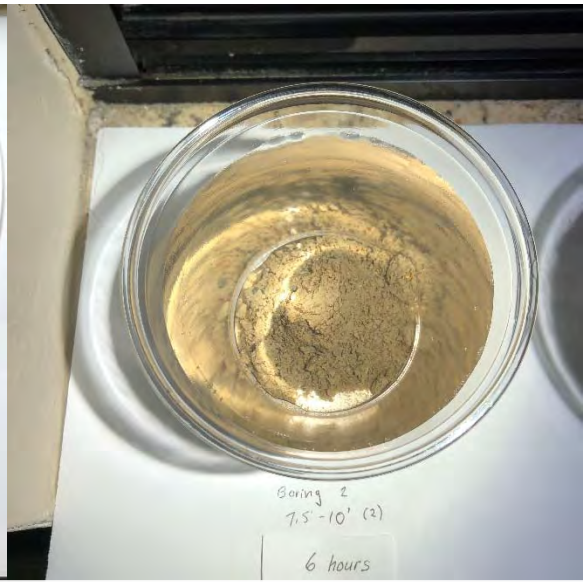
GF-2 7.5’ - 10’ (2) Outwash



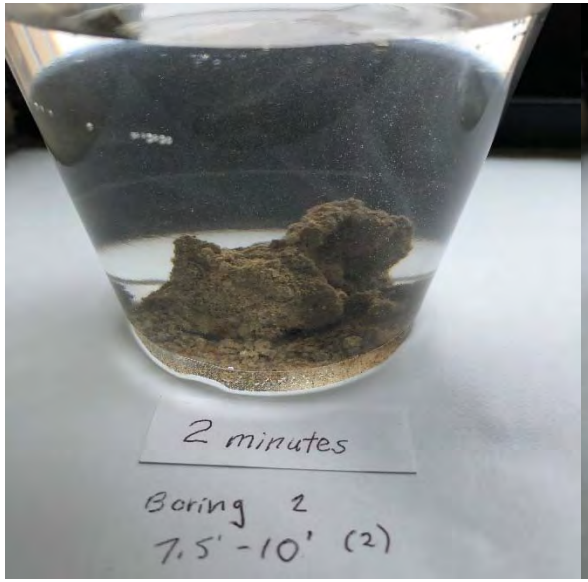
Time = 2 minutes Grade = 1

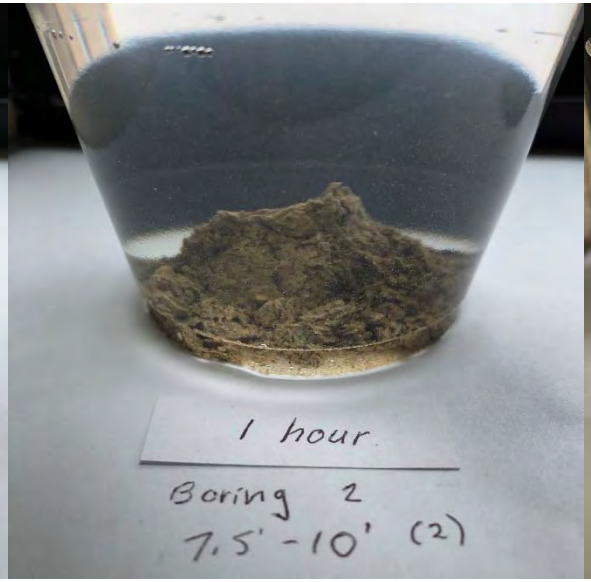


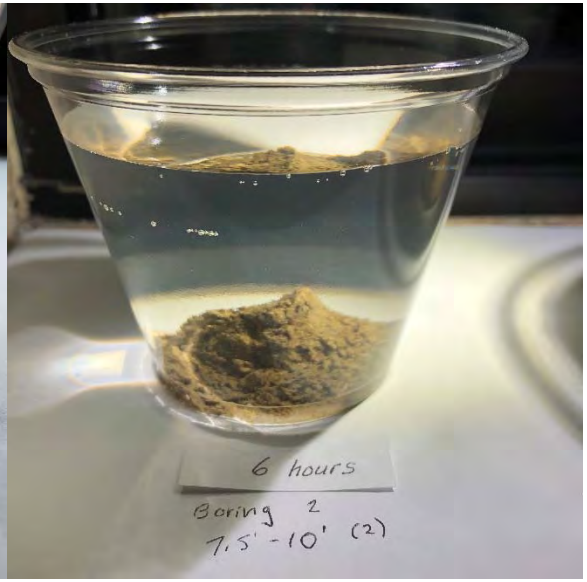
Time = 1 hour Grade = 1



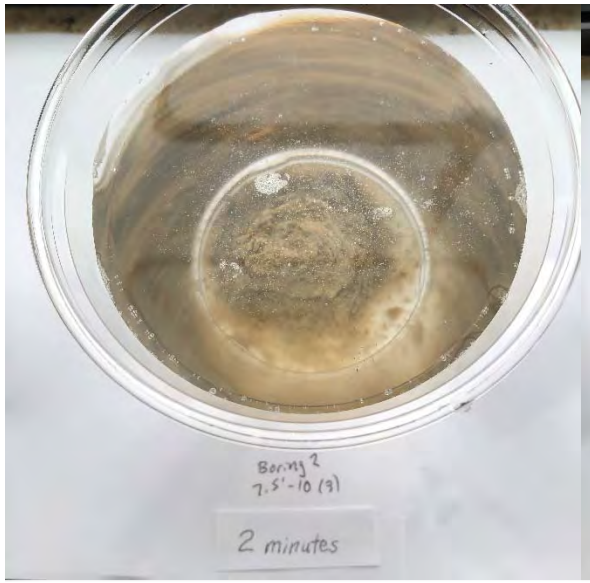
Time = 6 hours Grade = 1



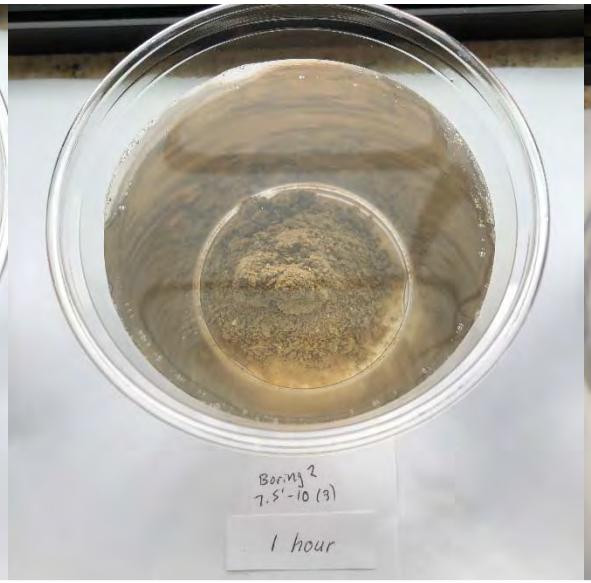




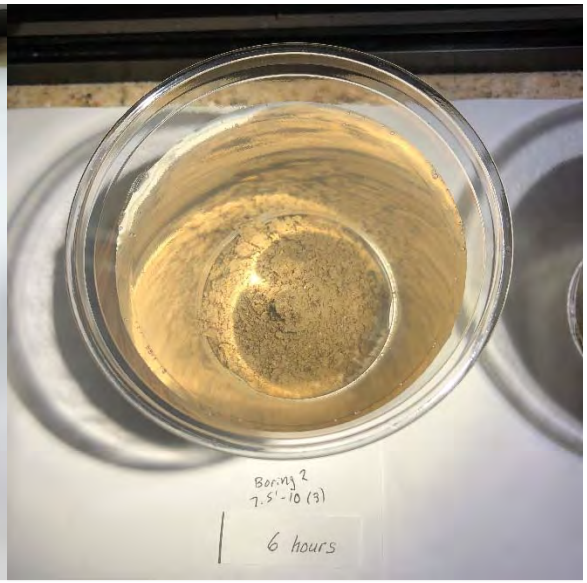
GF-2 7.5’ - 10’ (3) Outwash



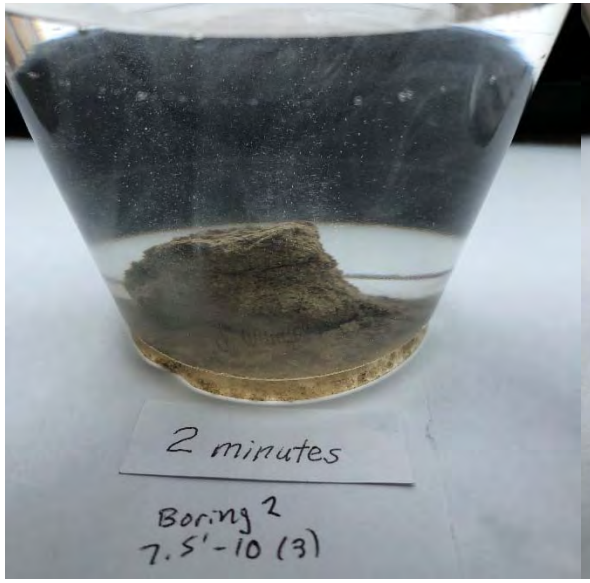
Time = 2 minutes Grade = 2

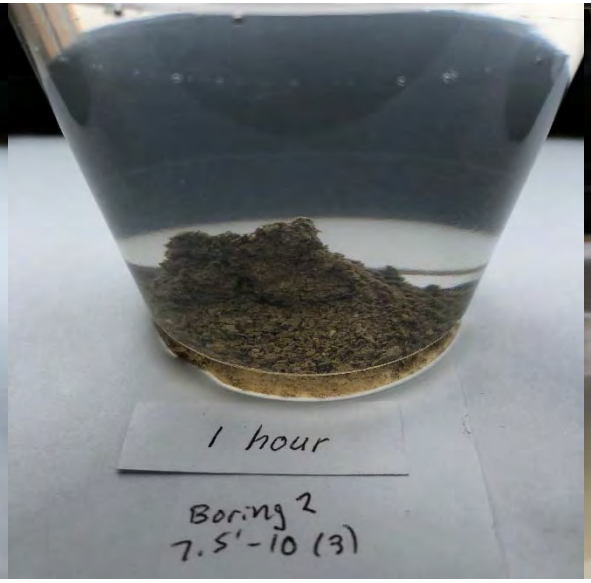


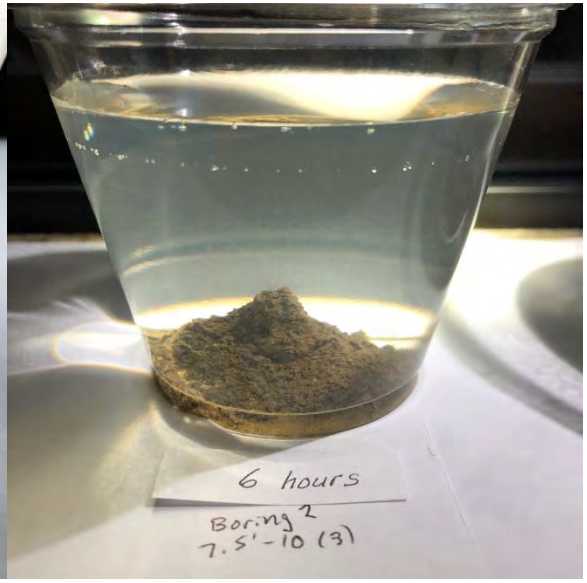
Time = 1 hour Grade = 1



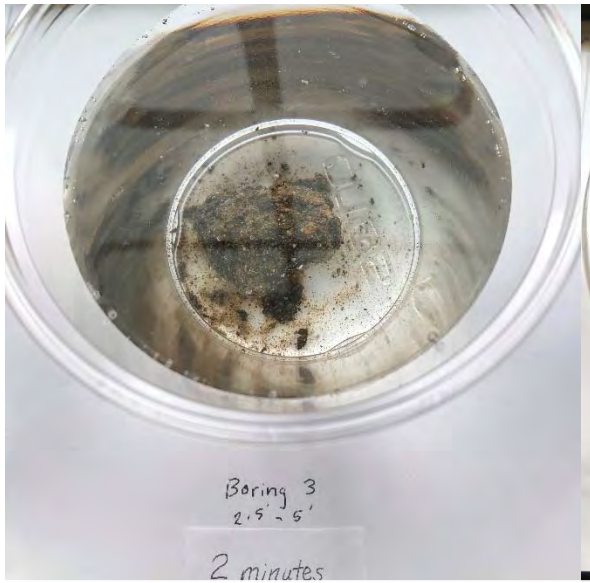
Time = 6 hours Grade = 2



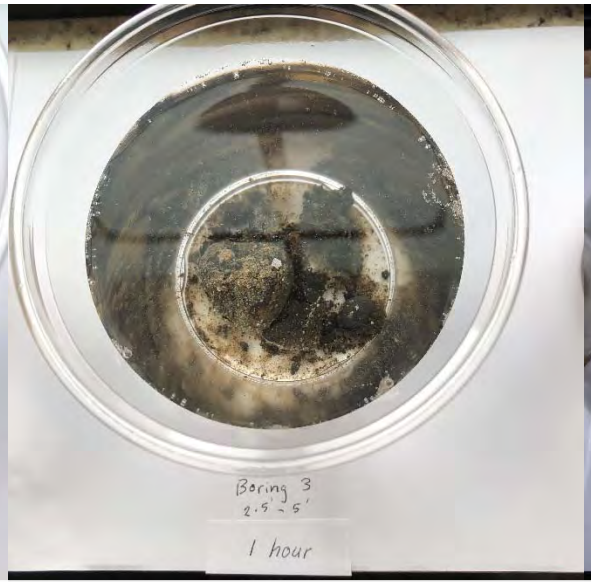




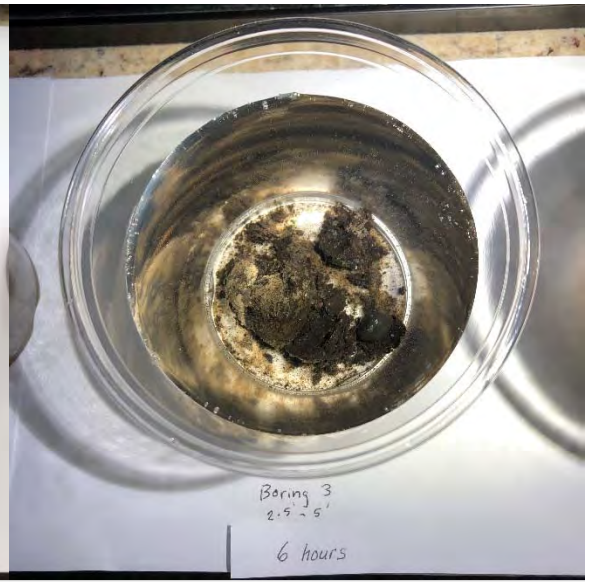
GF-3 2.5' - 5' Outwash



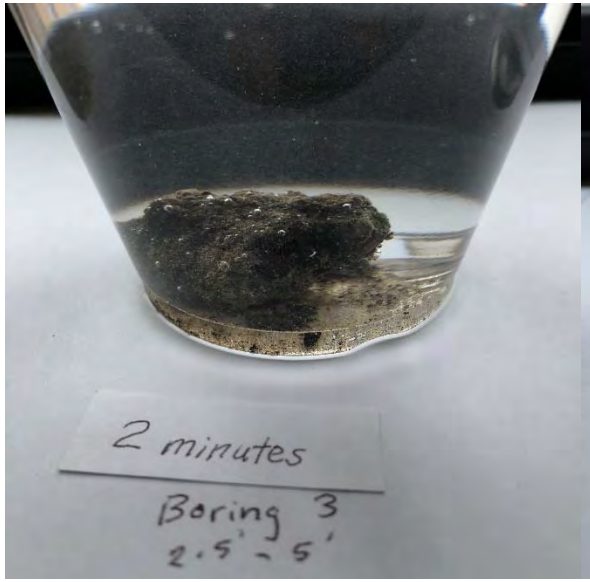
Time = 2 minutes Grade = 1

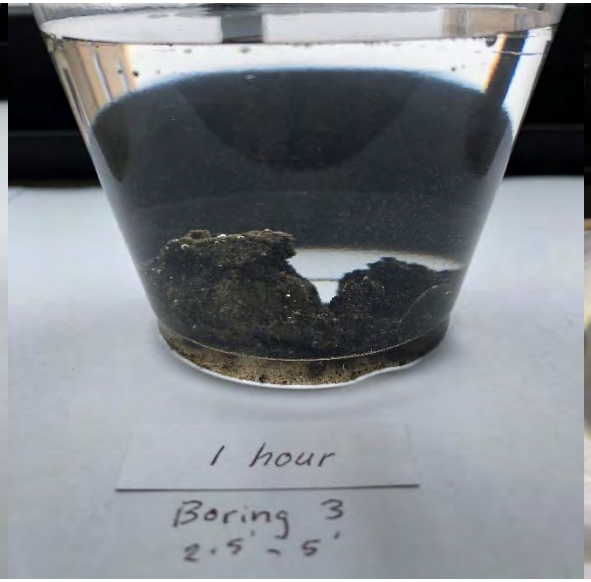


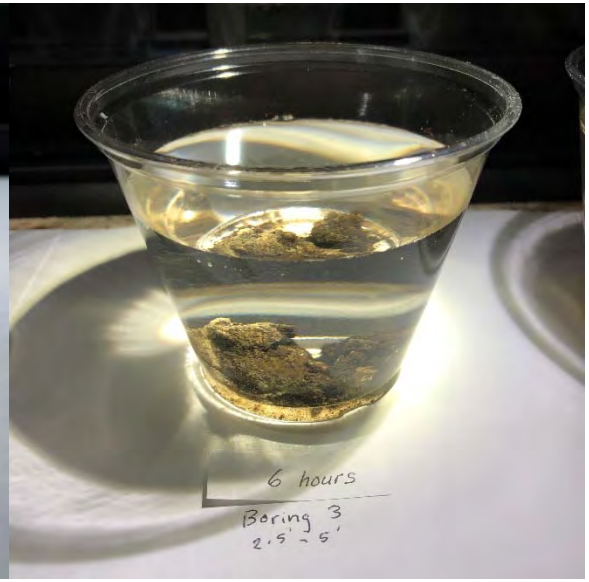
Time = 1 hour Grade = 1



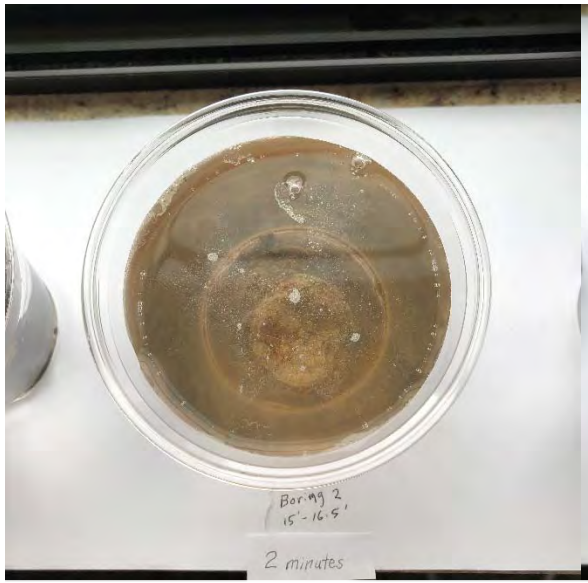
Time = 6 hours Grade = 1



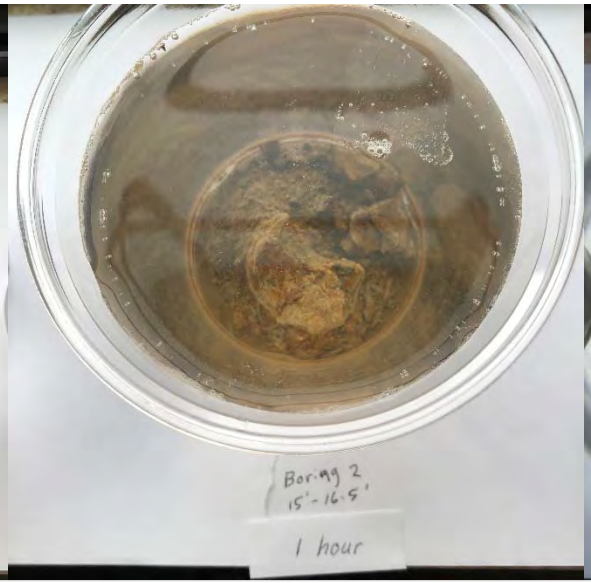




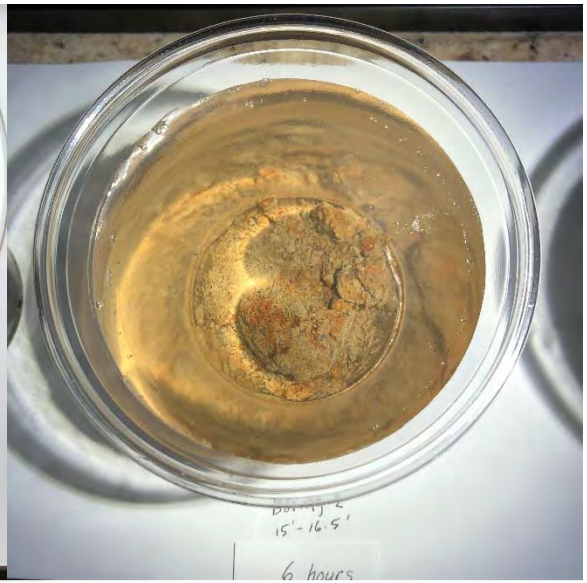
GF-2 15’ - 16.5’ Brown Oxidized Till



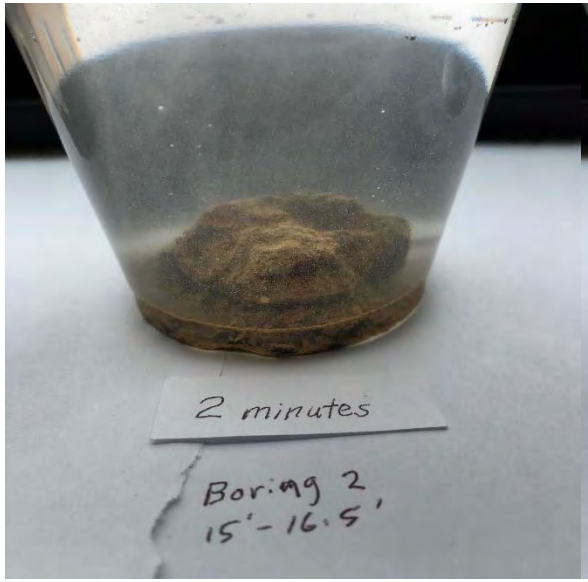
Time = 2 minutes Grade = 2

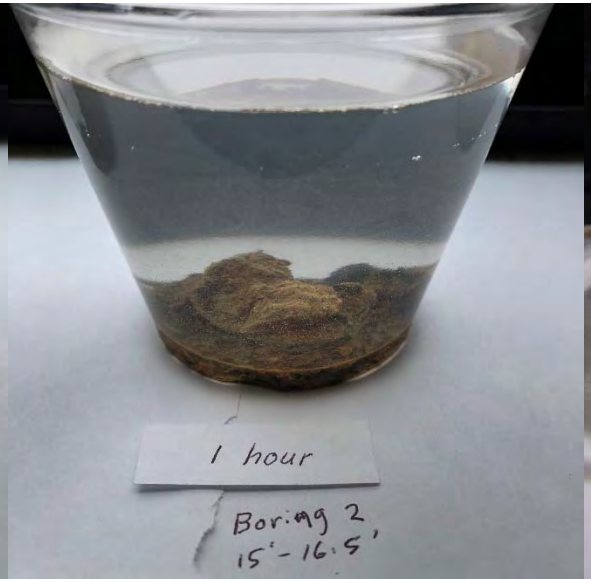


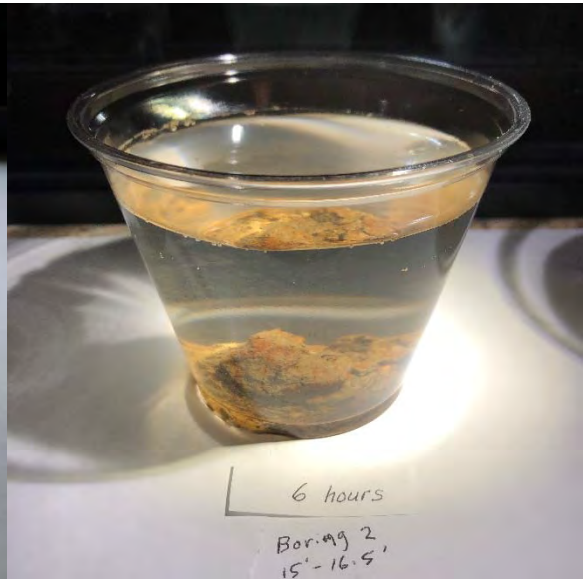
Time = 1 hour Grade = 2



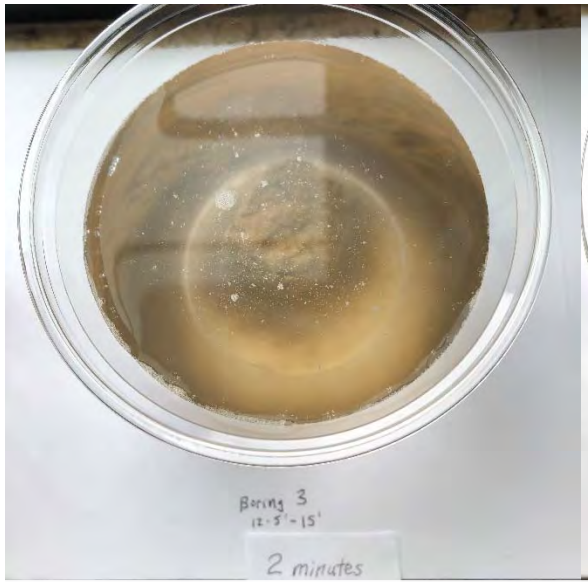
Time = 6 hours Grade = 2



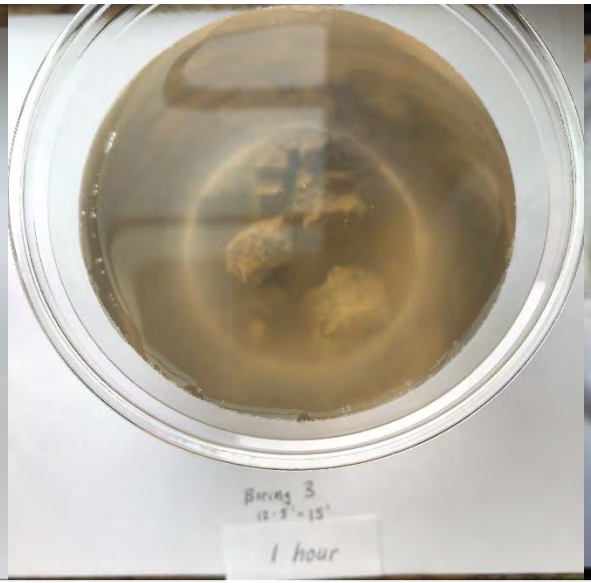




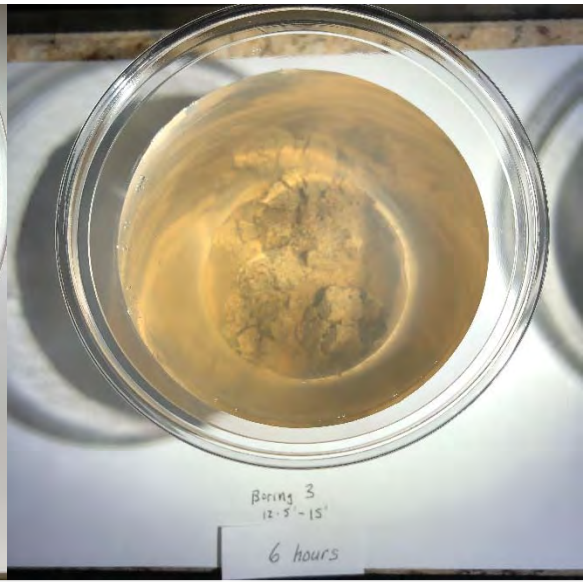
GF-3 12.5’ - 15’ Brown Oxidized Till



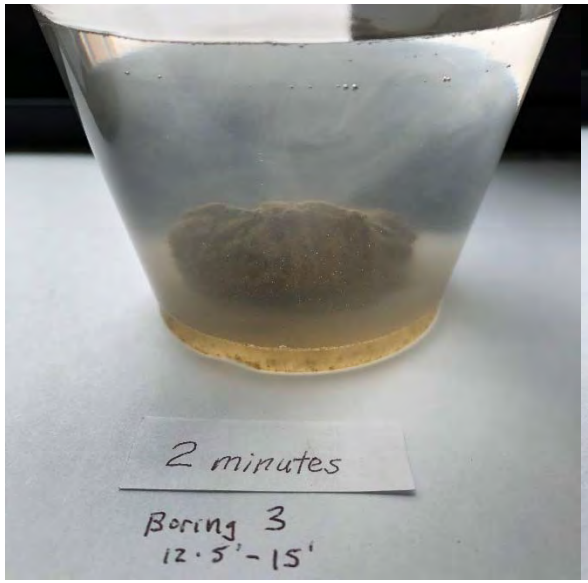
Time = 2 minutes Grade = 3

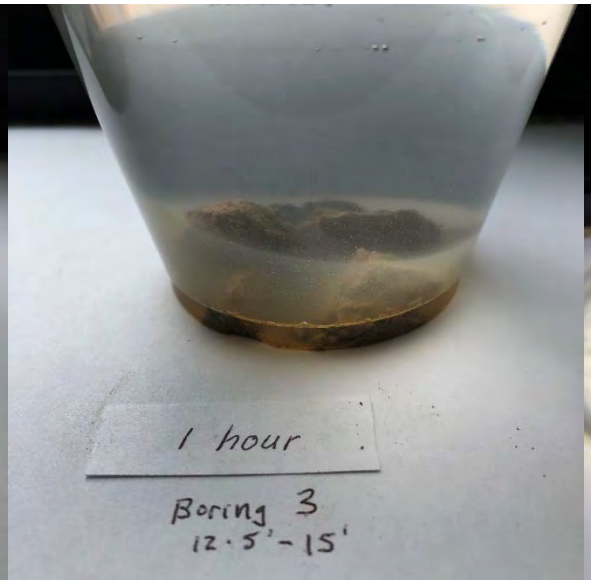


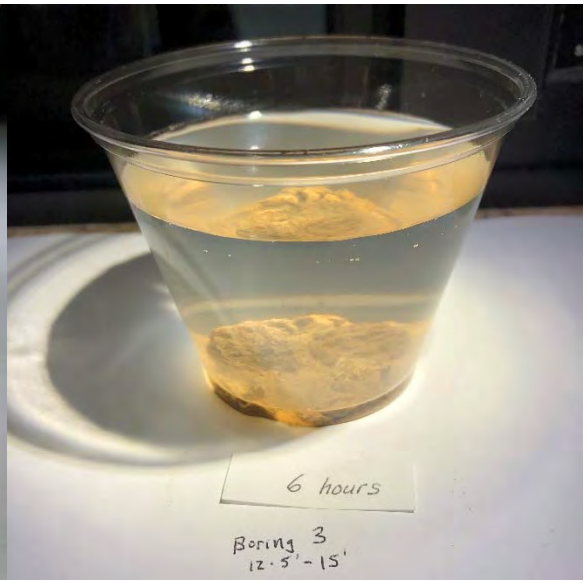
Time = 1 hour Grade = 3



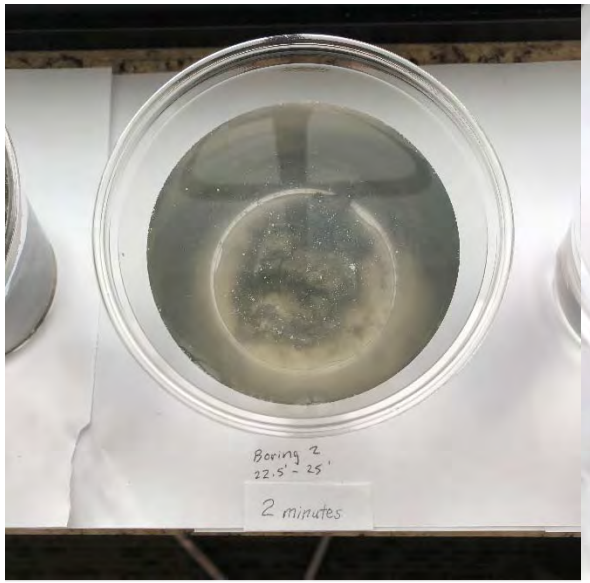
Time = 6 hours Grade = 3







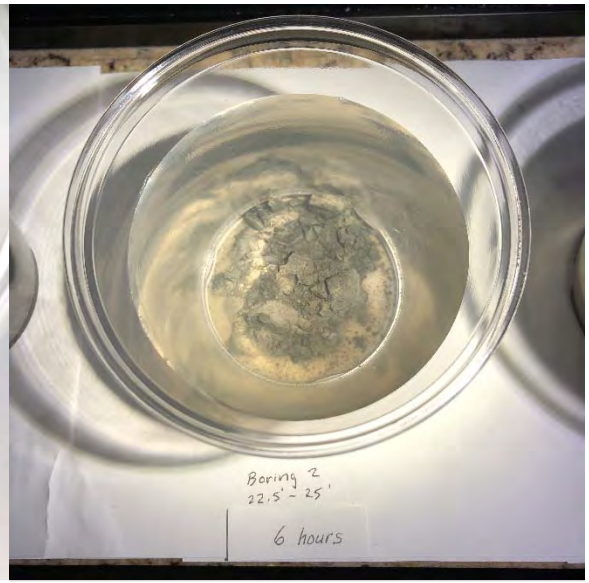
GF-2 22.5' - 25' Till



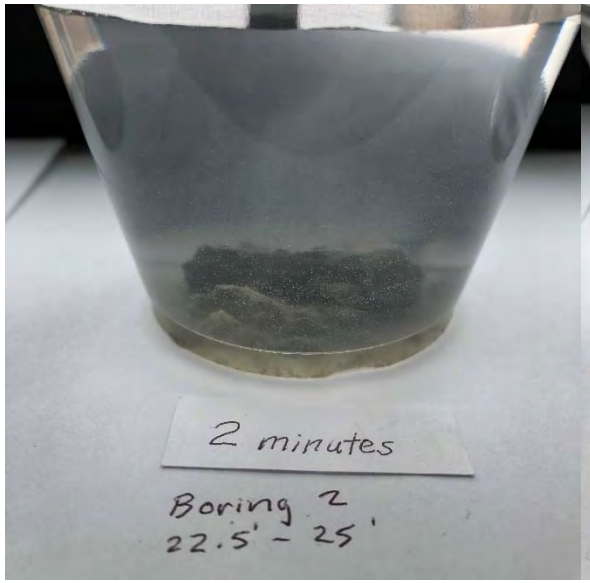
Time = 2 minutes Grade = 2

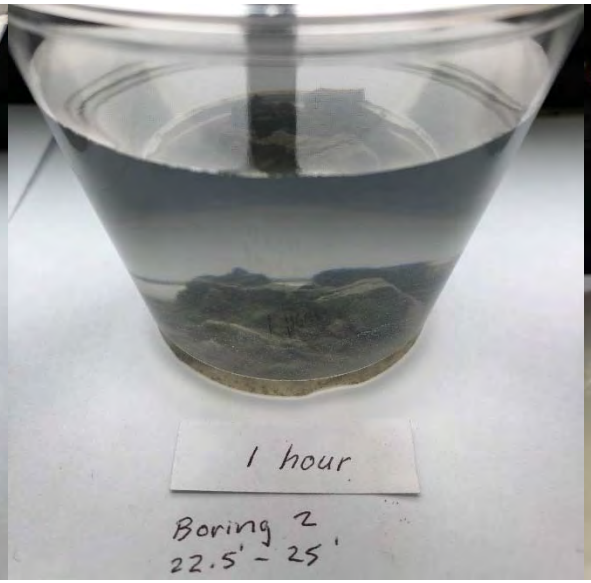


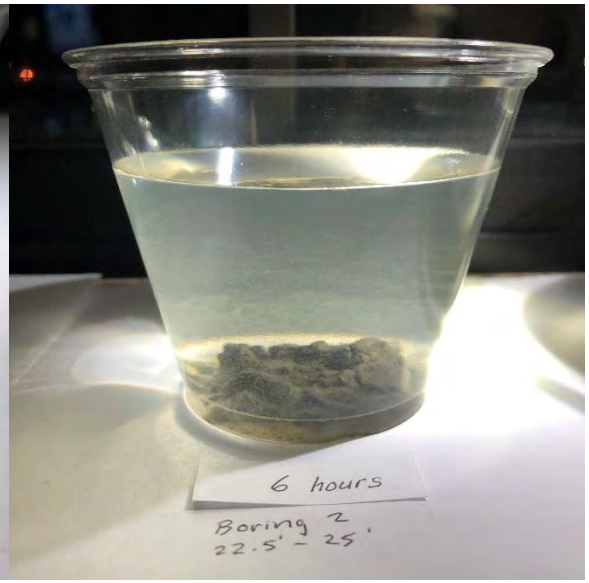
Time = 1 hour Grade = 2



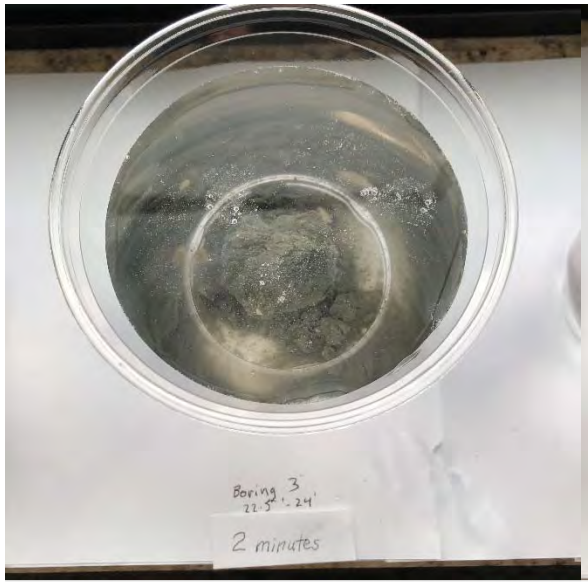
Time = 6 hours Grade = 3



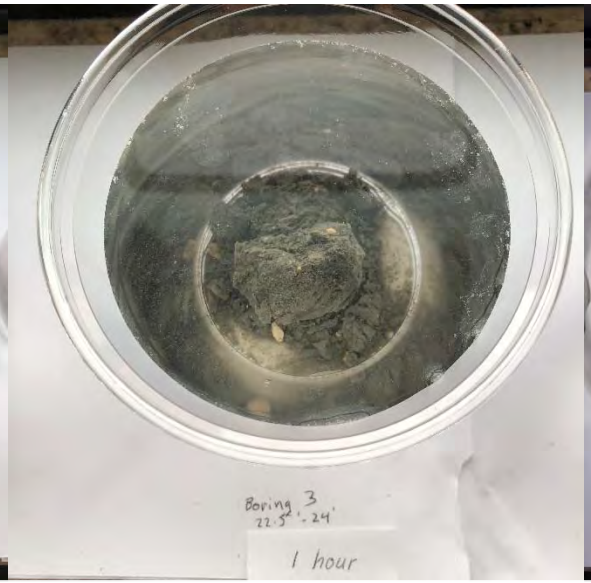




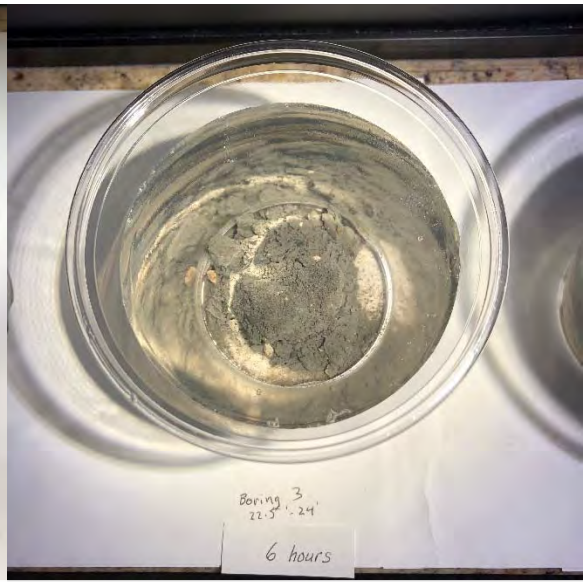
GF-2 22.5' - 24' Till



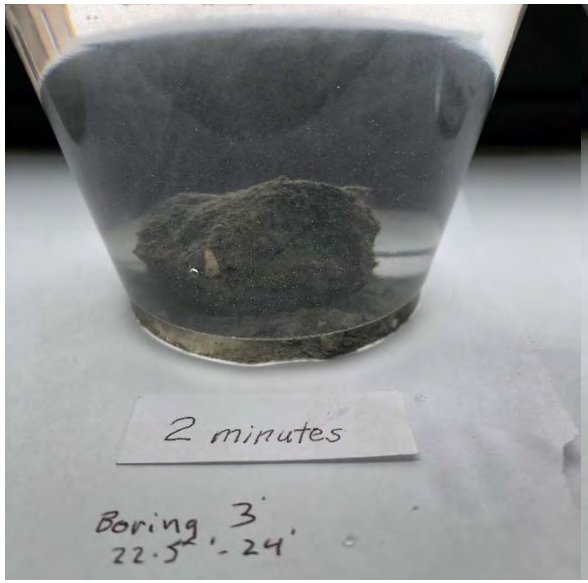
Time = 2 minutes Grade = 1

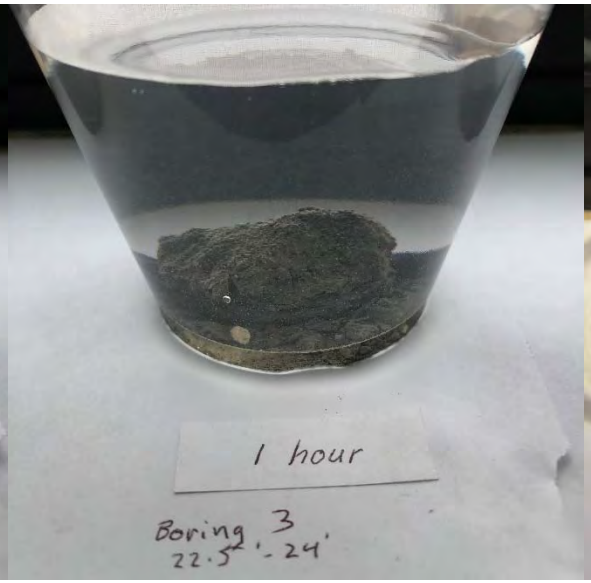


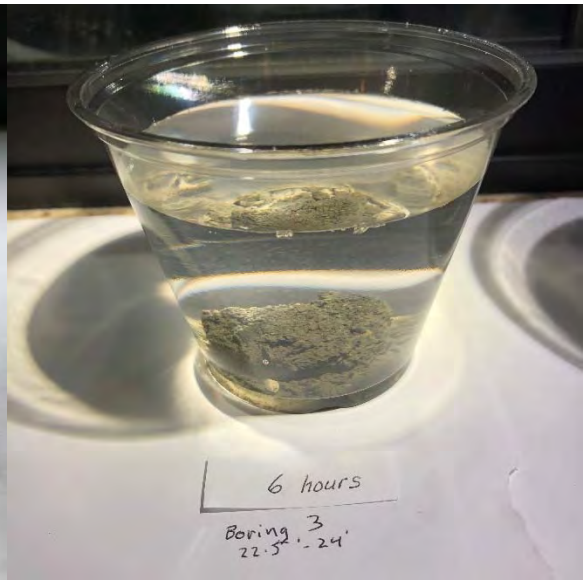
Time = 1 hour Grade = 1



Time = 6 hours Grade = 1



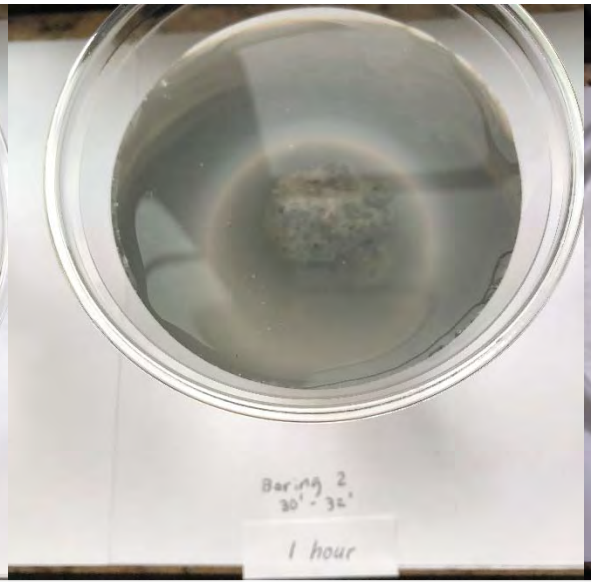




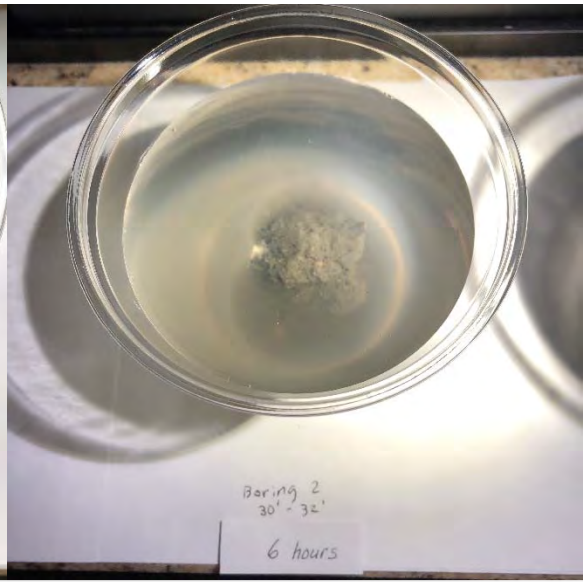
GF-2 30’ - 32’ Till



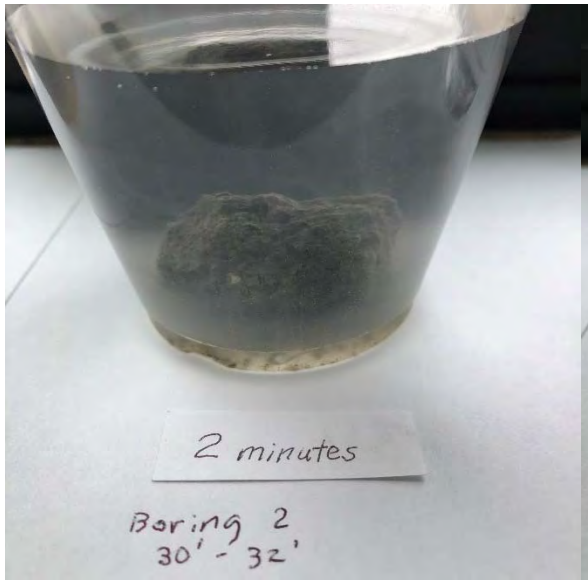
Time = 2 minutes Grade = 2

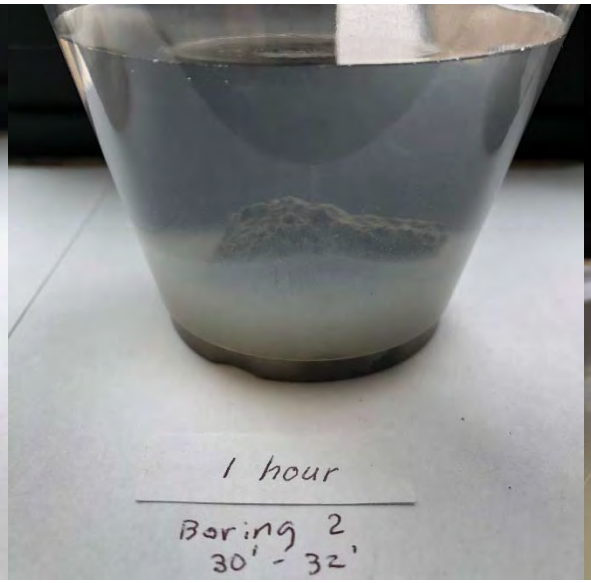


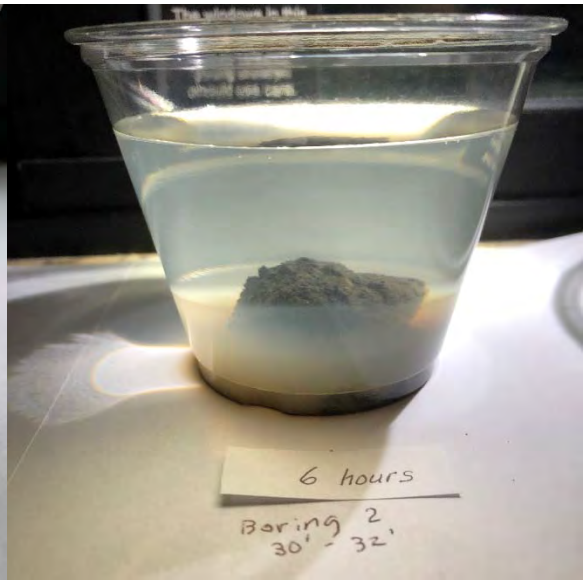
Time = 1 hour Grade = 4



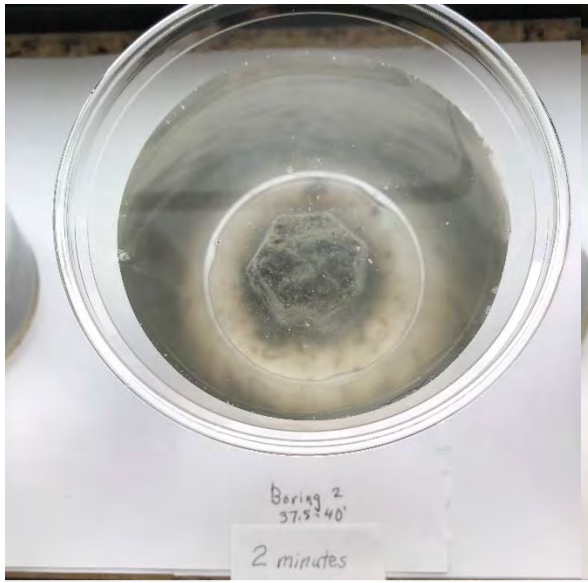
Time = 6 hours Grade = 4



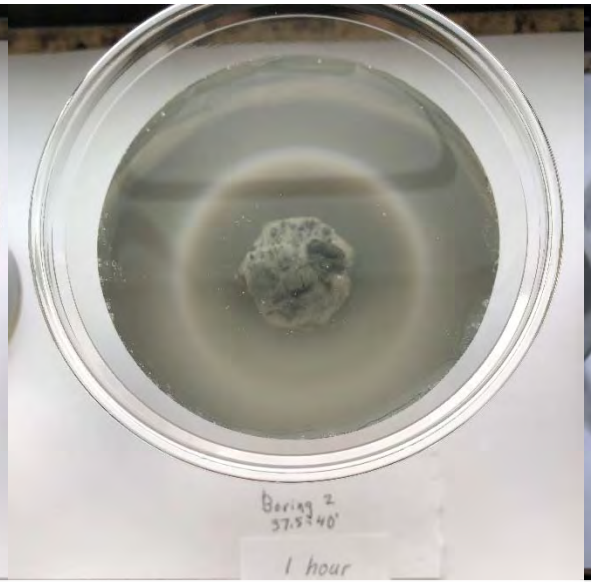




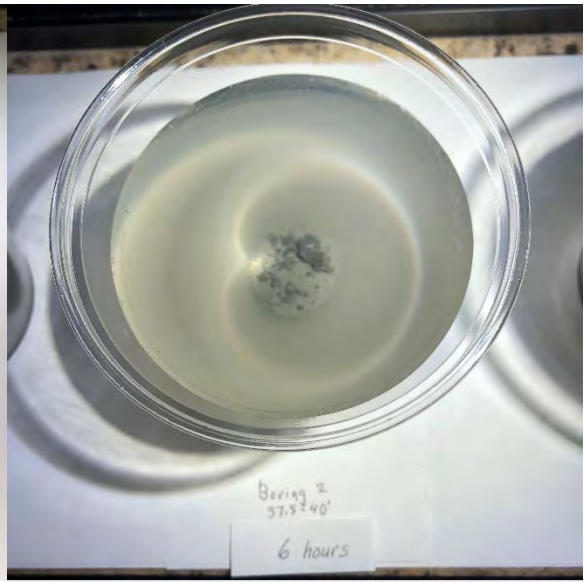
GF-2 37.5’ - 40’ Till



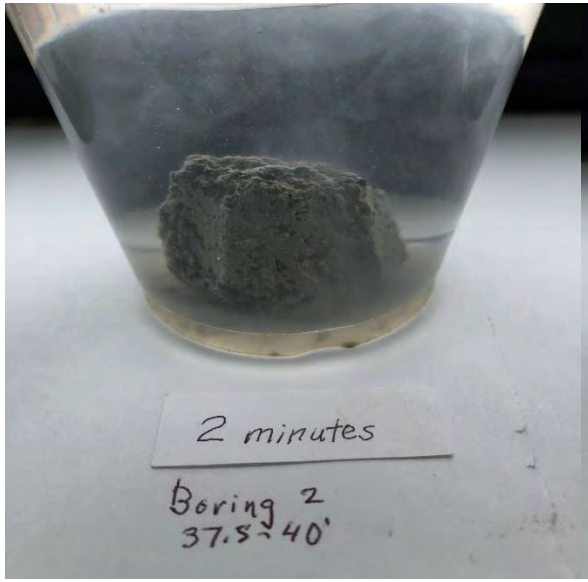
Time = 2 minutes Grade = 2

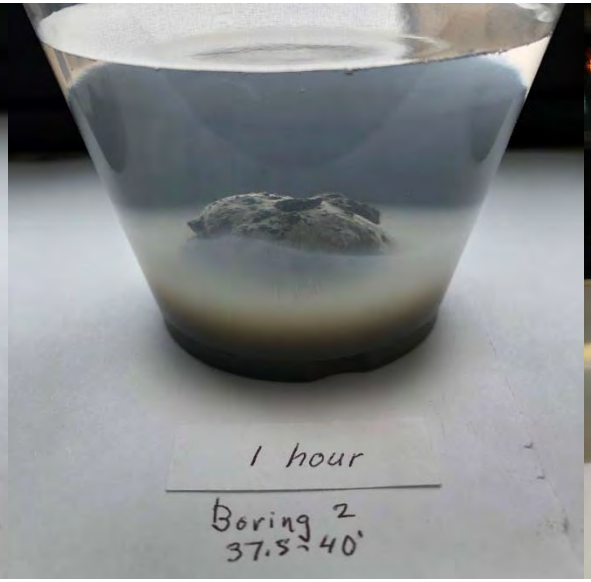


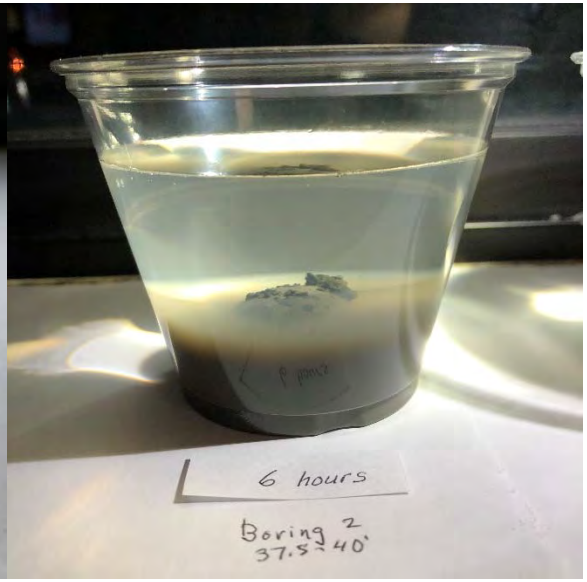
Time = 1 hour Grade = 4



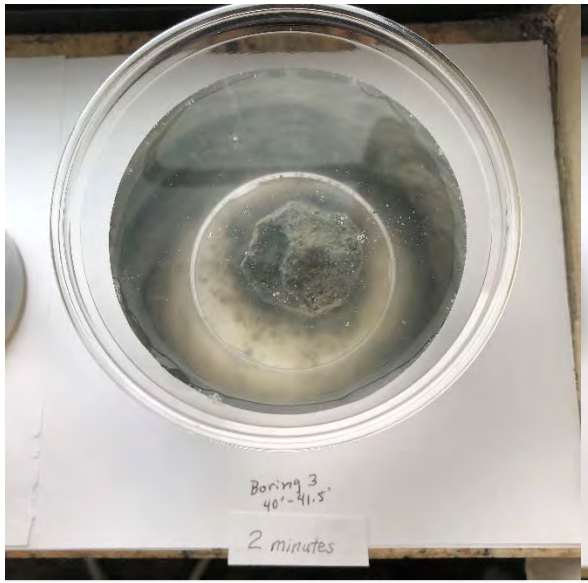
Time = 6 hours Grade = 4



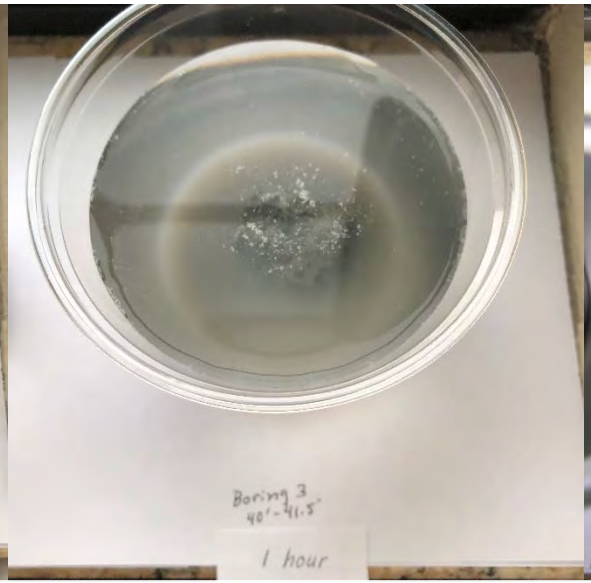




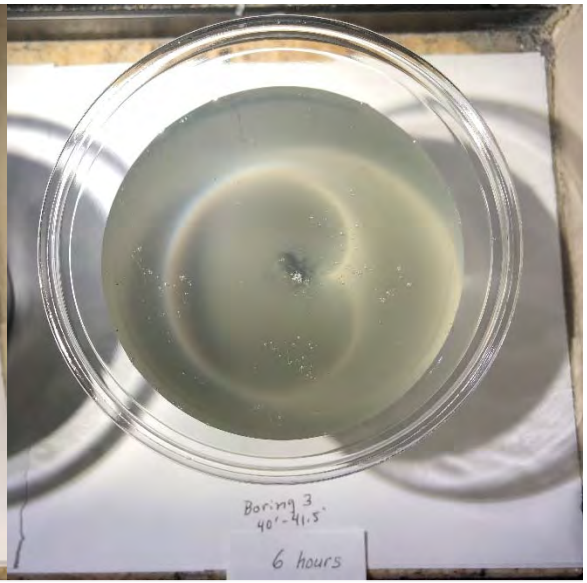
GF-3 40’ - 41.5’ Till



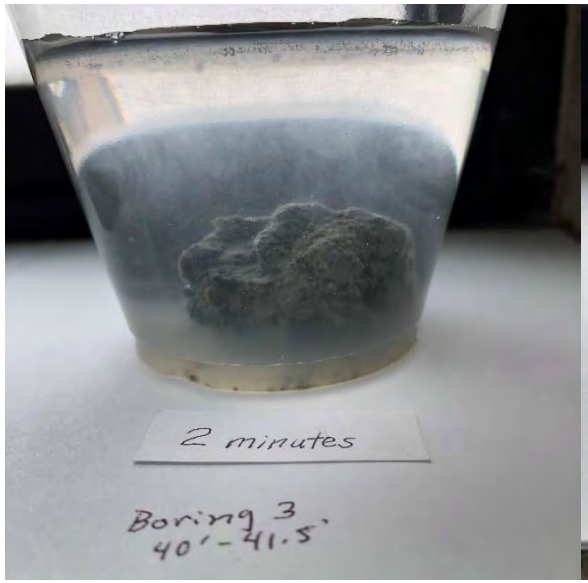
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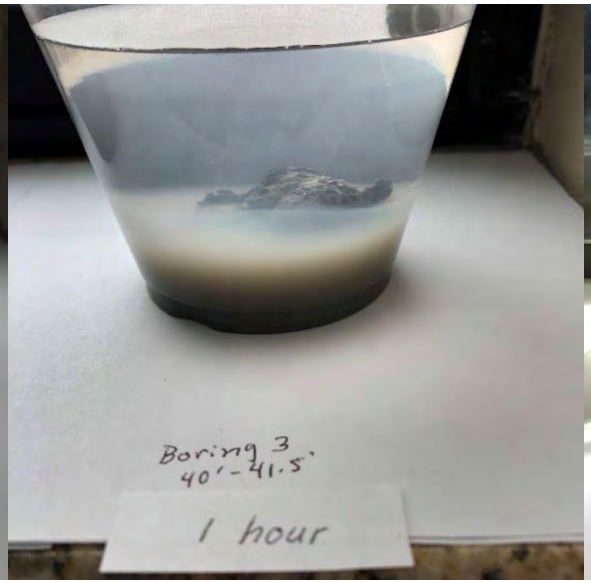


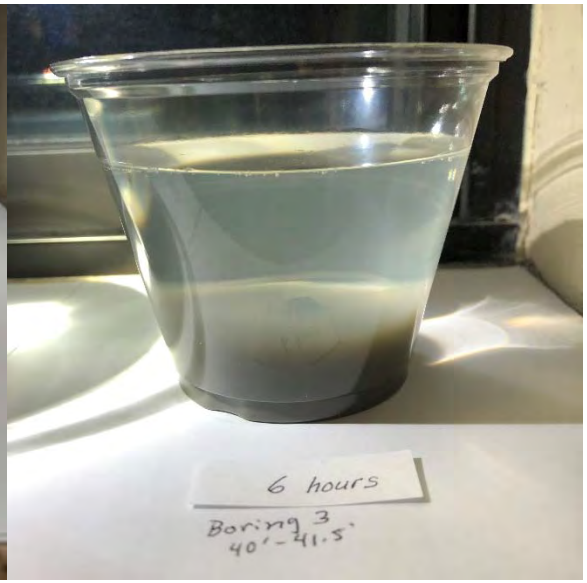
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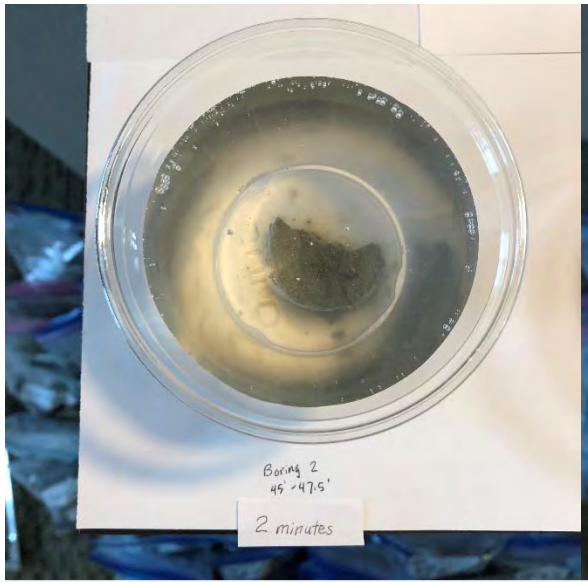
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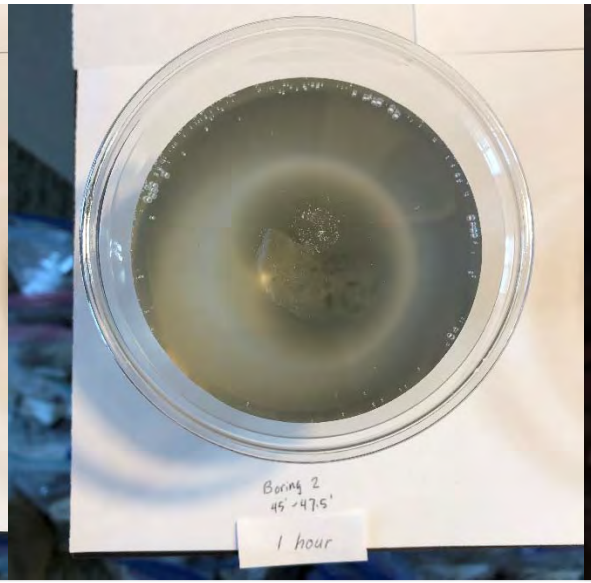




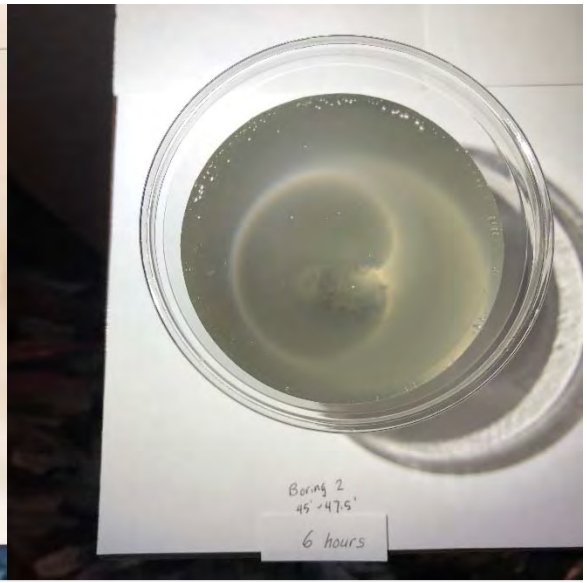
GF-2 45' - 47.5' Clay/Shale



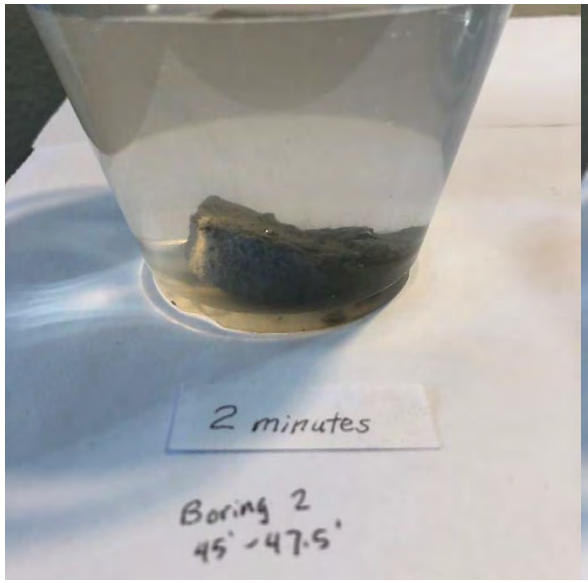
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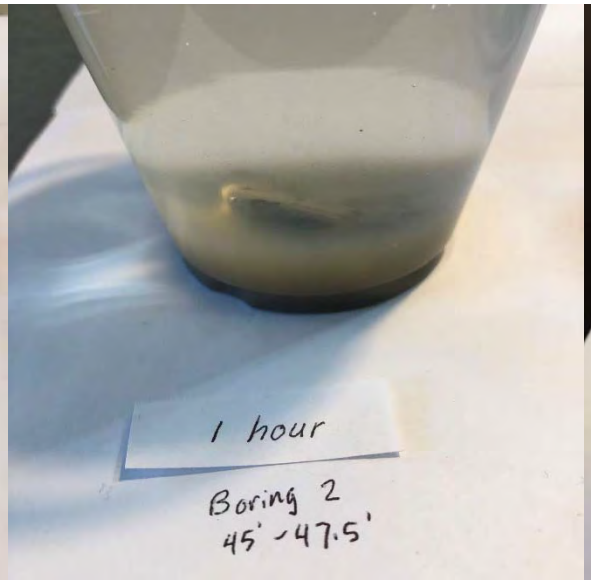


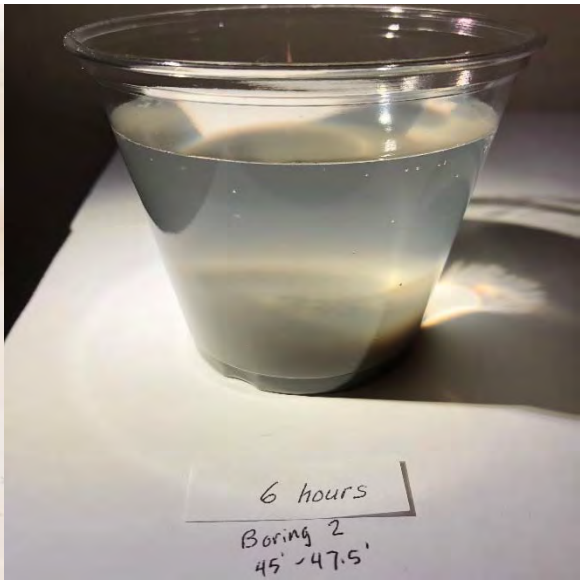
Time = 1 hour Grade = 4



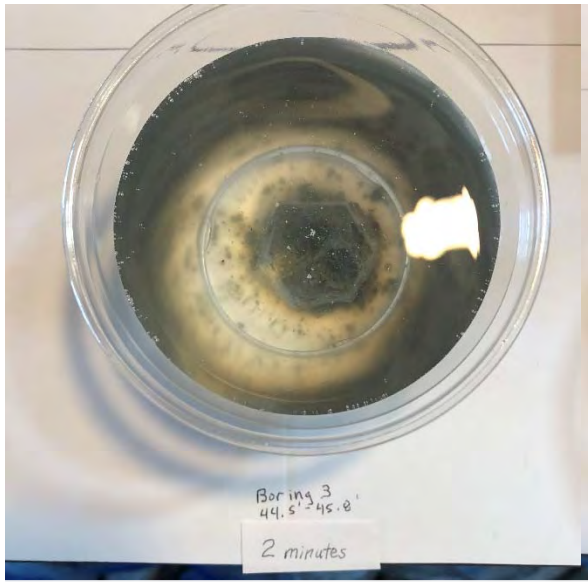
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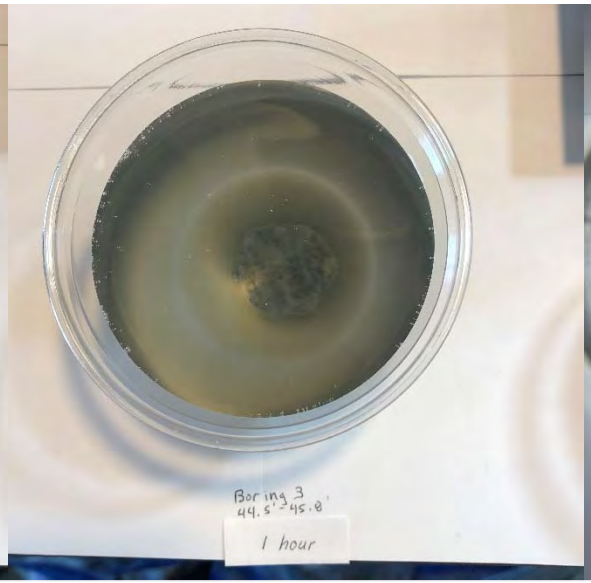




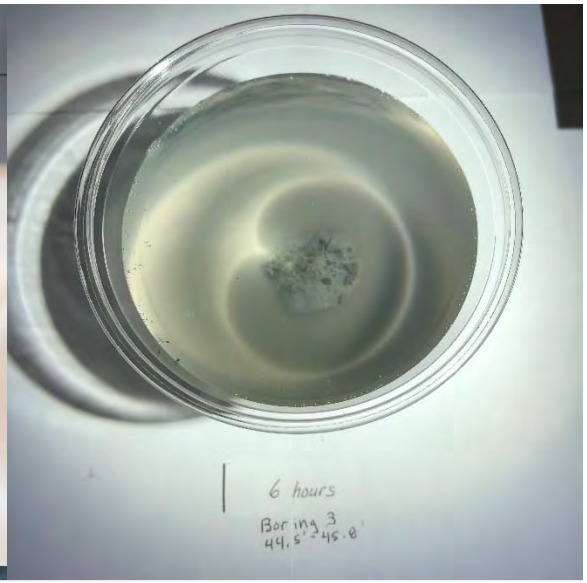
GF-3 44.5' - 45.8' Clay/Shale



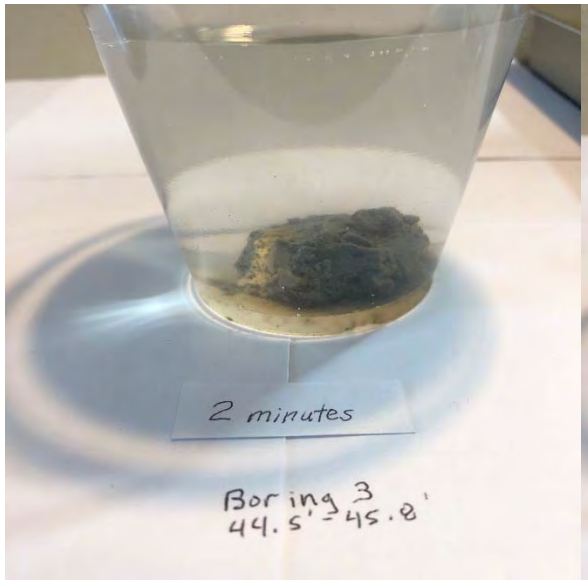
Time = 2 minutes Grade = 2

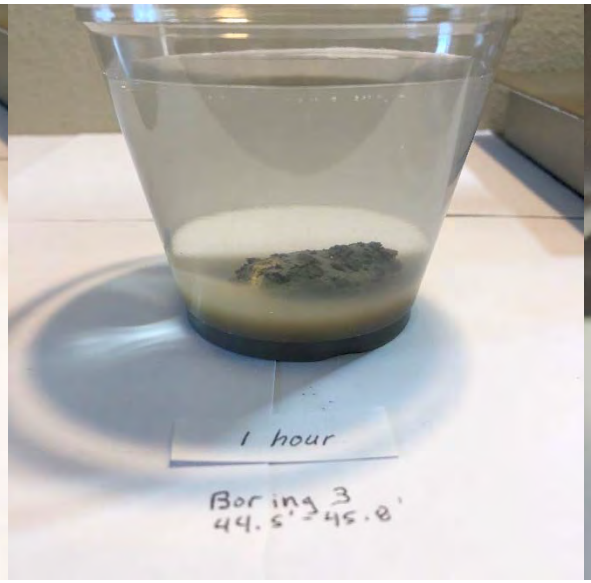


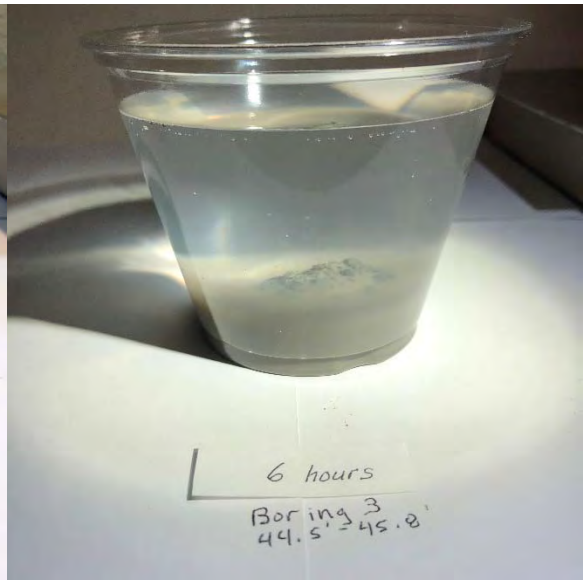
Time = 1 hour Grade = 4



Time = 6 hours Grade = 4







APPENDIX F

Laboratory Test Reports

Gannett Fleming

Matejcek Dam
Summary of Laboratory Soil & Rock Test Results

crb 3/2019
EJB 5/2019

Test Boring Number	Sample Number	Sample Depth (ft)	Elevation Top of Sample (ft)	Stratum	USCS Class	Material Description	% Gravel	% Sand	% Silt	% Clay	LL (%)	PL (%)	Plasticity Index	Natural Moisture (%)	Specific Gravity (dim.)	Dry Unit Weight (pcf)	Moist Unit Weight (pcf)	Slake Durability		Crumb Dispersion Grade
																		Index (%)	Fragment Type	
Dam																				
GF-4	S-6 to 18	15 - 47.5	1353.6	Emb (Zone 1)	ML	Sandy SILT	0.0	30.3	51.3	18.4	45	32	13	29.2	2.55					
GF-4	S-9	22.5 - 25	1346.1	Emb (Zone 1)										29.2						
GF-4	S-10	25 - 27.5	1343.6	Emb (Zone 1)										23.6		93.4	115.4			
GF-4	S-16	40 - 42.5	1328.6	Emb (Zone 1)																1
GF-5	S-10 to 13	25 - 35	1302	Emb (Zone 3)	MH	Sandy Elastic SILT	5.2	40.2	29.4	25.1	57	33	24	25.7	2.57					1
GF-5	S-12	30 - 32.5	1297	Emb (Zone 3)										25.7						
GF-5	S-15 to 19	37.5 - 50	1289.5	Fndn Till	ML	Sandy SILT	0.5	36.7	40.7	22.1	45	32	13	26.3	2.61					
GF-5	S-15	37.5 - 40	1289.5	Fndn Till										26.3						
GF-5	S-16	40.0 - 42.5	1287	Fndn Till																1
GF-5	S-17	42.5 - 45	1284.5	Fndn Till										21.7						
GF-5	S-18	45.0 - 47.5	1282	Fndn Till																1
GF-5	S-19	47.5 - 50	1279.5	Fndn Till										30.5		90.8	118.5			
GF-4	S-39	97.5 - 100	1271.1	Fndn Till										22.3		100.6	123.0			
GF-6	S-3 to 10	7.5 - 30	1319.5	Colluvial/Residual	ML	SILT with Sand	0.0	29.5	53.4	17.1	42	33	9	25.9	2.58					
GF-6	S-4	10 - 12.5	1317	Colluvial/Residual										25.5						
GF-6	S-5	12.5 - 15	1314.5	Colluvial/Residual										28.0						
GF-6	S-6	15.0 - 17.5	1312	Colluvial/Residual										26.3						1
GF-6	S-10	27.5 - 30	1299.5	Colluvial/Residual										36.3						
GF-4	S-42 to 49	105 - 124	1263.6	Clayey SHALE	CH	Fat CLAY	0.0	1.5	20.4	78.1	83	31	52	27.1	2.74					
GF-4	S-44	110 - 112.5	1258.6	Clayey SHALE										25.9		101.4	127.7			3
GF-4	S-46	115 - 117.5	1253.6	Clayey SHALE										27.1						
GF-4	S-48	120 - 122.5	1248.6	Clayey SHALE										28.8		97.2	125.2			
GF-4	S-49	122.5 - 124	1246.1	Clayey SHALE																2
Spillway																				
GF-3	S-1 to 3	2.5 - 10.0	1359.5	Outwash	SM	Silty SAND	3.5	49.8	32.3	14.4	49	32	17	12.6	2.58					
GF-3	S-1	2.5 - 5.0	1359.5	Outwash										12.6						
GF-2	S-4 to 6	10 - 16.5	1351.6	Till	ML	Sandy SILT	0.0	37.4	40.5	22.1	46	32	14	28.8	2.55					
GF-2	S-4	10 - 12.4	1351.6	Till																1
GF-2	S-6	15 - 16.5	1346.6	Till																1
GF-2	S-11 to 14	27.5 - 37.5	1334.1	Till	ML	Sandy SILT	0.2	35.5	45.0	19.2	39	26	13	27.6	2.59					
GF-2	S-11	27.5 - 29.5	1334.1	Till																1
GF-2	S-12	30 - 32	1331.6	Till																1
GF-2	S-17,18	42.5 - 45.9	1319.1	Clayey SHALE	MH	Elastic SILT	0.0	5.1	48.1	46.8	79	40	39	31.0	2.53					2
GF-3	S-18,19	44.5 - 48.8	1317.5																	2
GF-2	R1	47.5	1314.1	Clayey SHALE																2
GF-2	R1	48 - 49.5	1313.6	Clayey SHALE														19.5	3	
GF-2	R3	52 - 53	1309.6	Clayey SHALE										21.4		90.8	110.2			
GF-2	R4	54.5	1307.1	Clayey SHALE																2
GF-2	R4	55 - 56.5	1306.6	Clayey SHALE														40.7	2	

PERMEABILITY

Test Boring Number	Sample Number	Sample Depth (ft)	Elevation Top of Sample (ft)	Stratum	USCS Class	Material Description	Permeability (cm/s)	Void Ratio	Porosity	Bulk Density (g/cm^3)	Water Content (cm^3/cm^3)[1]	Intrinsic Permeability (cm^2)[1]
GF-4	S-6 to 18	15 - 47.5	1353.6	Emb (Zone 1)	ML	Sandy SILT	3.89E-08	0.83	0.45	1.86	0.38	3.99E-13
GF-5	S-15 to 19	37.5 - 50	1289.5	Fndn Till	ML	Sandy SILT	2.57E-06	0.81	0.45	1.92	0.43	2.63E-11
GF-6	S-3 to 10	7.5 - 30	1319.5	Colluvial/Residual	ML	SILT with Sand	6.75E-06	0.77	0.44	1.93	0.40	6.91E-11
GF-4	S-42 to 49	105 - 124	1263.6	Clayey SHALE	CH	Fat CLAY	5.88E-06	0.69	0.41	2.03	0.43	6.03E-11

1. at 20°C — 1. at 20°C

Gannett Fleming

Matejcek Dam
Summary of Laboratory Soil & Rock Test Results

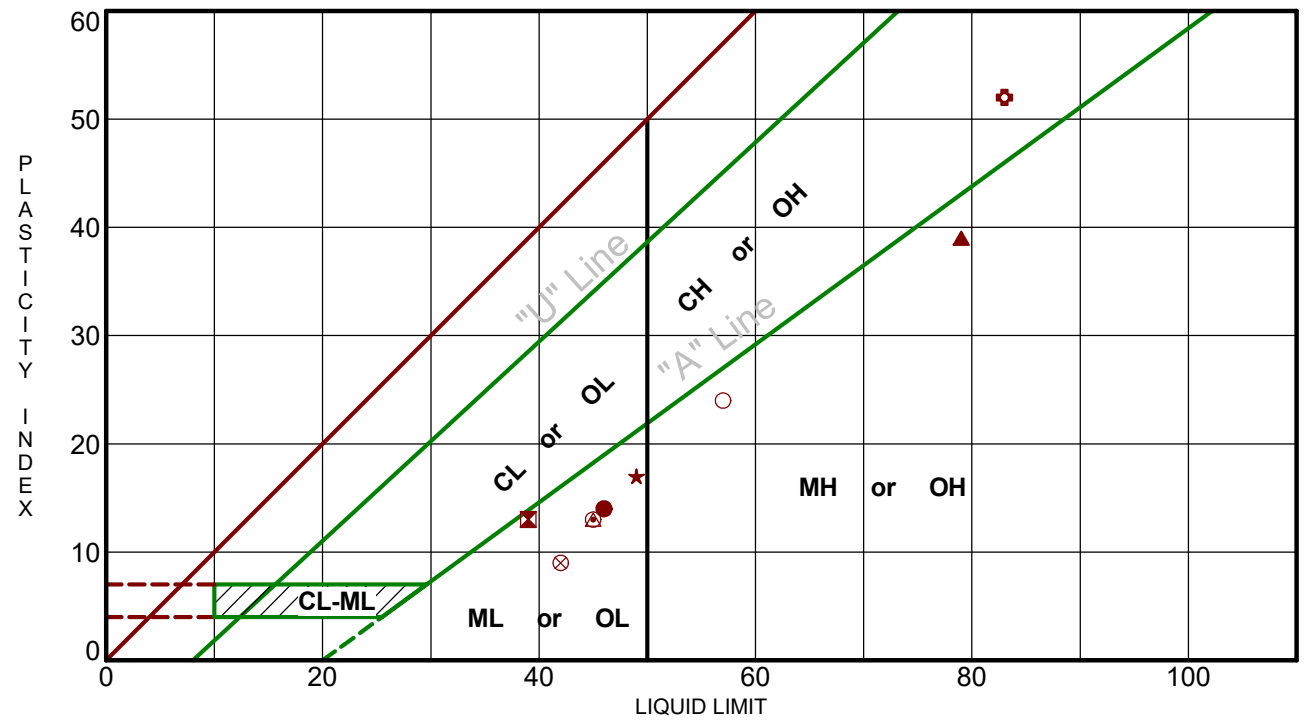
crb 3/2019
EJB 5/2019

CU TRIAXIAL SHEAR													
Test Boring Number	Sample Number	Sample Depth (ft)	Elevation Top of Sample (ft)	Stratum	USCS Class	Material Description	Moisture (%)	Dry Unit Weight (pcf)	Specific Gravity (dim.)	Total Stress Cohesion (ksf)	Total Stress Friction Angle (°)	Effective Stress Cohesion (ksf)	Effective Stress Friction Angle (°)
GF-4	S-6 to 18	15 - 47.5	1353.6	Emb (Zone 1)	ML	Sandy SILT	Remolded to: 26.0	92.0	2.7 (assumed)	0.362	25.3	0.161	34.4
GF-5	S-15 to 19	37.5 - 50	1289.5	Fndn Till	ML	Sandy SILT	Remolded to: 29.0	93.0	2.7 (assumed)	0.183	23.5	0.253	35.5
GF-6	S-3 to 10	7.5 - 30	1319.5	Colluvial/Residual	ML	SILT with Sand	Remolded to: 26.5	95.0	2.7 (assumed)	0.836	24.1	0.568	31.1
GF-4	S-42 to 49	105 - 124	1263.6	Clayey SHALE	CH	Fat CLAY	Remolded to: 27.0	99.5	2.7 (assumed)	0.806	6.6	0.688	12.6

*Listed strength parameters are as reported by soil testing laboratory. See Appendix G for interpretation of shear strength parameters used in embankment stability calculations.

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
GF-2	10 - 16.5	46	32	14	63	ML	SANDY SILT
GF-2	27.5 - 37.5	39	26	13	64	ML	SANDY SILT
GF-2/GF-3	42.5 - 48.8	79	40	39	95	MH	ELASTIC SILT
GF-3	2.5 - 10	49	32	17	47	SM	SILTY SAND
GF-4	15 - 47.5	45	32	13	70	ML	SANDY SILT
GF-4	105 - 124	83	31	52	99	CH	FAT CLAY
GF-5	25 - 35	57	33	24	55	MH	SANDY ELASTIC SILT
GF-5	37.5 - 50	45	32	13	63	ML	SANDY SILT
GF-6	7.5 - 30	42	33	9	71	ML	SILT with SAND

PROJECT: Matejcek Dam

SITE: Matejcek Dam
Fordville, North Dakota

Terracon
1555 N 42nd St, Unit B
Grand Forks, ND

PROJECT NUMBER: M5191000

CLIENT: Gannett Fleming, Inc.
Harrisburg, Pennsylvania

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS M5191000.GPJ TERRACON_DATATEMPLATE.GDT 4/19/19

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-2	4	10.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 1

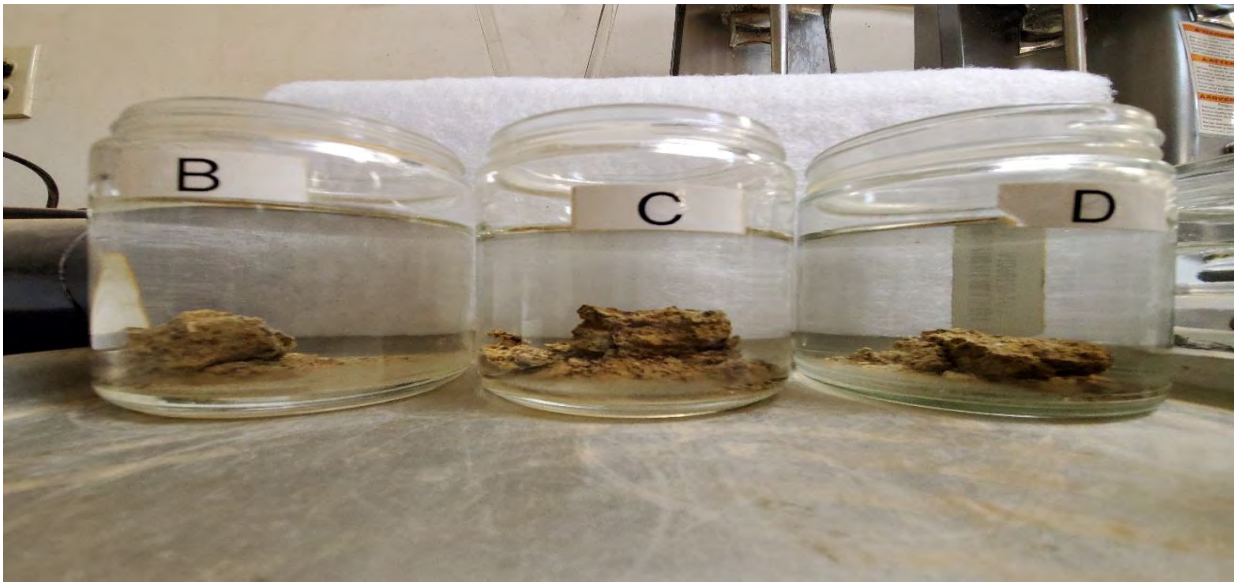
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6 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-2	6	15.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 1

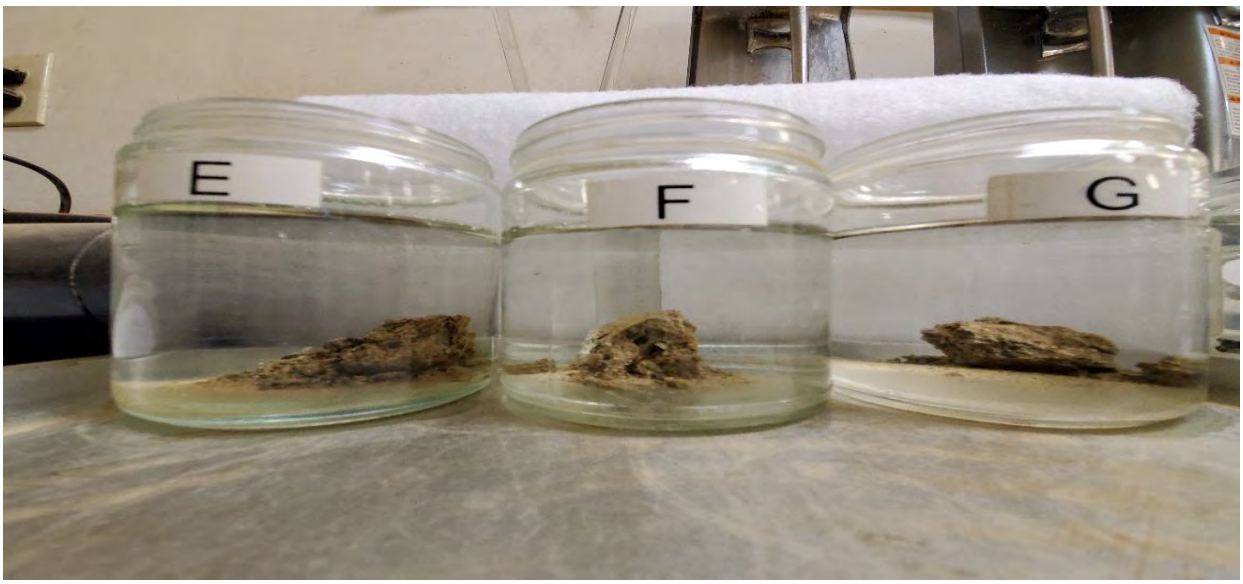
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6 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-2 11 27.5

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

6 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-2	12	30.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 1

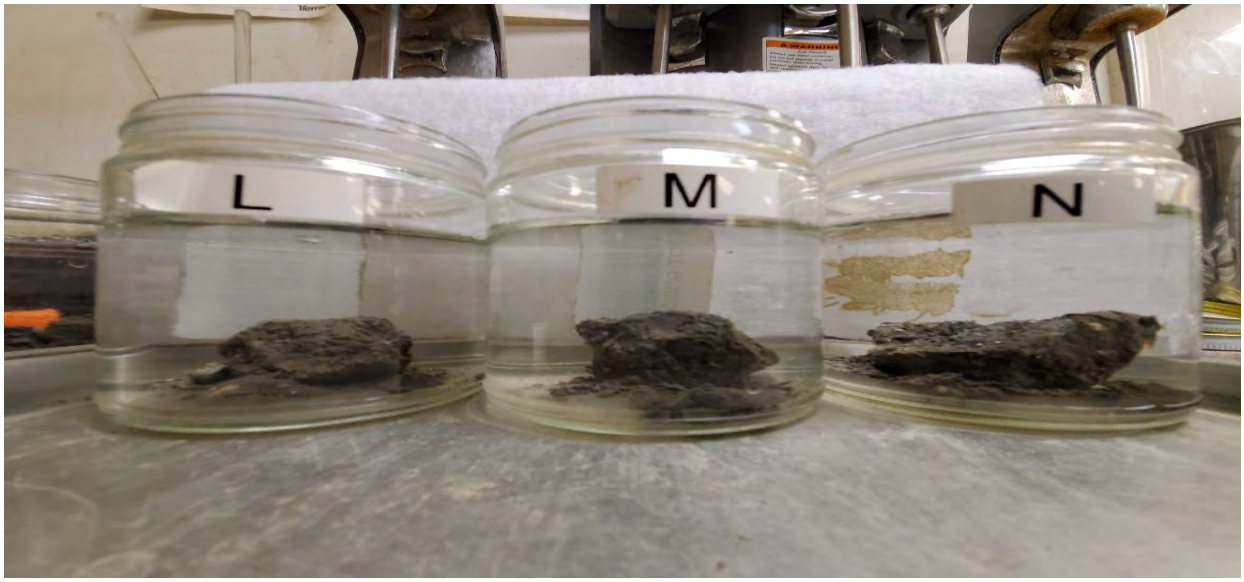
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6 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-2 17-18 42.5

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 2

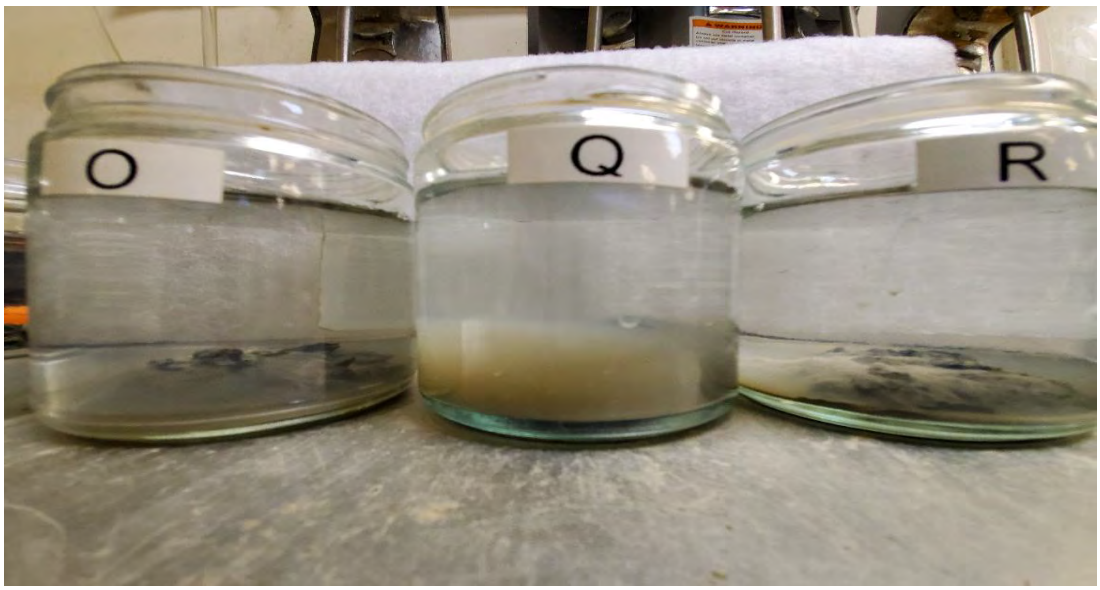
DISPERSIVE CLASSIFICATION: Intermediate (I)

6 HOUR

GRADE: 2

DISPERSIVE CLASSIFICATION: Intermediate (I)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-3	18-19	44.5

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 2

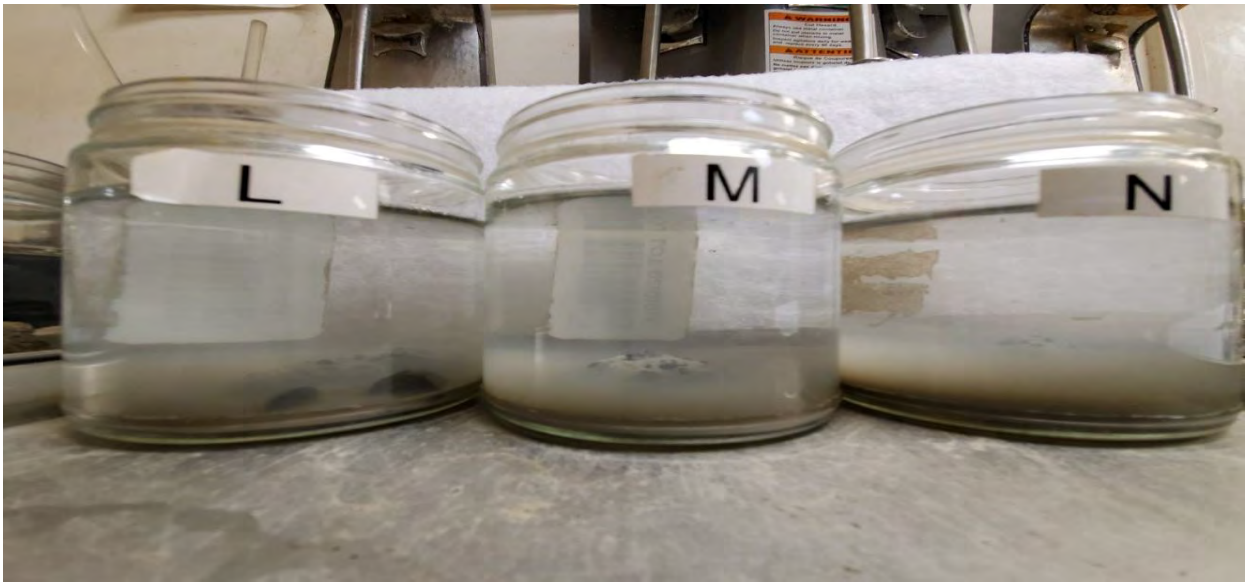
DISPERSIVE CLASSIFICATION: Intermediate (I)

6 HOUR

GRADE: 2

DISPERSIVE CLASSIFICATION: Intermediate (I)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-2 R1 47.5

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 2

DISPERSIVE CLASSIFICATION: Intermediate (I)

6 HOUR

GRADE: 2

DISPERSIVE CLASSIFICATION: Intermediate (I)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-2 R4 54.5

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 2

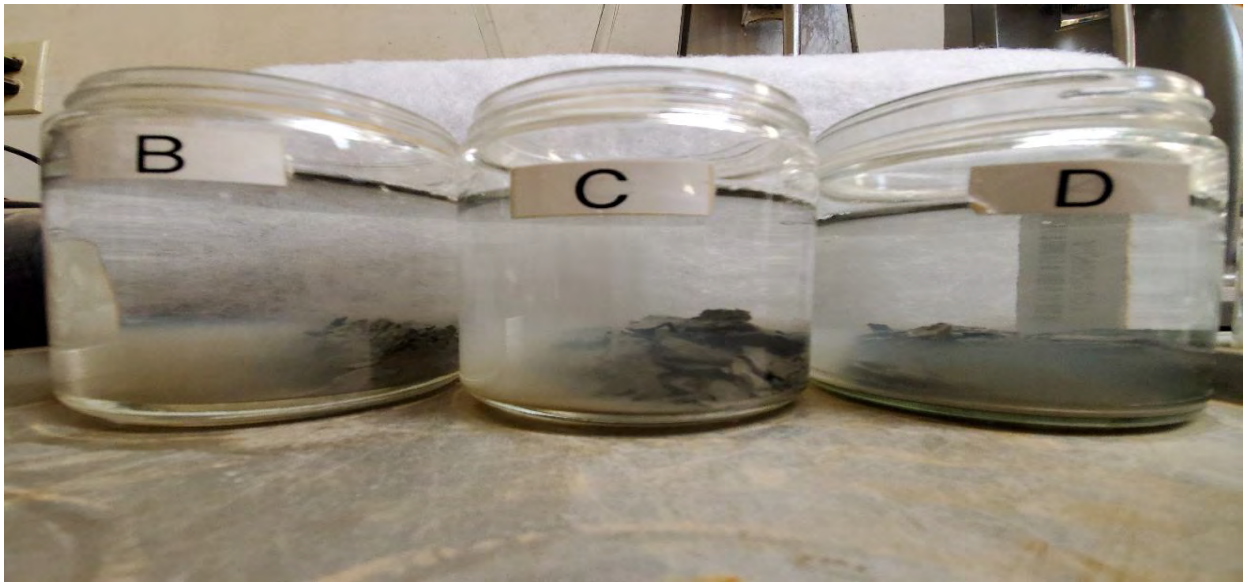
DISPERSIVE CLASSIFICATION: Intermediate (I)

6 HOUR

GRADE: 2

DISPERSIVE CLASSIFICATION: Intermediate (I)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-4	16	40.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 1

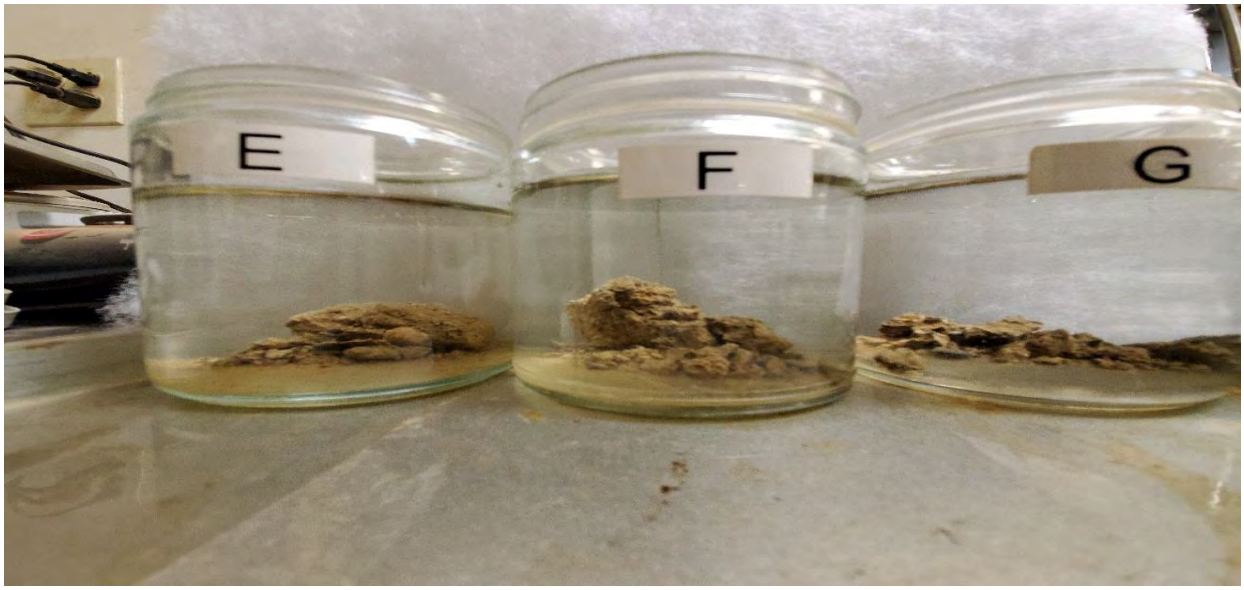
DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

6 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-4 44 110.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 2

DISPERSIVE CLASSIFICATION: Intermediate (I)

6 HOUR

GRADE: 3

DISPERSIVE CLASSIFICATION: Dispersive (D)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-4	49	122.5

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 2

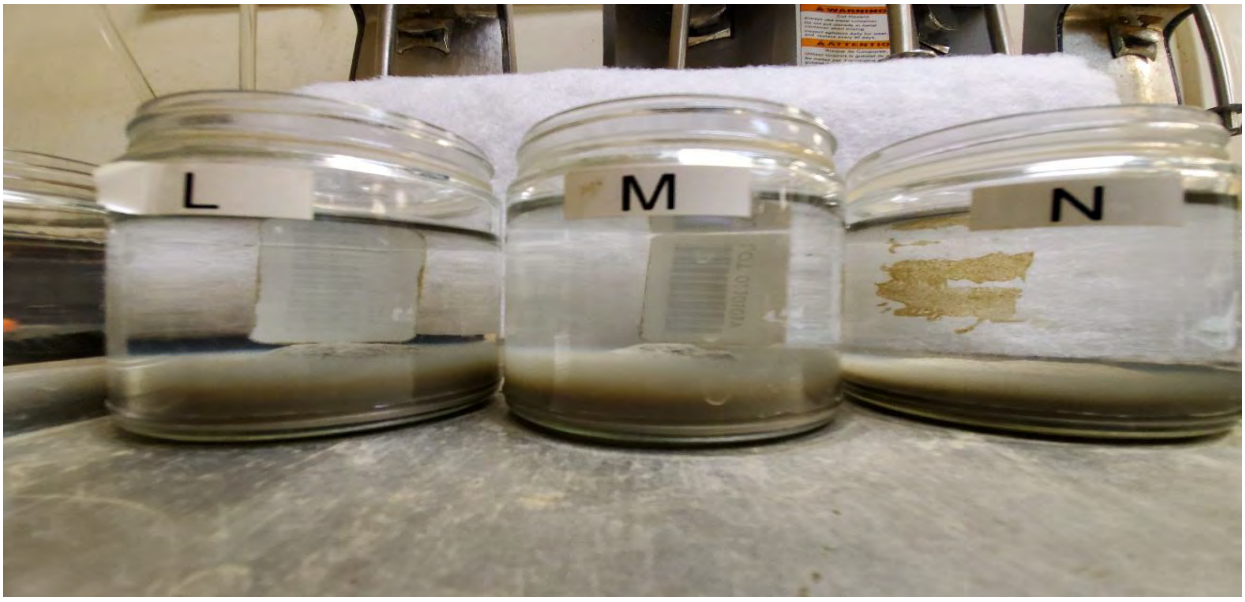
DISPERSIVE CLASSIFICATION: Intermediate (I)

6 HOUR

GRADE: 2

DISPERSIVE CLASSIFICATION: Intermediate (I)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-5	10-13	25.0-35.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 1

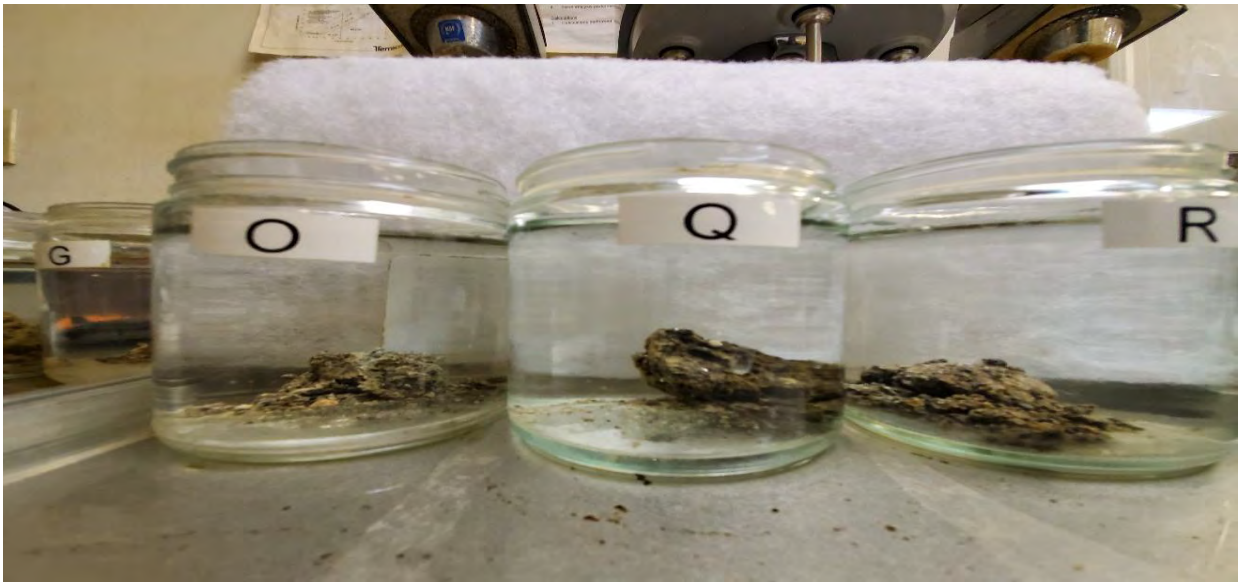
DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

6 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-5 16 40.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 1

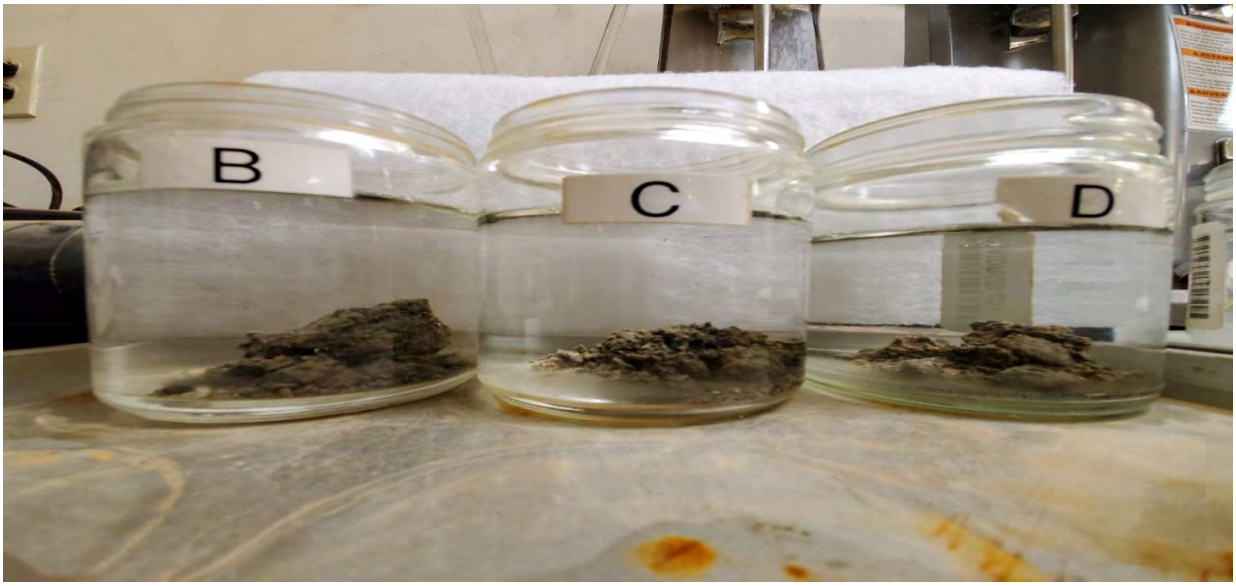
DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

6 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-5	18	45.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 1

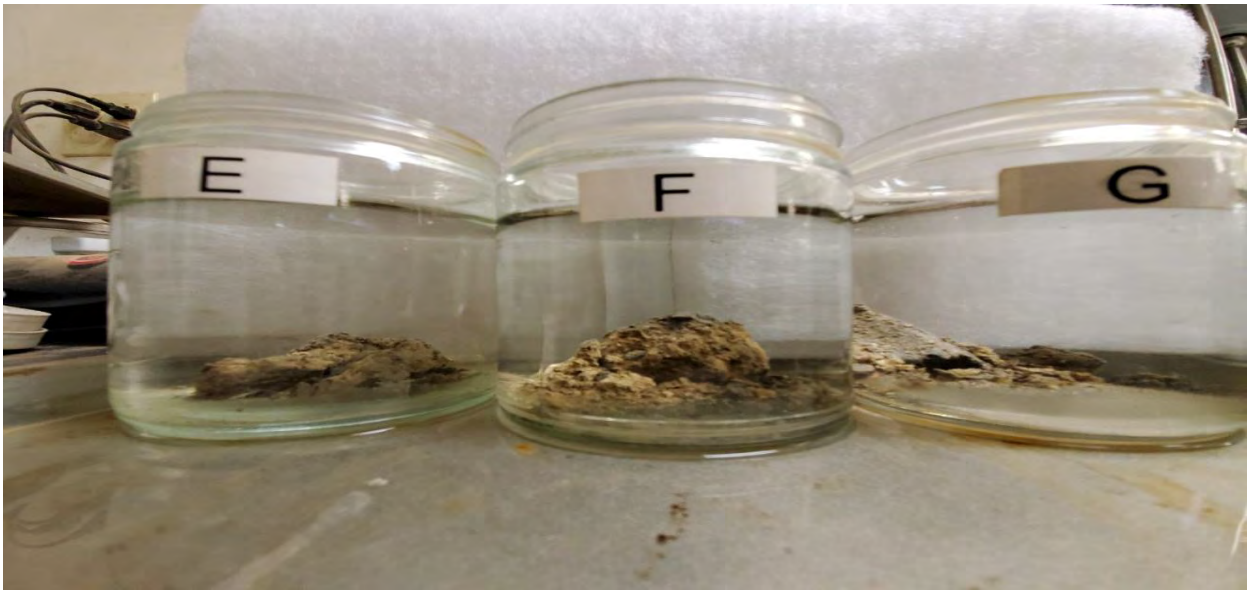
DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

6 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-6	6	15.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 1

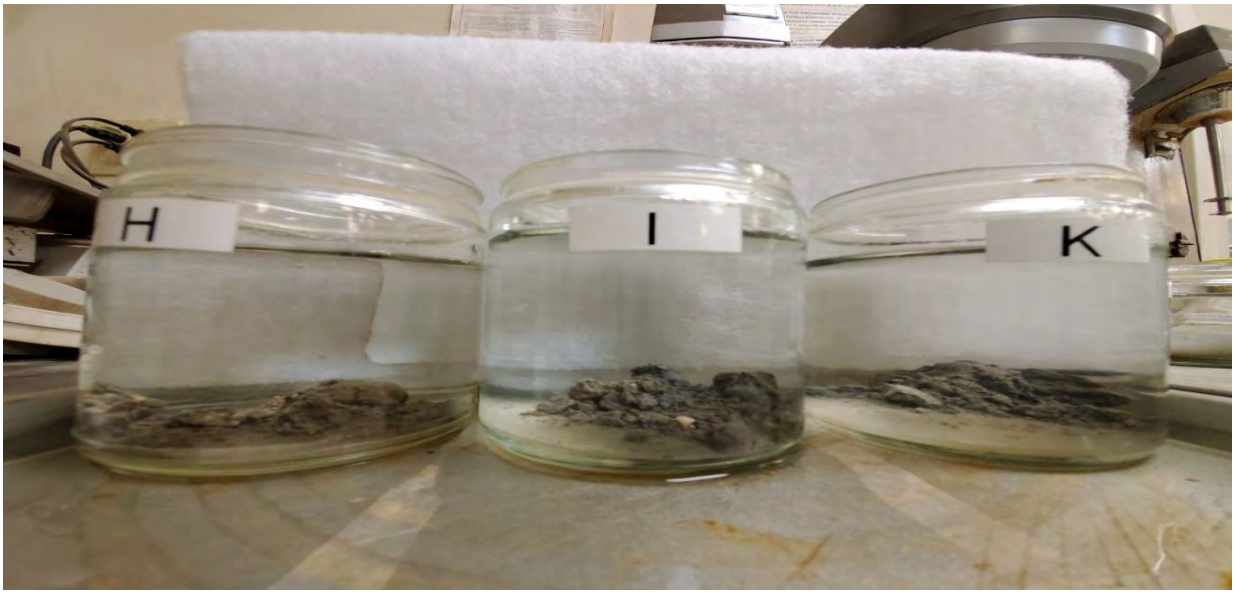
DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

6 HOUR

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

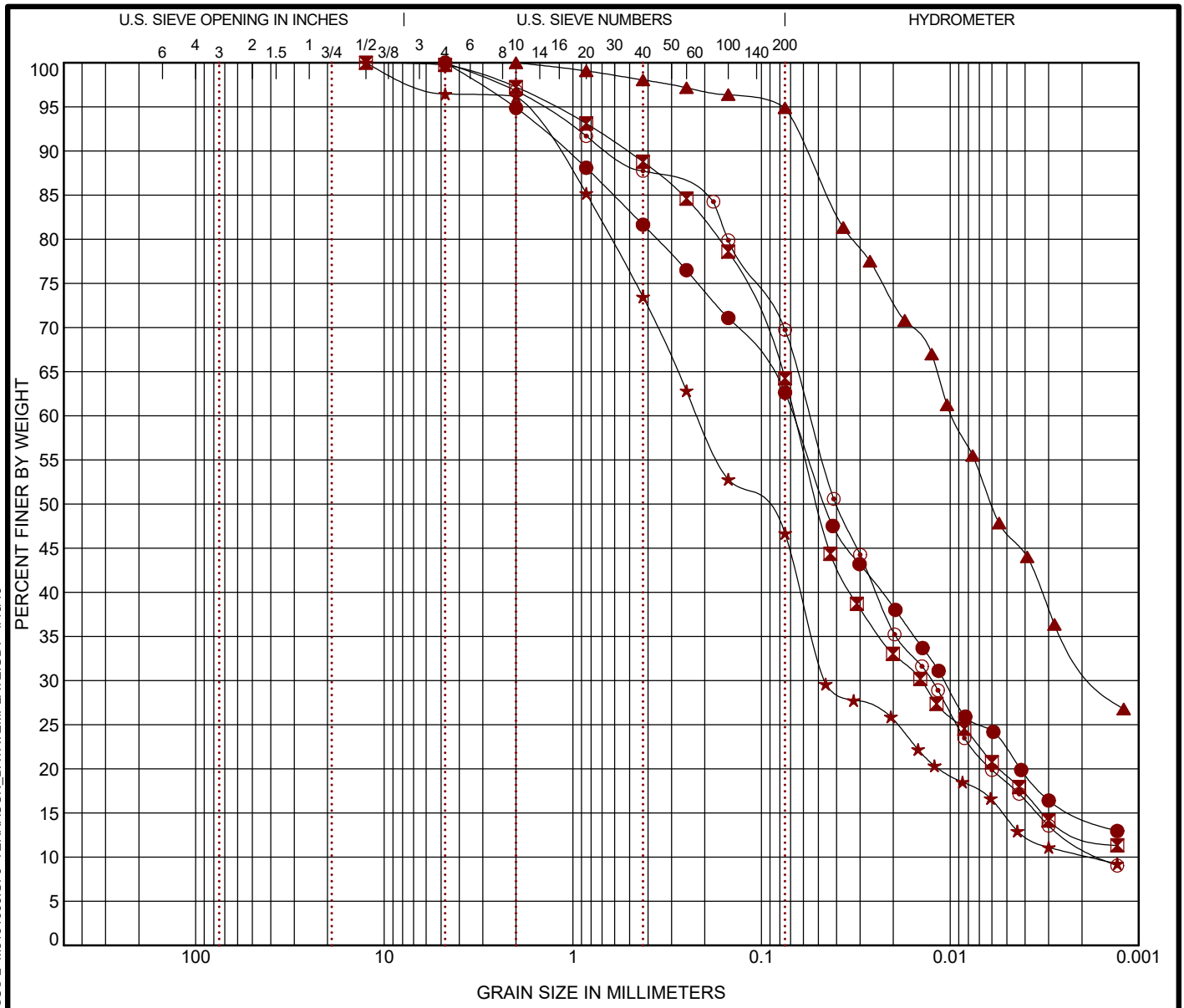
Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	GF-2	10 - 16.5	SANDY SILT (ML)	29	46	32	14		
⊠	GF-2	27.5 - 37.5	SANDY SILT (ML)	28	39	26	13		
▲	GF-2/GF-3	42.5 - 48.8	ELASTIC SILT (MH)	31	79	40	39		
★	GF-3	2.5 - 10	SILTY SAND (SM)	13	49	32	17	5.41	118.52
⊙	GF-4	15 - 47.5	SANDY SILT (ML)	29	45	32	13	1.83	35.66

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	GF-2	10 - 16.5	4.75	0.068	0.011		0.0	0.0	37.4	40.5		22.1
⊠	GF-2	27.5 - 37.5	12.5	0.067	0.014		0.0	0.2	35.5	45.0		19.2
▲	GF-2/GF-3	42.5 - 48.8	2	0.01	0.002		0.0	0.0	5.1	48.1		46.8
★	GF-3	2.5 - 10	12.5	0.216	0.046	0.002	0.0	3.5	49.8	32.3		14.4
⊙	GF-4	15 - 47.5	4.75	0.055	0.013	0.002	0.0	0.0	30.3	51.3		18.4

PROJECT: Matejcek Dam

SITE: Matejcek Dam
Fordville, North Dakota

Terracon
1555 N 42nd St, Unit B
Grand Forks, ND

PROJECT NUMBER: M5191000

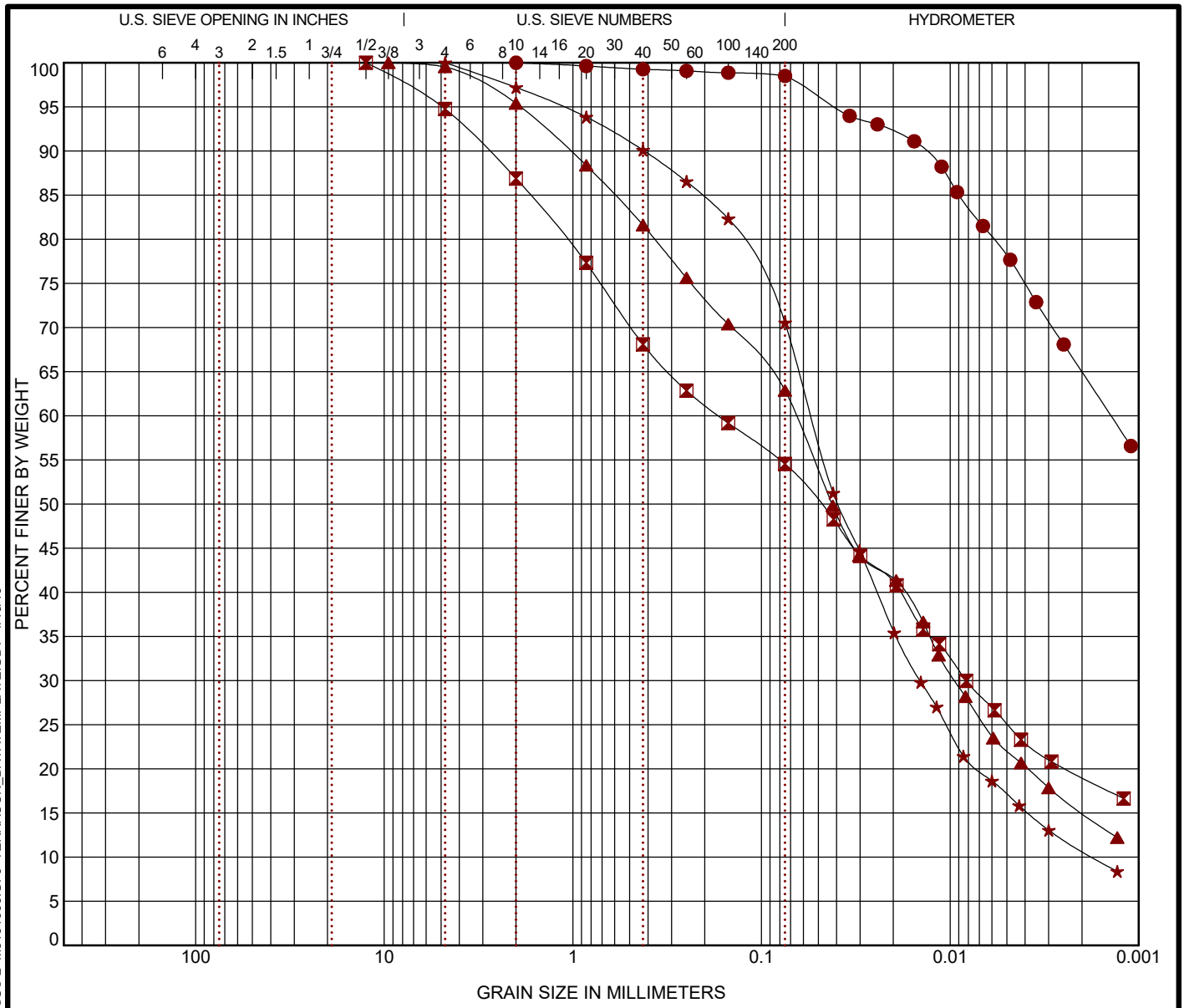
CLIENT: Gannett Fleming, Inc.
Harrisburg, Pennsylvannia

EXHIBIT: B-1

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 M5191000.GPJ TERRACON_DATATEMPLATE.GDT 4/15/19

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	GF-4	105 - 124	FAT CLAY (CH)	27	83	31	52		
⊠	GF-5	25 - 35	SANDY ELASTIC SILT (MH)	26	57	33	24		
▲	GF-5	37.5 - 50	SANDY SILT (ML)	26	45	32	13		
★	GF-6	7.5 - 30	SILT with SAND (ML)	26	42	33	9	2.21	31.33

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	GF-4	105 - 124	2	0.001			0.0	0.0	1.5	20.4		78.1
⊠	GF-5	25 - 35	12.5	0.168	0.008		0.0	5.2	40.2	29.4		25.1
▲	GF-5	37.5 - 50	9.5	0.066	0.009		0.0	0.5	36.7	40.7		22.1
★	GF-6	7.5 - 30	4.75	0.054	0.014	0.002	0.0	0.0	29.5	53.4		17.1

PROJECT: Matejcek Dam

SITE: Matejcek Dam
Fordville, North Dakota

Terracon
1555 N 42nd St, Unit B
Grand Forks, ND

PROJECT NUMBER: M5191000

CLIENT: Gannett Fleming, Inc.
Harrisburg, Pennsylvannia

EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 M5191000.GPJ TERRACON_DATATEMPLATE.GDT 4/15/19

Specific Gravity Testing

Boring No.	GF-2	GF-2	GF-2/GF-3	GF-3	GF-4	GF-4	GF-5	GF-5	GF-6
Depth, ft.	**10 – 16.5**	**27.5 – 37.5**	**42.5- 45.9/ 44.5 -48.8**	**2.5 – 10**	**15 – 47.5**	**105 – 124**	**25 – 35**	**37.5 – 50**	**7.5 – 30**
Specific Gravity	2.55	2.59	2.53	2.58	2.55	2.74	2.57	2.61	2.58
Water Content, %	28.8	27.6	31.0	12.6	29.2	27.1	25.7	26.3	25.9

Unit Weight Testing

Boring No.	GF-2	GF-4	GF-4	GF-4	GF-4	GF-5
Sample No.	**R-3**	**S-10**	**S-39**	**S-44**	**S-48**	**S-19**
Depth, ft.	**52 – 53**	**25 – 27.5**	**97.5 – 100**	**110 – 112.5**	**120 – 122.5**	**47.5 – 50**
Dry Density, pcf	90.8	93.4	100.6	101.4	97.2	90.8
Water Content, %	21.4	23.6	22.3	25.9	28.8	30.5

Moisture Content Testing

Boring No.	GF-3	GF-4	GF-4	GF-5	GF-5	GF-5	GF-6	GF-6	GF-6	GF-6
Sample No.	**S-1**	**S-9**	**S-46**	**S-12**	**S-15**	**S-17**	**S-4**	**S-5**	**S-6**	**S-10**
Depth, ft.	**2.5 – 5**	**22.5 – 25**	**115 – 117.5**	**30 – 32.5**	**37.5 – 40**	**42.5 – 45**	**10 – 12.5**	**12.5 – 15**	**15 – 17.5**	**27.5 – 30**
Water Content, %	12.6	29.2	27.1	25.7	26.3	21.7	25.5	28.0	26.3	36.3

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Matejcek Dam
Date: 4/18/2019 Panel Number : P-1
Project No. : M5191000 Permometer Data

Boring No.:	GF-4	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	S6-S18	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	15.0-47.5	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:		M_2 =	1.040953	T = 0.0658646				

Material Description : gray sandy clay

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			524.85	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			524.85	g	Tare No.:	54	Tare No.:	N/A
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	126.00	Wet Wt.+tare:	529.80
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	100.00	Dry Wt.+tare:	405.00
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	0.00	Tare Wt:	0.00
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	100	Dry Wt.:	405
Unit Wt.(wet):	**115.92**	pcf	**1.86**	g/cm^3	Water Wt.:	26	Water Wt.:	124.8
Unit Wt.(dry):	**92.00**	pcf	**1.47**	g/cm^3	% moist.:	**26.0**	% moist.:	**30.8**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 99.98 Void ratio (e) = **0.83** Porosity (n)= **0.45**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

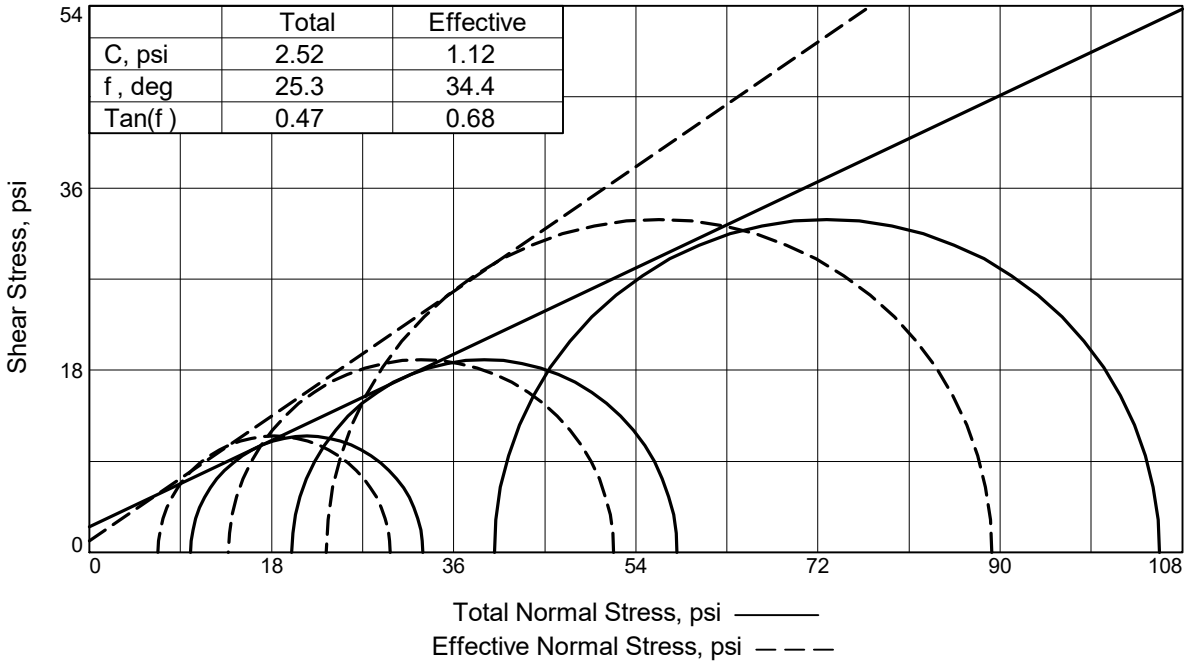
Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

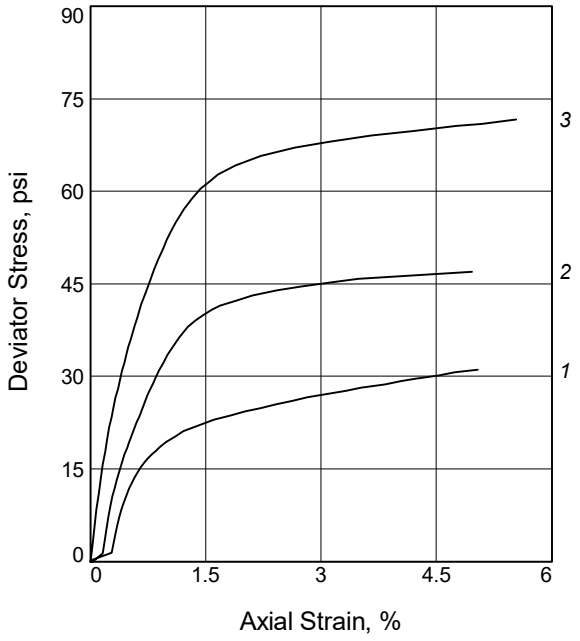
Date	elapsed t (seconds)	Z (pipet @ t)	DZp (cm)	temp (deg C)	a (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
4/15/2019	120	16.6	0.182666	21	0.977	4.22E-08	1.20E-04	
4/15/2019	240	16.45	0.332666	21	0.977	3.87E-08	1.10E-04	
4/15/2019	360	16.3	0.482666	21	0.977	3.76E-08	1.07E-04	
4/15/2019	480	16.15	0.632666	21	0.977	3.71E-08	1.05E-04	

SUMMARY

k_a =	3.89E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	4.22E-08	cm/sec	8.6	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	3.87E-08	cm/sec	0.6	%	
k3 =	3.76E-08	cm/sec	3.4	%	
k4 =	3.71E-08	cm/sec	4.5	%	

Hydraulic conductivity	k =	**3.89E-08**	cm/sec	**1.10E-04**	ft/day
Void Ratio	e =	**0.83**			
Porosity	n =	**0.45**			
Bulk Density	g =	**1.86**	g/cm^3	**115.9**	pcf
Water Content	W =	**0.38**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**3.99E-13**	cm^2	(at 20 deg C)	





Sample No.		1	2	3
Initial	Water Content, %	26.0	26.0	26.0
	Dry Density, pcf	92.0	92.0	92.0
	Saturation, %	84.4	84.4	84.4
	Void Ratio	0.8313	0.8313	0.8313
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	28.7	28.1	27.3
	Dry Density, pcf	93.8	94.7	95.8
	Saturation, %	97.1	97.1	97.0
	Void Ratio	0.7970	0.7808	0.7594
	Diameter, in.	2.783	2.835	2.886
	Height, in.	5.563	5.313	5.063
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.0	50.0	50.0
Cell Pressure, psi		60.0	70.0	90.0
Fail. Stress, psi		23.0	38.1	65.8
Excess Pore Pr., psi		3.2	6.3	16.6
Ult. Stress, psi				
Excess Pore Pr., psi				
$\bar{s}_1$ Failure, psi		29.7	51.8	89.2
$\bar{s}_3$ Failure, psi		6.8	13.7	23.4

Type of Test:
CU with Pore Pressures

Sample Type: Remold

Description: gray sandy clay

LL= X **PI=** X

Assumed Specific Gravity= 2.7

Remarks: Specimen remolded to 92.0 pcf dry denisty at 26.0% moisture.

Client: Gannet Fleming, Inc

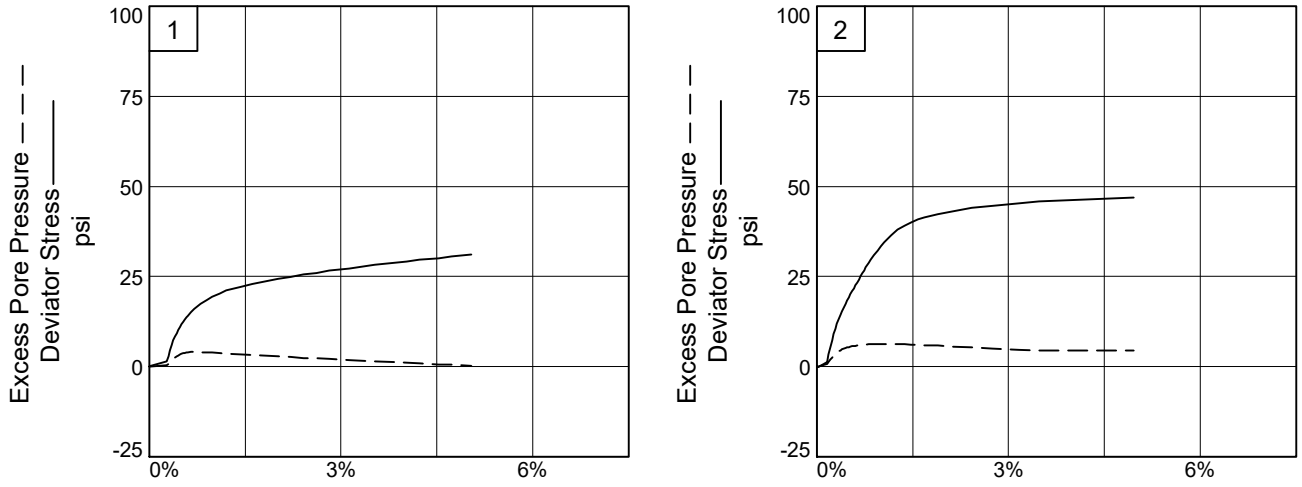
Project: Matejcek Dam

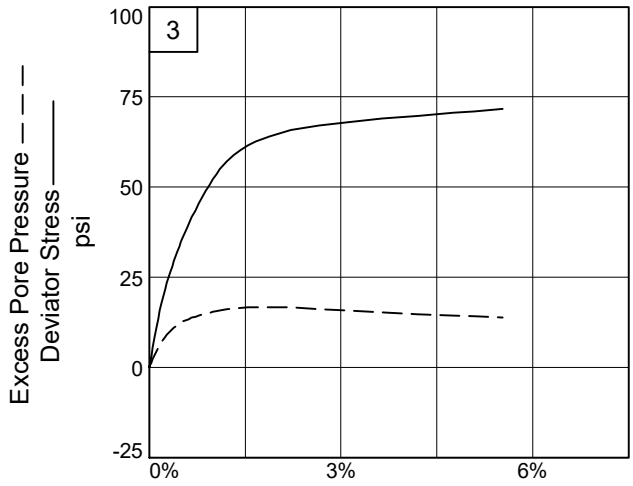
Source of Sample: GF-4 **Depth:** 15.0-47.5 ft

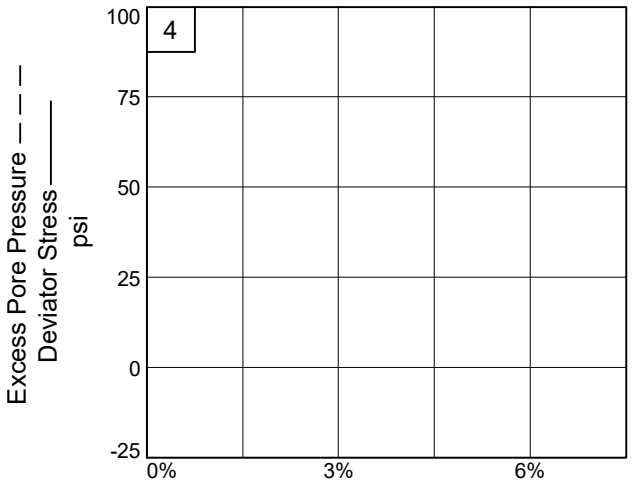
Sample Number: S6-S18

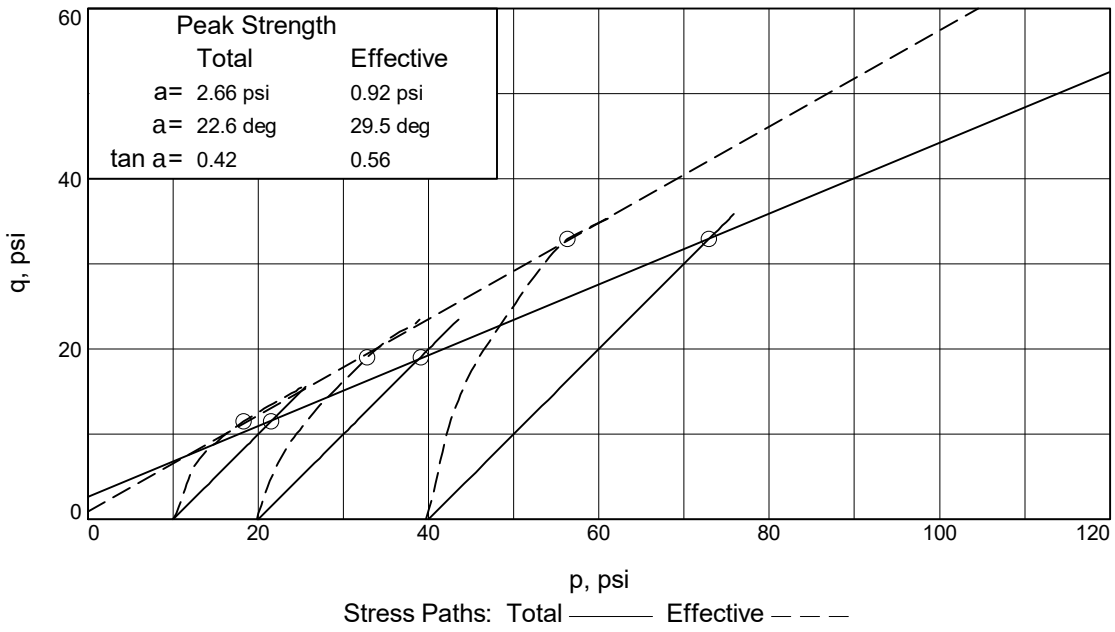
Proj. No.: M5191000 **Date Sampled:** N/A

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN









Client: Gannet Fleming, Inc
Project: Matejcek Dam
Source of Sample: GF-4 **Depth:** 15.0-47.5 ft **Sample Number:** S6-S18
Project No.: M5191000

Terracon Consultants, Inc.

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Matejcek Dam							
Date:	4/18/2019	Panel Number : P-1						
Project No. :	M5191000	Permometer Data						
Boring No.:	GF-4	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	S42-S49	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	105.0-124.0	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:		M_2 =	1.040953	T = 0.0658646				

Material Description : gray clay

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			572.14	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			572.14	g	Tare No.:	59	Tare No.:	N/A
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	127.00	Wet Wt.+tare:	595.19
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	100.00	Dry Wt.+tare:	474.61
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	0.00	Tare Wt:	0.00
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	100	Dry Wt.:	474.61
Unit Wt.(wet):	**126.36**	pcf	**2.03**	g/cm^3	Water Wt.:	27	Water Wt.:	120.58
Unit Wt.(dry):	**99.50**	pcf	**1.59**	g/cm^3	% moist.:	**27.0**	% moist.:	**25.4**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 98.83 Void ratio (e) = **0.69** Porosity (n)= **0.41**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

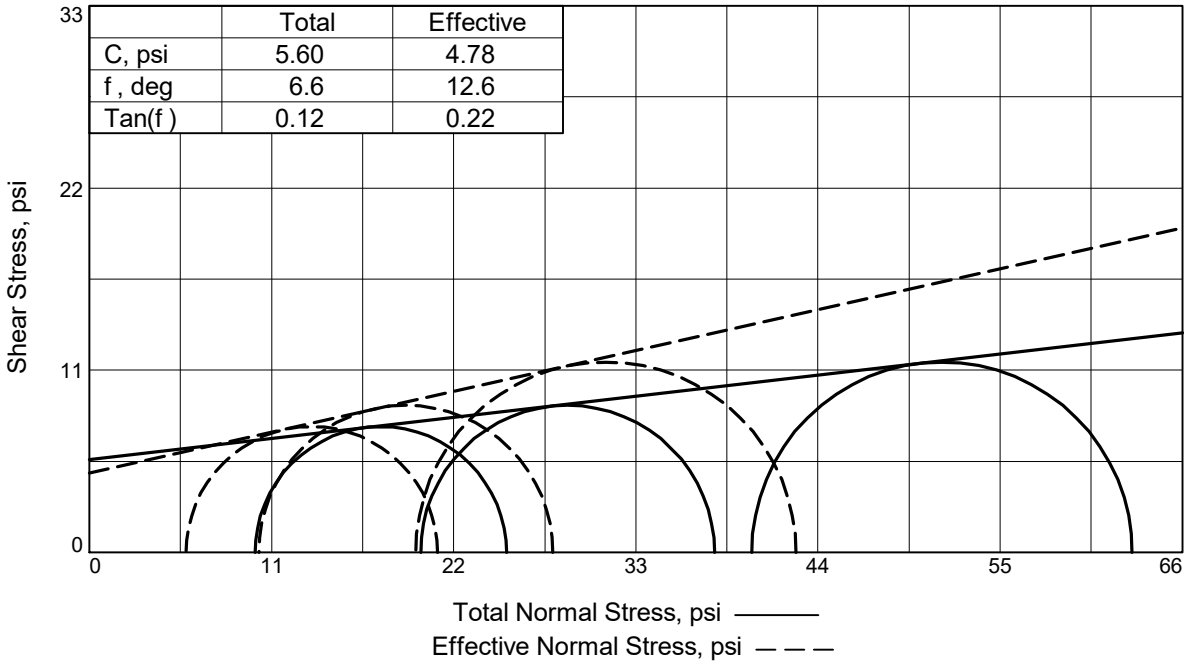
Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

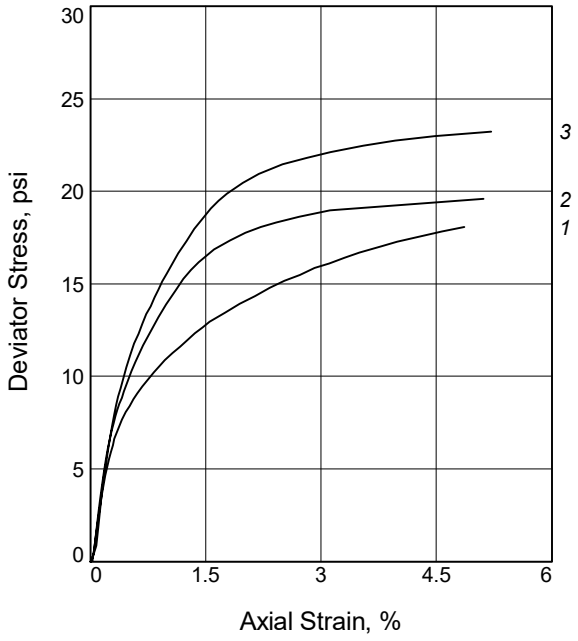
Date	elapsed t (seconds)	Z (pipet @ t)	DZp (cm)	temp (deg C)	a (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
4/15/2019	5	15.8	0.982666	21	0.977	5.61E-06	1.59E-02	
4/15/2019	10	14.8	1.982666	21	0.977	5.86E-06	1.66E-02	
4/15/2019	15	13.9	2.882666	21	0.977	5.88E-06	1.67E-02	
4/15/2019	20	12.9	3.882666	21	0.977	6.19E-06	1.75E-02	

SUMMARY

k_a =	5.88E-06	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	5.61E-06	cm/sec	4.7	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	5.86E-06	cm/sec	0.4	%	
k3 =	5.88E-06	cm/sec	0.1	%	
k4 =	6.19E-06	cm/sec	5.1	%	

Hydraulic conductivity	k =	**5.88E-06**	cm/sec	**1.67E-02**	ft/day
Void Ratio	e =	**0.69**			
Porosity	n =	**0.41**			
Bulk Density	g =	**2.03**	g/cm^3	**126.4**	pcf
Water Content	W =	**0.43**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**6.03E-11**	cm^2	(at 20 deg C)	





Sample No.		1	2	3
Initial	Water Content, %	27.0	27.0	27.0
	Dry Density, pcf	99.5	99.5	99.5
	Saturation, %	105.2	105.2	105.2
	Void Ratio	0.6933	0.6933	0.6933
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	29.8	29.8	29.2
	Dry Density, pcf	93.0	93.0	94.0
	Saturation, %	99.2	99.2	99.2
	Void Ratio	0.8121	0.8121	0.7935
	Diameter, in.	2.855	2.902	2.941
	Height, in.	5.764	5.579	5.375
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.0	50.0	50.0
Cell Pressure, psi		60.0	70.0	90.0
Fail. Stress, psi		15.2	17.7	23.0
Excess Pore Pr., psi		4.2	9.8	20.3
Ult. Stress, psi				
Excess Pore Pr., psi				
$\bar{s}_1$ Failure, psi		21.0	28.0	42.7
$\bar{s}_3$ Failure, psi		5.8	10.2	19.7

Type of Test:
CU with Pore Pressures
Sample Type: Remold
Description: gray clay

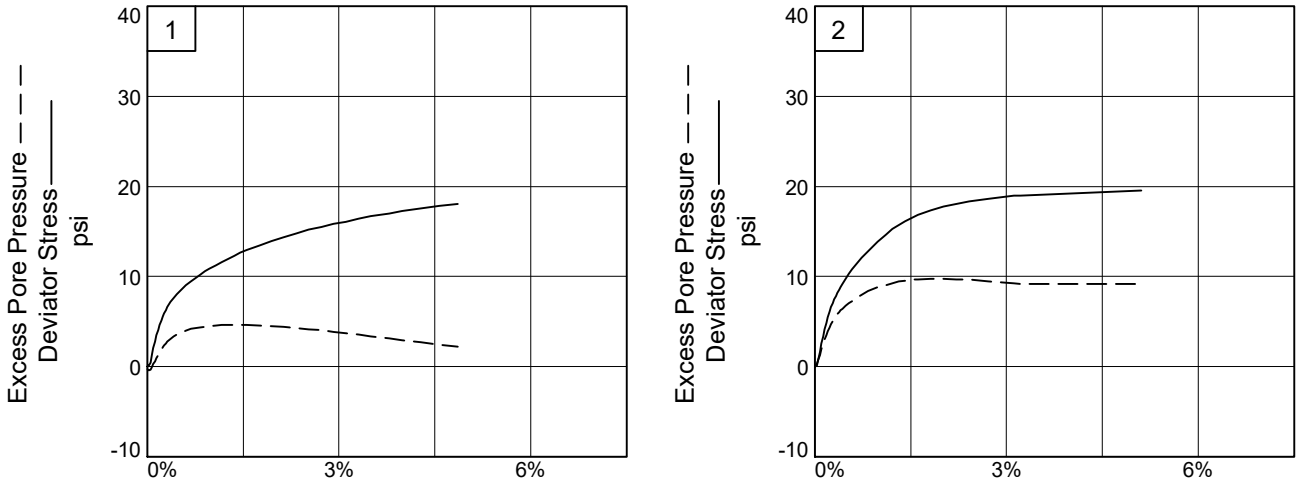
LL= X **PI=** X
Assumed Specific Gravity= 2.7
Remarks: Specimen remolded to 99.5 pcf dry density at 27.0% moisture.

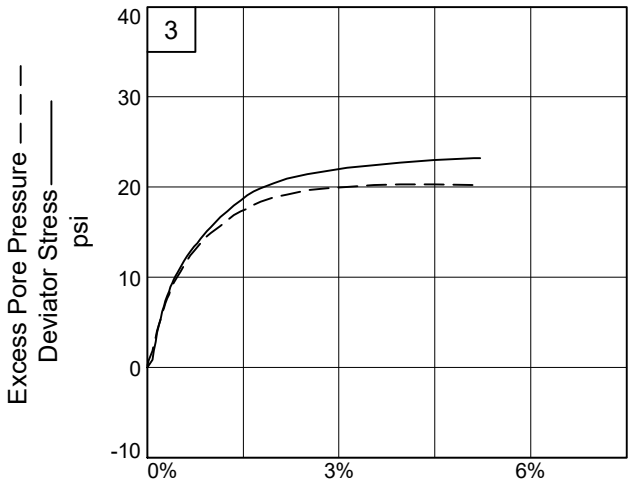
Client: Gannet Fleming, Inc

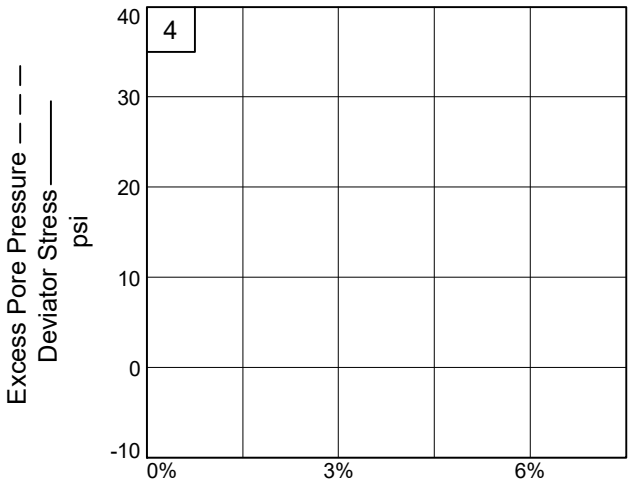
Project: Matejcek Dam

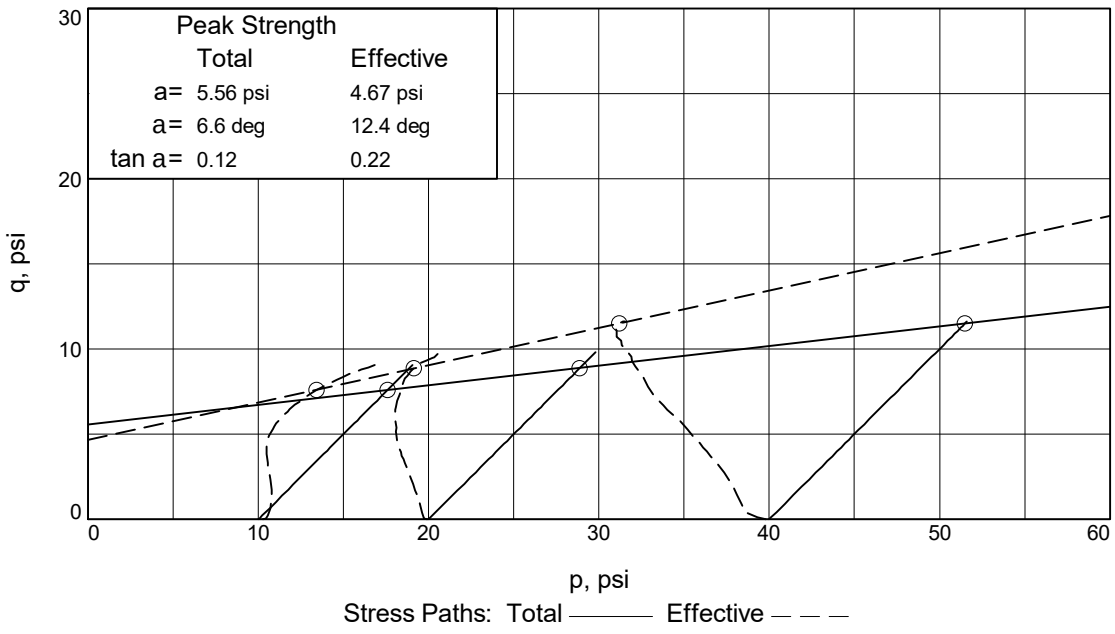
Source of Sample: GF-4 **Depth:** 105.0-124.0 ft
Sample Number: S42-S49
Proj. No.: M5191000 **Date Sampled:** N/A

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN









Client: Gannet Fleming, Inc
Project: Matejcek Dam
Source of Sample: GF-4 **Depth:** 105.0-124.0 ft **Sample Number:** S42-S49
Project No.: M5191000

Terracon Consultants, Inc.

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Matejcek Dam
Date: 4/18/2019 Panel Number : P-1
Project No. : M5191000 Permometer Data

Boring No.:	GF-5	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	S15-S19	a_a =	0.767120	cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	37.5-50.0	M_1 =	0.030180	C = 0.0004288		Annulus **Ra**	1.0	cm^3
Other Location:		M_2 =	1.040953	T = 0.0658646				

Material Description : gray sandy clay

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			543.19	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			543.19	g	Tare No.:	75	Tare No.:	N/A
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	129.00	Wet Wt.+tare:	537.41
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	100.00	Dry Wt.+tare:	414.61
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	0.00	Tare Wt:	0.00
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	100	Dry Wt.:	414.61
Unit Wt.(wet):	**119.97**	pcf	**1.92**	$g/cm^{\wedge 3}$	Water Wt.:	29	Water Wt.:	122.8
Unit Wt.(dry):	**93.00**	pcf	**1.49**	$g/cm^{\wedge 3}$	% moist.:	**29.0**	% moist.:	**29.6**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 98.42 Void ratio (e) = **0.81** Porosity (n)= **0.45**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

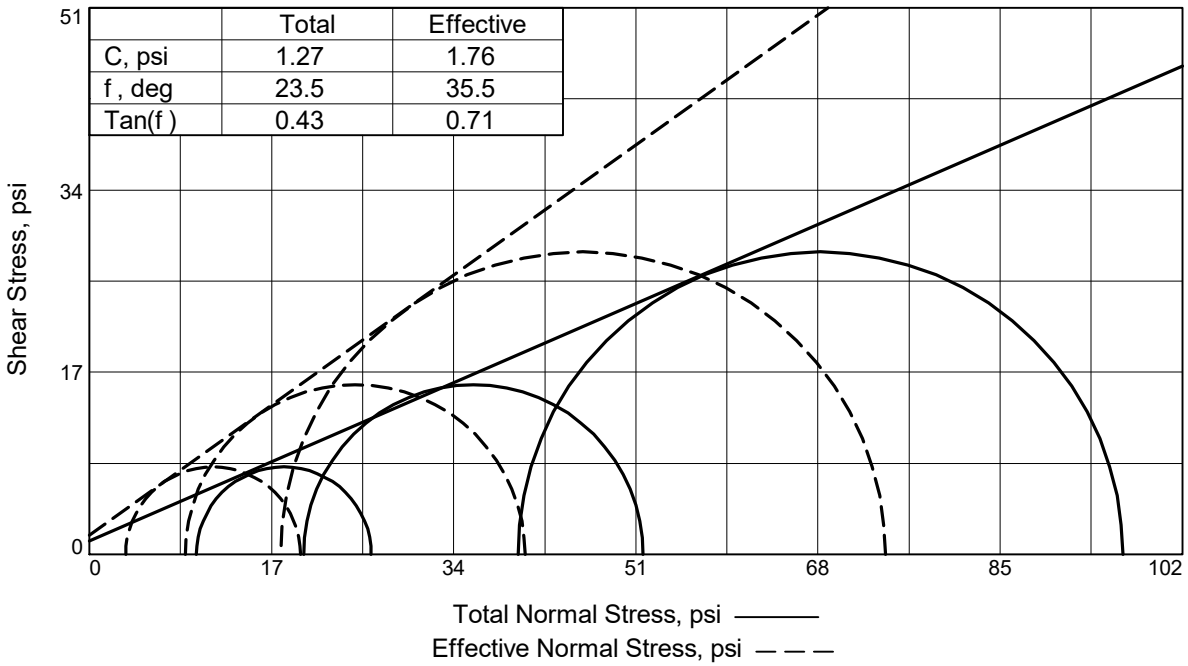
Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

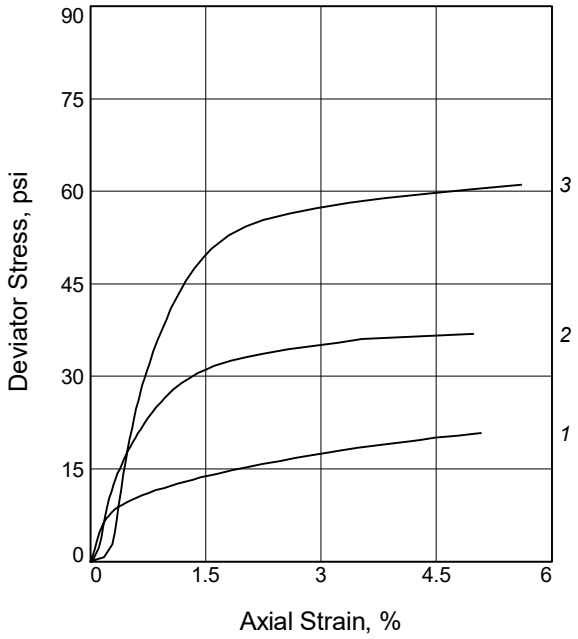
Date	elapsed t (seconds)	Z (pipet @ t)	DZp (cm)	temp (deg C)	a (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
4/15/2019	5	16.3	0.482666	21	0.977	2.71E-06	7.67E-03	
4/15/2019	10	15.8	0.982666	21	0.977	2.80E-06	7.94E-03	
4/15/2019	15	15.5	1.282666	21	0.977	2.46E-06	6.99E-03	
4/15/2019	20	15.2	1.582666	21	0.977	2.31E-06	6.54E-03	

SUMMARY

k_a =	2.57E-06	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	2.71E-06	cm/sec	5.3	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	2.80E-06	cm/sec	9.1	%	
k3 =	2.46E-06	cm/sec	4.1	%	
k4 =	2.31E-06	cm/sec	10.3	%	

Hydraulic conductivity	k =	**2.57E-06**	cm/sec	**7.28E-03**	ft/day
Void Ratio	e =	**0.81**			
Porosity	n =	**0.45**			
Bulk Density	g =	**1.92**	g/cm^3	**120.0**	pcf
Water Content	W =	**0.43**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**2.63E-11**	cm^2	(at 20 deg C)	





Sample No.		1	2	3
Initial	Water Content, %	29.0	29.0	29.0
	Dry Density, pcf	93.0	93.0	93.0
	Saturation, %	96.5	96.5	96.5
	Void Ratio	0.8116	0.8116	0.8116
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	27.4	26.4	25.4
	Dry Density, pcf	96.7	98.2	99.8
	Saturation, %	99.5	99.5	99.5
	Void Ratio	0.7428	0.7172	0.6889
	Diameter, in.	2.766	2.816	2.861
	Height, in.	5.519	5.247	5.001
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.0	50.0	50.0
Cell Pressure, psi		60.0	70.0	90.0
Fail. Stress, psi		16.3	31.7	56.4
Excess Pore Pr., psi		6.6	11.0	22.2
Ult. Stress, psi				
Excess Pore Pr., psi				
$\bar{s}_1$ Failure, psi		19.7	40.7	74.3
$\bar{s}_3$ Failure, psi		3.4	9.0	17.8

Type of Test:
CU with Pore Pressures

Sample Type: Remolded from SPT

Description: gray sandy clay

LL= X **PI=** X

Assumed Specific Gravity= 2.7

Remarks: Specimen remolded to 93.0 pcf dry density at 29.0% moisture.

Client: Gannet Fleming, Inc

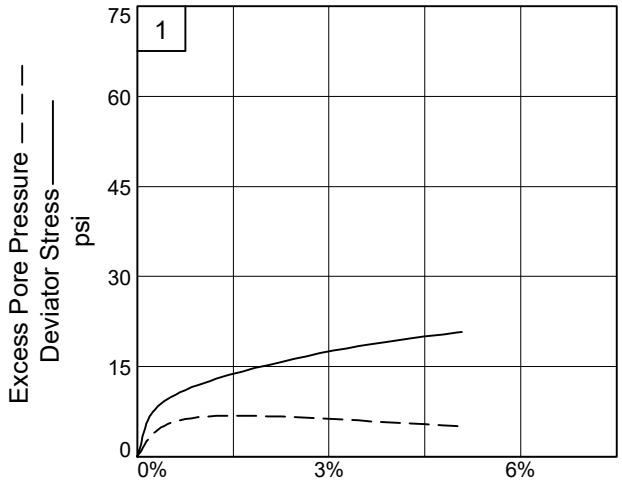
Project: Matejcek Dam

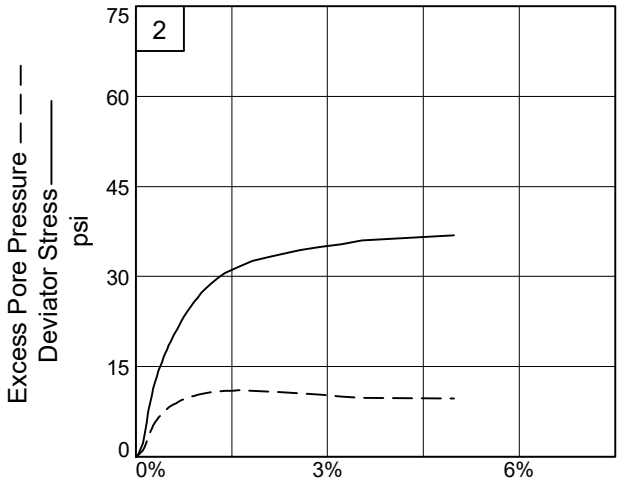
Source of Sample: GF-5 **Depth:** 37.5-50.0 ft

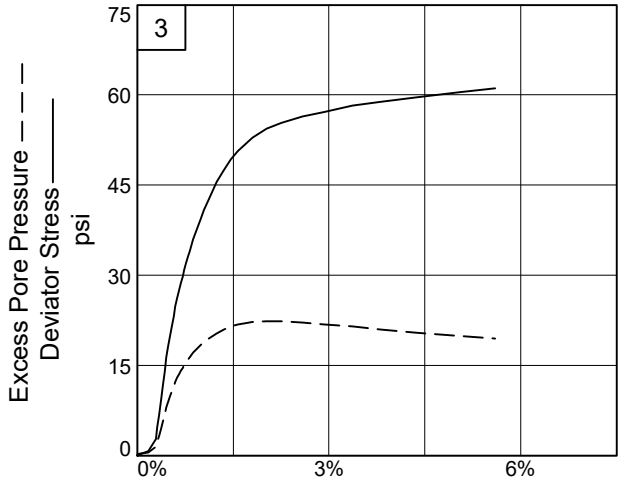
Sample Number: S15-S19

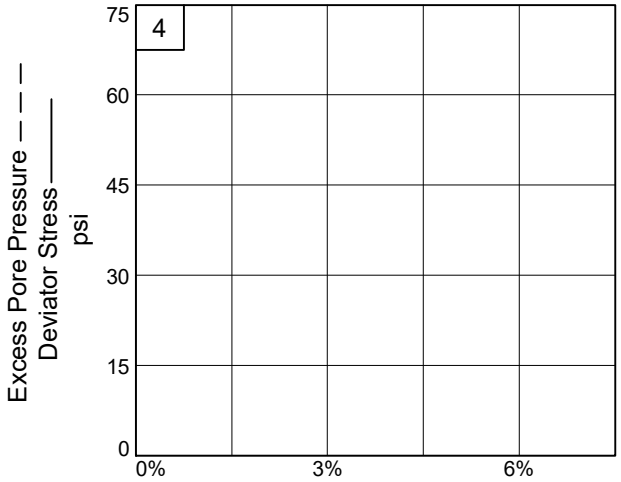
Proj. No.: M5191000 **Date Sampled:** N/A

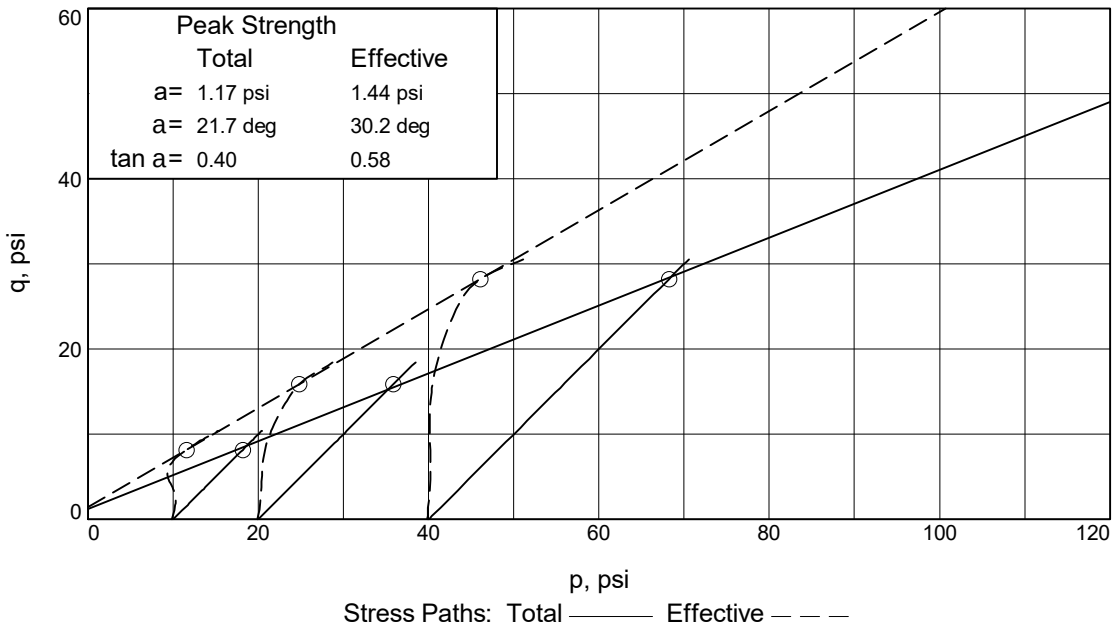
TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN











Client: Gannet Fleming, Inc
Project: Matejcek Dam
Source of Sample: GF-5 **Depth:** 37.5-50.0 ft **Sample Number:** S15-S19
Project No.: M5191000

Terracon Consultants, Inc.

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Matejcek Dam							
Date:	4/18/2019	Panel Number : P-1						
Project No. :	M5191000	Permometer Data						
Boring No.:	GF-6	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	S3-S10	a_a =	0.767120	cm^2		Pipet **Rp**	**9.2**	cm^3
Depth (ft):	7.5-30.0	M_1 =	0.030180	C = 0.0002144		Annulus **Ra**	1.3	cm^3
Other Location:		M_2 =	1.040953	T = 0.1317292				

Material Description : gray sandy clay

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			272.06	g				
Tare or ring Wt. :			0.0	g				
Wet Wt: of Sample :			272.06	g	Tare No.:	52	Tare No.:	N/A
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	126.50	Wet Wt.+tare:	278.79
Length :	1.40	in	3.56	cm	Dry Wt.+tare:	100.00	Dry Wt.+tare:	217.01
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	0.00	Tare Wt:	0.00
Volume :	8.62	in^3	141.27	cm^3	Dry Wt.:	100	Dry Wt.:	217.01
Unit Wt.(wet):	**120.18**	pcf	**1.93**	g/cm^3	Water Wt.:	26.5	Water Wt.:	61.78
Unit Wt.(dry):	**95.00**	pcf	**1.52**	g/cm^3	% moist.:	**26.5**	% moist.:	**28.5**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = OMC =
% of max = +/- OMC =
Calculated % saturation: 99.27 Void ratio (e) = **0.77** Porosity (n)= **0.44**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

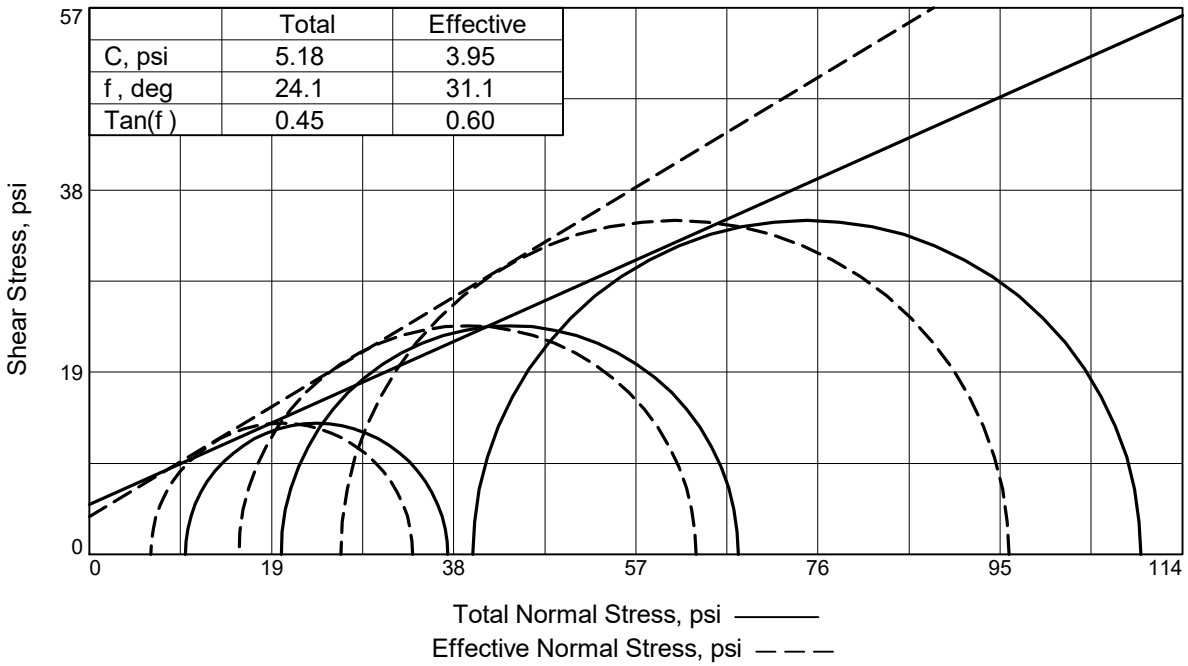
Z_1(Mercury Height Difference @ t_1): 7.9 cm Hydraulic Gradient = 28.00

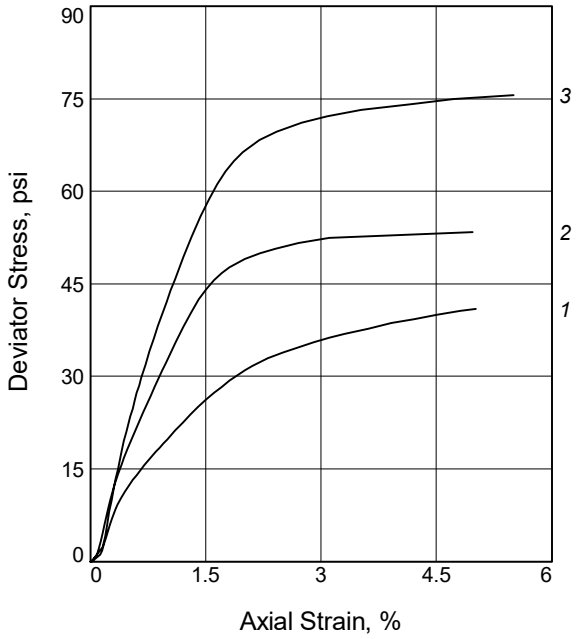
Date	elapsed t (seconds)	Z (pipet @ t)	DZp (cm)	temp (deg C)	a (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
4/15/2019	3	8.6	0.591333	21	0.977	5.66E-06	1.60E-02	
4/15/2019	6	7.5	1.691333	21	0.977	8.80E-06	2.49E-02	
4/15/2019	9	7.4	1.791333	21	0.977	6.26E-06	1.78E-02	
4/15/2019	12	6.9	2.291333	21	0.977	6.27E-06	1.78E-02	

SUMMARY

k_a =	6.75E-06	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	5.66E-06	cm/sec	16.1	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	8.80E-06	cm/sec	30.4	%	
k3 =	6.26E-06	cm/sec	7.2	%	
k4 =	6.27E-06	cm/sec	7.1	%	

Hydraulic conductivity	k =	**6.75E-06**	cm/sec	**1.91E-02**	ft/day
Void Ratio	e =	**0.77**			
Porosity	n =	**0.44**			
Bulk Density	g =	**1.93**	g/cm^3	**120.2**	pcf
Water Content	W =	**0.40**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**6.91E-11**	cm^2	(at 20 deg C)	





Sample No.		1	2	3
Initial	Water Content, %	26.5	26.5	26.5
	Dry Density, pcf	95.0	95.0	95.0
	Saturation, %	92.5	92.5	92.5
	Void Ratio	0.7735	0.7735	0.7735
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	28.1	27.7	27.0
	Dry Density, pcf	95.2	95.9	96.8
	Saturation, %	98.6	98.5	98.5
	Void Ratio	0.7706	0.7581	0.7411
	Diameter, in.	2.801	2.858	2.910
	Height, in.	5.586	5.329	5.091
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.0	50.0	50.0
Cell Pressure, psi		60.0	70.0	90.0
Fail. Stress, psi		27.4	47.7	69.7
Excess Pore Pr., psi		3.6	4.4	13.8
Ult. Stress, psi				
Excess Pore Pr., psi				
$\bar{s}_1$ Failure, psi		33.7	63.3	95.9
$\bar{s}_3$ Failure, psi		6.4	15.6	26.2

Type of Test:
CU with Pore Pressures
Sample Type: Remold
Description: gray sandy clay

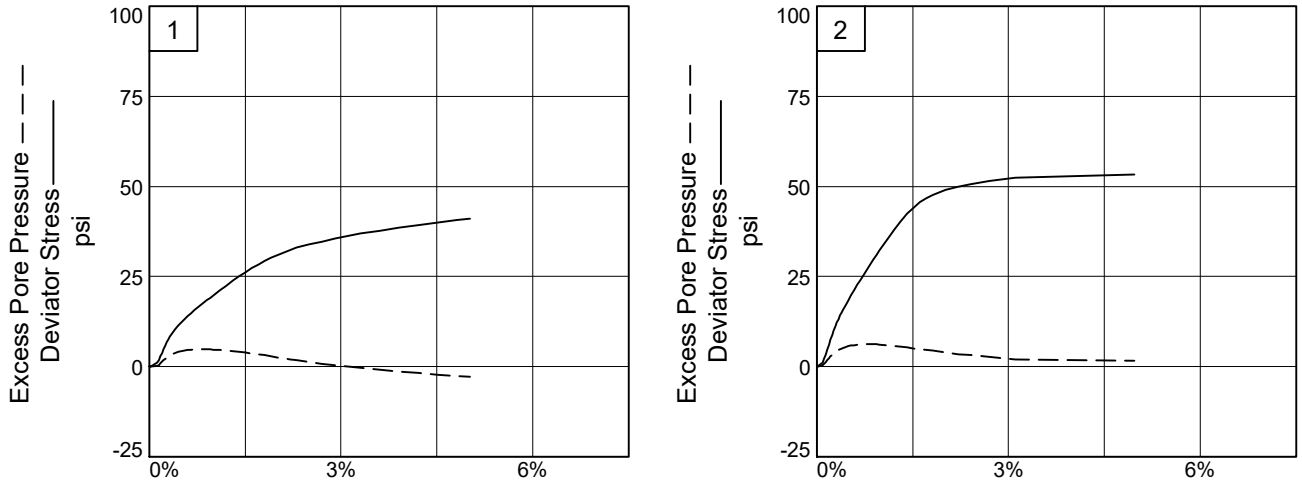
LL= X **PI=** X
Assumed Specific Gravity= 2.7
Remarks: Specimen remolded to 95.0 pcf dry density at 26.5% moisture.

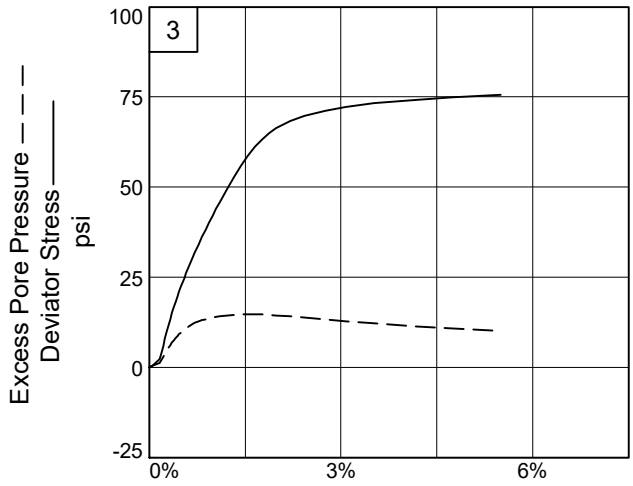
Client: Gannet Fleming, Inc

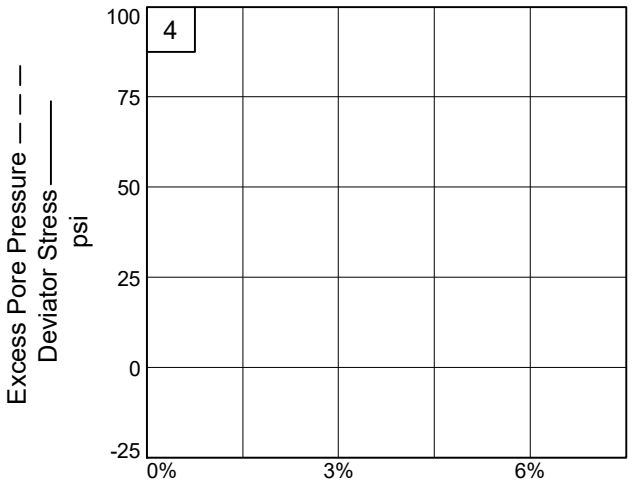
Project: Matejcek Dam

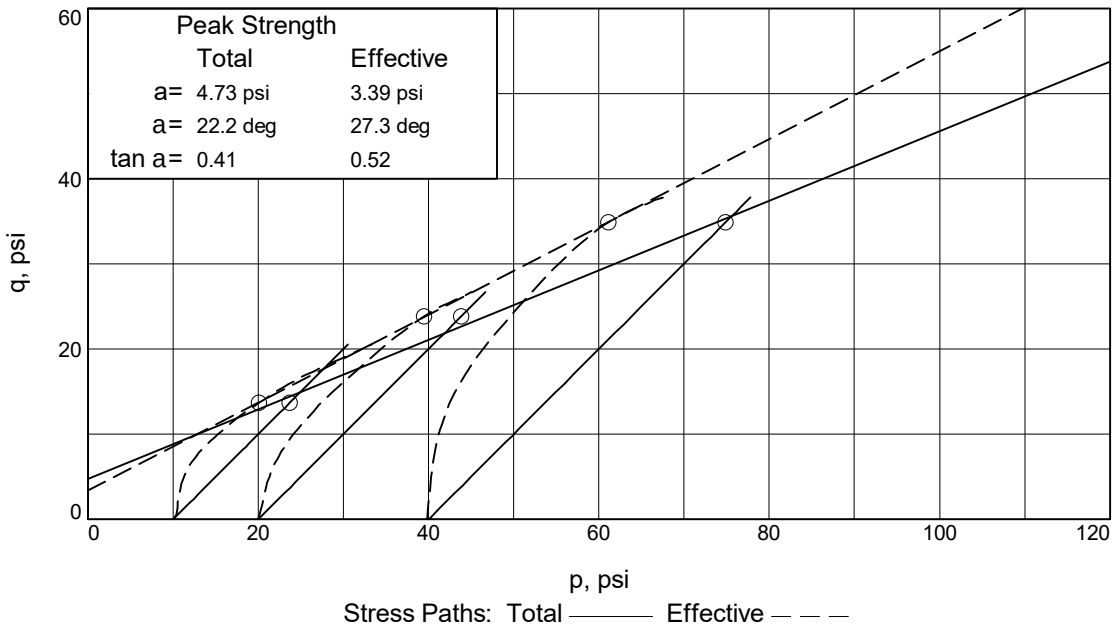
Source of Sample: GF-6 **Depth:** 7.5-30.0 ft
Sample Number: S3-S10
Proj. No.: M5191000 **Date Sampled:** N/A

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN









Client: Gannet Fleming, Inc
Project: Matejcek Dam
Source of Sample: GF-6 **Depth:** 7.5-30.0 ft **Sample Number:** S3-S10
Project No.: M5191000

Terracon Consultants, Inc.

SLAKE DURABILITY of SHALES and OTHER SIMILAR WEAK ROCKS (SDI)
TEST SUMMARY (ASTM D4644-16)

Client: Gannett Fleming, Inc **Date:** 4/5/2019

Project: Matejcek dam **Project No:** M5191000

Location:

Lab No.:			2112
Boring No.:			GF-2
Sample No.:			
Depth (ft):			48-49.5'
Tare Weight (grams):			844.1
Moist weight, Sample+Tare (gram			1306.2
Dry weight, Sample+Tare (grams			1221.4
Natural Moisture Content (%):			**22.5**
After Cycle No. 1			
Temperature (°F)			Dry Weight, Sample
Start	End	Average	+Tare (grams)
21	21	21	1045.6
After Cycle No. 2			
Temperature (°F)			Dry Weight, Sample
Start	End	Average	+Tare (grams)
21	21	21	917.6
SLAKE DURABILITY INDEX (%):			**19.5**
Fragment Type (1, 2 or 3):			**3**
Material Description:	Shale		
Notes/Comments:			



Before Test



After Test

Lab No.:			2114
Boring No.:			GF-2
Sample No.:			
Depth (ft):			55-56.5'
Tare Weight (grams):			845.5
Moist weight, Sample+Tare (gram			1316.2
Dry weight, Sample+Tare (grams			1241.8
Natural Moisture Content (%):			**18.8**
After Cycle No. 1			
Temperature (°F)			Dry Weight, Sample
Start	End	Average	+Tare (grams)
21	21	21	1125.5
After Cycle No. 2			
Temperature (°F)			Dry Weight, Sample
Start	End	Average	+Tare (grams)
21	21	21	1006.8
SLAKE DURABILITY INDEX (%):			**40.7**
Fragment Type (1, 2 or 3):			**2**
Material Description:	Shale		
Notes/Comments:			



Before Test



After Test

Terracon Consultants, Inc. 611 Lunken Park Drive Cincinnati, Ohio 45226

P [513] 321 5816 F [513] 321 0294 terracon.com

APPENDIX G

Calculations

APPENDIX G

Calculations

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   g. Downstream Slope Stability at Flood Pool, Assumes Impenetrable Rock G-161
   h. Rapid Drawdown G-169

Title: Geotechnical Parameters for SITES Analysis

Project: Matejcek Dam

GJ Job #: 064799

Calculations:

- Headcut Erodibility Index and SITES parameters for overburden (soil) stratigraphy
- Headcut Erodibility Index and SITES parameters for rock stratigraphy

References:

- NRCS. 2001. NEH Chapter 52. Field Procedures Guide for the Headcut Erodibility Index.
- Gannett Fleming. 2019. Matejcek Dam boring logs.
- Bowles, J.E. 1996. Foundation Analysis and Design, 5th ed.
- Terracon. 2019. Matejcek Dam Laboratory Testing Results.
- Hvorslev, M.J. 1962. Subsurface Exploration and Sampling for Civil Engineering Purposes. Table 6, page 120.

Summary:

Overburden (Soil) Layers

Layer	Unit Weight (pcf)	% Clay	K_h	D_{75} (mm)	PI
Outwash	92	14	0.042	2.0	0
Till	95	20	0.102	0.1	13
Lacustrine	100	20	0.049	0.5	0

(See Overburden Calcs for Individual Depths)

Rock Layer

Layer	Unit Weight (pcf)	K_h	D_{75} (in)
Rock	121	2.0	1.375

Top of Rock: Borehole GF-2 = 42.5 ft, Borehole GF-3 = 43.5 ft

Gannett Fleming

By: EJB Date: May 2019
Chkd by: KEC Date: July 2019

Title: Geotechnical Parameters for SITES Analysis

Project: Matejcek Dam
GF Job #: 064799

Purpose: Determine the Headcut Erodibility Index, K_h, for overburden (soil) stratigraphy, and parameters needed for SITES model.

References:
1. NRCS. 2001. NEH Chapter 52. Field Procedures Guide for the Headcut Erodibility Index.
2. Gannett Fleming. 2019. Matejcek Dam boring logs.
3. Bowles, J.E. 1996. Foundation Analysis and Design, 5th ed.
4. Terracon. 2019. Matejcek Dam Laboratory Testing Results.
5. Hvorslev, M.J. 1962. Subsurface Exploration and Sampling for Civil Engineering Purposes. Table 6, page 120.

Calculation:

From Ref. 1:

Headcut Erodibility, $K_h = M_s \times K_b \times K_d \times J_s$

Where: M_s = material strength number of the earth material
K_b = block or particle size number
K_d = discontinuity or interparticle bond shear strength number
J_s = relative ground structure number

The subsurface exploration at Matejcek Dam encountered three distinct soil layers (see Ref. 2):

Glacial Outwash:
GF-2: 2.5' - 7.5', field classified as clayey SAND (sc)
GF-2: 7.5' - 10.0', field classified as silty SAND with gravel (sm)
GF-3: 2.5' - 10.5', laboratory classified as silty SAND (SM)

Glacial Till:
GF-2: 10.0' - 20.0' & 27.0'-37.5', laboratory classified as sandy SILT (ML)
GF-2: 20.0' - 22.5', field classified as silty SAND with gravel (sm)
GF-2: 37.5' - 42.5', field classiefied as sandy SILT (ml)
GF-3: 10.5' - 15.5' & 40.0'-43.5', field classified as clayey SAND with gravel (sc)
GF-3: 15.5' - 40.0', field classified as clayey SAND (sc)

Glaciolacustrine:
GF-2: 22.5'-27.0': field classified as sandy SILT (ml)

Determine soil strength parameter, M_s:

Use Ref. 1, Table 52-2 and 53-3 to determine M_s. Use Ref. 5 to correlate split-spoon sampler blow counts (summations or 2nd and 3rd 6-inch intervals) to relative density for soils; correlate relative soil density to M_s. Relative density descriptors and corresponding M_s values are not dependent on the cohesiveness of the soils, e.g., a loose cohesionless soil and a soft cohesive soil both yield M_s = 0.02 to 0.05.
Glacial Outwash:

Boring	Depth (ft)	Sampler Blows (bpf)	Density Description	USCS
2	2.5 - 5	68	very dense	sc
2	5 - 7.5	26	medium dense	sc
2	7.5 - 10	29	medium dense	sm
3	2.5 - 5	14	medium dense	SM
3	5 - 7.5	30	dense	SM
3	7.5 - 10	21	medium dense	SM

Using Ref. 1, Table 52-3, Glacial Outwash soils have an M_s ranging between 0.05 and 0.45 for medium dense to very dense (i.e., firm) soils.

For Glacial Outwash use $M_{s_Outwash} := 0.10$

Glacial Till:

Boring	Depth (ft)	Sampler Blows (bpf)	Density Description	USCS
2	10 - 12.4	40	dense	ML
2	15 - 16.5	78	very dense	ML
2	20 - 21.5	89	very dense	sm
2	27.5 - 29.5	67	very dense	sc
2	30 - 32	52	very dense	sc
2	35 - 37.5	43	dense	sc
2	37.5 - 40	59	very dense	ml
2	40 - 41.5	80	very dense	ml
3	10 - 12.5	23	medium dense	sc
3	12.5 - 14.5	21	medium dense	sc
3	15 - 16.5	94	very dense	sc
3	17.5 - 20	48	dense	sc
3	20 - 21.9	63	very dense	sc
3	22.5 - 24	77	very dense	sc
3	27.5 - 30	52	very dense	sc
3	30 - 32	48	dense	sc
3	32.5 - 34.5	64	very dense	sc
3	37.5 - 39.5	57	very dense	sc
3	40 - 41.9	69	hard	cl

Using Ref. 1 Table 52-2. Glacial Till soils have an M_s ranging from 0.05 (medium dense) to 0.45 (very dense / hard).

For Glacial Till, use $M_{s_Till} := 0.20$

Glaciolacustrine:

Boring	Depth (ft)	Sampler Blows (bpf)	Density Description	USCS
GF-2	22.5 - 25	42	dense	ml
GF-2	25 - 27.5	44	dense	ml

Using Ref. 1, Table 52-2, Glaciolacustrine soils have an M_s ranging from 0.10 to 0.20.

For Glaciolacustrine, use $M_{s_Lacustrine} := 0.15$ (conservative)

Determine block size, K_b:

Block size is most applicable for rock material. Ref. 1 section 628.5203.b.2 recommends K_b = 1.0 for intact cohesive soils and gravels, which are not descriptive of the onsite soils (silts and sands). Sample worksheets in Ref. 1 Appendix B doesn't provide an option to determin K_b for soils. Therefore, use K_b = 1.0 for conservatism.

$K_{b_Outwash} := 1.0$ $K_{b_Till} := 1.0$ $K_{b_Lacustrine} := 1.0$

Determine discontinuity or interparticle bond shear strength number, K_d:

According to Ref. 1, K_d is approximately equal to tan ϕ'_r where ϕ'_r is the residual friction angle of the soil. Because residual shear testing was not completed, utilize empirical relationships from Ref. 1 to determine ϕ'_r.

Atterberg limit testing on spillway soils per Ref. 4 yielded liquid limits and clay contents depicted below:

Layer	USCS	% clay	LL
Outwash	SM	14	49
Till	ML	22	46
Till	ML	19	39

$LL_{Outwash} := 49$

$LL_{Till} := 42$

Eq. 52-7, for ≤ 20% clay,

$\phi_{r_52.7} := 169.58 \cdot LL_{Outwash}^{-0.4925} = 24.943$

$\phi_{r_52.7} := 169.58 \cdot LL_{Till}^{-0.4925} = 26.911$

Use results of equation 52-10.

$K_{d_Outwash} := \tan(\phi_{r_52.7} \cdot deg) = 0.465$

$K_{d_Till} := \tan(\phi_{r_52.7} \cdot deg) = 0.508$

For Glaciolacustrine, assume ϕ_r=18 degrees. This is reasonable for a minimum residual shear strength for sandy silt material.

$K_{d_Lacustrine} := \tan(18 \cdot deg) = 0.325$

Determine relative ground structure number, J_s:

According to Section 628.5203.d, J_s equals 1.0 for intact soil material (without structure).

$$J_s := 1.0$$

Computation of Headcut Index:

$$K_{h_Outwash} := M_{s_Outwash} \cdot K_{b_Outwash} \cdot K_{d_Outwash} \cdot J_s = 0.05$$

$$K_{h_Till} := M_{s_Till} \cdot K_{b_Till} \cdot K_{d_Till} \cdot J_s = 0.10$$

$$K_{h_Lacustrine} := M_{s_Lacustrine} \cdot K_{b_Lacustrine} \cdot K_{d_Lacustrine} \cdot J_s = 0.05$$

Estimate dry unit weight of soil:

Unit weight test results are unavailable for spillway soils. Use test results for glacial till from testing performed on soil obtained elsewhere onsite. Use Ref. 3 to estimate unit weight for outwash and glaciolacustrine. Assume 20% moisture to determine dry unit weight.

Layer	Density Description (per Ref. 5)	γ_m range (pcf) (per Ref. 3)	Design γ_m (pcf)	Design γ_d (pcf)
Outwash	medium dense	108 - 127	110	92
Till	dense	108 - 140	120	95
Lacustrine	dense	108 - 140	120	100

Determine representative particle diameter:

The representative particle diameter, D_{75}, is another SITES parameter that needs to be established for input into the model. Use Ref. 4 for Till, estimate Outwash and Lacustrine based on boring log descriptions.

Outwash: Use D_{75} = 2 mm Till: Use D_{75} = 0.11 mm Lacustrine: Use D_{75} = 0.5 mm

Determine plasticity index:

From Ref. 2 and 4:

Till: Use PI = 13

Outwash and Lacustrine: use PI = 0.

Summary Table for Matejcek Dam Soil Overburden Parameters

Layer	Unit Weight (pcf)	% Clay	K_h	D_{75} (mm)	PI
Outwash	92	14	0.042	2.0	0
Till	95	20	0.102	0.1	13
Lacustrine	100	20	0.049	0.5	0

Gannett Fleming

By: EJB Date: May 2019
Chkd by: KEC Date: July 2019

Title: Geotechnical Parameters for SITES Analysis

Project: Matejcek Dam
GF Job #: 064799

Purpose: Determine the Headcut Erodibility Index, K_h, for rock stratigraphy and parameters needed for SITES model.

References:
1. NEH Chapter 52, Field Procedures Guide for the Headcut Erodibility Index, 2001.
2. Matejcek Dam Boring Logs
3. Matejcek Dam Laboratory Testing Results

Typically, the Microsoft Excel spreadsheet provided by NRCS would be utilized to determine K_h for rock strata. However, extensive site reconnaissance, including strike and dip measurements of representative joints has not been completed at the site. Therefore, the method used to determine K_h will be more conservative and not readily computed using the NRCS spreadsheet method. The guidelines in NEH Chapt. 52 (Ref. 1) will still be followed.

Headcut Erodibility, $K_h = M_s \times K_b \times K_d \times J_s$

Where: M_s = material strength number of the earth material
K_b = block or particle size number
K_d = discontinuity or interparticle bond shear strength number
J_s = relative ground structure number

The subsurface exploration at Matejcek Dam encountered one distinct rock layer of clayey shale. This calculation assumes that the clayey shale encountered behaves as a "rock-like" material.

Clayey Shale:
GF-2: 42.5'-59.5'
GF-3: 43.5'-48.8'

Estimate unit weight of rock:

Use all available rock laboratory testing results:

Boring	Depth	Unit Weight (pcf)
GF-2	52 - 53	110
GF-4	110 - 112.5	128
GF-4	120 - 122.5	125

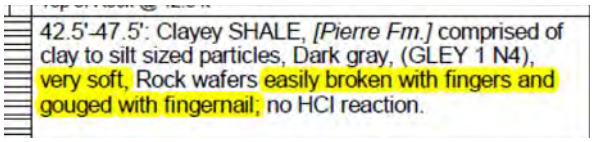
Average		121

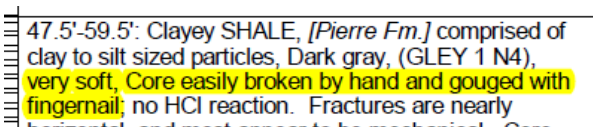
Use average value: $\gamma_{rock} := 121 pcf$

Determine rock strength number, M_s:

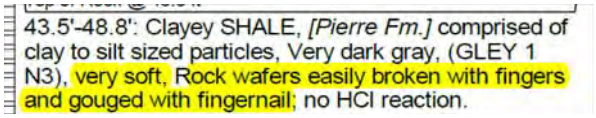
Use Ref. 1, Table 52-4. Base estimation on material descriptions from Ref. 2.

GF-2:





GF-3:



Per Ref. 1, Table 52-4, M_s ranges from 0.45 - 1.0. $M_s := 0.70$

Determine block size, K_b:

For rock and rock like materials, $K_b = \frac{RQD}{J_n}$

Where, RQD = rock quality designation
J_n = joint set number

From Ref. 2, RQD:

Boring	Core Run	RQD Length (ft)	Core Length (ft)
GF-2	R-1	0.8	2
	R-2	1.6	2
	R-3	3	3
	R-4	2.9	5
Total		8.3	12

$RQD := \frac{8.3ft}{12.0ft} \cdot 100 = 69$

A rock joint survey was not conducted on local outcrops or test pit excavations for the rock. Table 52-5 in Ref. 1 correlates J_n to the number of observed joint sets. Since the number of joint sets is unknown, assume more than four joint sets (conservative), thus: $J_n := 5.00$

$K_b := \frac{RQD}{J_n} = 13.8$

Determine discontinuity or interparticle bond shear strength number, K_d:

For rock and rock like materials, K_d is representative of the discontinuity shear strength.

$K_d = J_r / J_a$ Where, J_r = joint roughness number
J_a = joint alteration number

Ref. 2 does not descripe joint roughness condition. For conservatism, assume fractures are smooth and planar. Using Table 52-8 in Ref. 1, use

$$J_r := 1.0$$

Using Table 52-9 in Ref. 1, conservatively estimate J_a. Boring logs (Ref. 2) indicate very soft clayey shale. Boring logs do not indicate that joints have wide apertures - joints appear to be mechanical - assume aperture width is less than 1.0 mm. Assume MH classification is equivalent to high plastic fines. Therefore, use:

$$J_a := 5.0 \qquad K_d := \frac{J_r}{J_a} = 0.2$$

Determine relative ground structure number, J_s:

The relative ground structure number represents the orientation of effective dip of the least favorable discontinuity with respect to spillway flow. For conservatism, J_s = 1.0 indicates a complete lack of structure and is usually used for soils. As stated previously, extensive strike and dip measurements of the bedrock was not completed during this subsurface investigation, therefore, the least favorable discontinuity is not known.

$$J_s := 1.0$$

Computation of Headcut Index:

$$K_{h_rock} := M_s \cdot K_b \cdot K_d \cdot J_s = 1.9$$

Determine representative block size:

The representative block size, D_{75}, is another SITES parameter that needs to be established for input into the model.

Fracture spacing for the clayey shale is not available. Most samples were obtained by split spoon indicating a very soft, "rock-like" structure versus a strongly cemented material. Additionally, slake durabilty tests indicated a slake durability index of Type II and Type III on two different samples from GF-2. For conservatism, use the inside dimension of the core bit (NQ3 = 1-3/8") as the representative block size. Due to uncertainties in determining the representative block size of the clayey shale, it is recommended a sensitivity analysis be conducted on this parameter during SITES to determine the influence of this parameter.

Summary of Matejcek Dam Rock SITES Parameters

$\gamma_{rock} = 121 \cdot pcf$ $K_{h_rock} = 2$ $D_{75} := 1.375 in$

Date Started: 2/16/19	**DRILLING LOG**		Hole Number: 3
Date Finished: 2/16/19	Gannett Fleming		Sheet: 1 of 2
Soil Drilling: 43.5 ft			Line & Station:
Rock Sampling: 5.3 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043		Offset:
Total Depth of Hole: 48.8 ft	Drilling Agency: Interstate Drilling Services, Inc.		N Coordinate: 17526675.5 ft
No. of Undist. Samples: 0	Driller: Jared Zak		E Coordinate: 1902887.8 ft
Total Number of Core Boxes:	Bit Size and Type: N/A	Bulk Sampler: N/A	Elev. Top of Hole: +1362.0 ft
GROUNDWATER OBSERVATIONS	Casing Size: N/A	Spoon Size: 2.0 " OD	Direction of Hole
	Hollow Stem Auger: 3.25 " ID x 6.5 " OD	Hammer Wt.: 140 lb	Vertical ☒ Inclined ☐
	Drilling Fluid: N/A	Hammer Drop: 30.0 "	Degrees from Vertical ---
	Drill Rig: Dietrich 50 Track Rig	Hammer Type: Automatic	Logged By: W. Roman

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.5						Unsampled El. 1359.5	Began 16-Feb-2019 at 0833
2.5 - 5.0	S-1	6-6-8-10-14	1.2	48	SM	2.5'-10.5': Silty SAND with gravel (sm) (GLACIAL OUTWASH), 15% gravel, 60% sand, 25% fines. Gravel is subrounded to rounded, soft, fine, max. particle size: 1"; Sand is fine to coarse, subrounded to rounded; Fines: low plasticity, Light brownish gray (2.5Y 6/2), Dry, Gravel consists of clasts of soft gray shale and light gray chalky dolomite; trace organics; weak to no HCl reaction 2.5'-5': Field dispersion test grade = 1 (non-dispersive)	
5.0 - 7.5	S-2	23-15-15-14-15	0.8	32			
7.5 - 10.0	S-3	7-10-11-9-10	0.5	20		El. 1351.5	P.P. = 2.3 tsf
10.0 - 12.5	S-4	--9-14-13-17	2.3	92		10.5'-15.5': Clayey SAND with gravel (sc) (GLACIAL TILL), 15% gravel, 45% sand, 40% fines. Gravel is subrounded to rounded, soft, fine, max. particle size: 1"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Grayish brown (2.5Y 5/2), Moist, weak HCl reaction, Gravel consists of clasts of light gray dolomite and dark gray shale; some iron-oxide staining 12.5'-14.5': reddish-brown (hematite) staining on fractures in till 12.5'-15': Field dispersion test grade = 3 (dispersive)	P.P. = >4.5 tsf
12.5 - 14.5	S-5	6-10-11-50	2.0	100			
14.5 - 15.0						El. 1346.5	P.P. = >4.5 tsf
15.0 - 16.5	S-6	26-44-50	1.4	93		15.5'-40.0': Clayey SAND (sc) (GLACIAL TILL), 5% gravel, 45% sand, 50% fines. Gravel is angular to subrounded, fine, max. particle size: 1"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Very dark gray (GLEY 1 N3), Moist, Gravel consists of clasts of light gray dolomite, dark gray shale, and red granite; weak to strong HCl reaction	
16.5 - 17.5							P.P. = >4.5 tsf
17.5 - 20.0	S-7	12-21-27-30-32	2.3	92			
20.0 - 21.9	S-8	9-23-40-50	1.8	95			P.P. = >4.5 tsf
21.9 - 22.5							
22.5 - 24.0	S-9	15-27-50	1.5	100		22.5'-24': strong HCl reaction 22.5'-24': Field dispersion test grade = 1 (non-dispersive)	P.P. = >4.5 tsf

Purpose: sample auxiliary spillway materials
Drilling Method: Continous split spoon sampling using hollow stem auger; drilled dry.
Termination: 10' of rock or total depth of 35'
Abandonment: Tremie grouted with cement-bentinite grout to full depth.
Additional Remarks: Drilled 5' 215 degrees from staked location.

DRAFT

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 3
Driller: Jared Zak	Gannett Fleming	Sheet: 2 of 2
Inspector: W. Roman		Elev. Top of Hole: +1362.0 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
24.0 - 25.0							
25.0 - 25.3	S-10	50	0.0	0		25.0'-25.3': no recovery	
25.3 - 27.5							
27.5 - 30.0	S-11	16-21-31-40-50	2.4	96		27.5'-30': strong HCl reaction	P.P. = >4.5 tsf
30.0 - 32.0	S-12	8-20-28-50	1.5	75		30'-32': includes clasts of red granite; slightly more moist; stong HCl reaction	P.P. = >4.5 tsf
32.0 - 32.0							
32.5 - 34.5	S-13	12-28-36-50	2.0	100		32.5'-34.5': strong HCl reaction	P.P. = >4.5 tsf
34.5 - 35.0							
35.0 - 36.0	S-14	22-50	1.0	100		35'-36': strong HCl reaction	P.P. = >4.5 tsf
36.0 - 37.5							
37.5 - 39.5	S-15	14-23-34-50	0.0	0		37.5'-39.5': no recovery	
39.5 - 40.0						El. 1322.0	
40.0 - 41.9	S-16	11-23-46-50	1.9	100		40.0'-43.5': Sandy CLAY with gravel (cl) (GLACIAL TILL), 15% gravel, 30% sand, 55% fines. Gravel is angular to subangular, soft, fine, max. particle size: 1"; Sand is fine to medium, subrounded to rounded; Fines: medium to high plasticity, Very dark gray (GLEY 1 N3), Moist, no HCl reaction, Gravel consists of clasts of dark gray shale; shaley till	P.P. = >4.5 tsf
41.9 - 42.5							
42.5 - 44.3	S-17	20-32-41-50	1.5	83		El. 1318.5 40'-41.5': Field dispersion test grade = 4 (highly dispersive) Top of Rock @ 43.5 ft	P.P. = >4.5 tsf
44.3 - 44.5							
44.5 - 45.8	S-18	11-23-46-50	1.7	100		43.5'-48.8': Clayey SHALE, *[Pierre Fm.]* comprised of clay to silt sized particles, Very dark gray, (GLEY 1 N3), very soft, Rock wafers easily broken with fingers and gouged with fingernail; no HCl reaction. 44.5'-45.8': specks of light gray dolomite 44.5'-45.8': Field dispersion test grade = 4 (highly dispersive) MH	P.P. = 1.5 to >4.5 tsf SPT completed 48.8' at 1050 16-Feb-2019. Boring grouted immediately after completion on 16-Feb-2019.
45.8 - 47.5							
47.5 - 48.8	S-19	20-25-50	1.3	100		El. 1313.2	P.P. = >4.5 tsf

Bottom of Borehole at 48.8 feet.

DRAFT

Date Started: 2/15/19	**DRILLING LOG**		Hole Number: 2
Date Finished: 2/15/19	Gannett Fleming		Sheet: 1 of 3
Soil Drilling: 40.0 ft			Line & Station:
Rock Sampling: 19.5 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043		Offset:
Total Depth of Hole: 59.5 ft	Drilling Agency: Interstate Drilling Services, Inc.		N Coordinate: 17526583.5 ft
No. of Undist. Samples: 0	Driller: Jared Zak		E Coordinate: 1902580.6 ft
Total Number of Core Boxes: 2	Bit Size and Type: NQ3	Bulk Sampler: N/A	Elev. Top of Hole: +1361.6 ft
GROUNDWATER OBSERVATIONS At 0.5 ft after 0 Hrs At 9.3 ft after 19 Hrs Elev. 1352.3 ft after 19 Hrs	Casing Size: N/A	Spoon Size: 2.0 " OD	Direction of Hole
	Hollow Stem Auger: 3.25 " ID x 6.5 " OD	Hammer Wt.: 140 lb	Vertical ☒ Inclined ☐
	Drilling Fluid: Quick Gel	Hammer Drop: 30.0 "	Degrees from Vertical ---
	Drill Rig: Dietrich 50 Track Rig	Hammer Type: Automatic	Logged By: W. Roman

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.5						Unsampled El. 1359.1	Began 15-Feb-2019 at 1218.
2.5 - 5.0	S-1	30-38-30-27-24	1.0	40		2.5'-7.5': Silty SAND (sc) (GLACIAL OUTWASH), 10% gravel, 50% sand, 40% fines. Gravel is subangular to rounded, soft, fine, max. particle size: <0.5"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Light brownish gray (2.5Y 6/2), Dry, strong HCl reaction, homogeneous, fine gravel and coarse sand consists of clasts of soft white chalky chert, soft gray shale, and trace pink granite; trace organics	
5.0 - 7.5	S-2	10-13-13-14-16	0.9	36		5'-7.5': includes pieces of high plasticity gray clay El. 1354.1	
7.5 - 10.0	S-3	8-11-18-25-27	1.8	72		7.5'-10.0': Silty SAND with gravel (sm) (GLACIAL OUTWASH), 15% gravel, 60% sand, 25% fines. Gravel is subangular to rounded, fine, max. particle size: <1"; Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Grayish brown (2.5Y 5/2), Dry to Moist, strong HCl reaction, homogeneous, fine gravel and coarse sand consists of clasts of soft white chalky chert, soft gray shale, and hard granodiorite El. 1351.6	P.P. = 3.6 to >4.5 tsf 2.5'-10': Overall fining-upward sequence
10.0 - 12.4	S-4	14-14-26-38-50	2.0	83		7.5'-10': Field dispersion test grade ranges from 1 (non-dispersive) to 3 (dispersive)	P.P. = >4.5 tsf
12.4 - 12.5 12.5 - 13.8	S-5	14-32-50	1.2	92		10.0'-20.0': Clayey SAND (sc) (GLACIAL TILL), 10% gravel, 50% sand, 40% fines. Gravel is subangular to rounded, soft, fine, max. particle size: <0.5"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Grayish brown (2.5Y 5/2), Moist, strong HCl reaction, homogeneous, fine gravel and coarse sand consists of clasts of soft white chalky chert and gray shale; reddish-brown mottling	P.P. = >4.5 tsf
13.8 - 15.0						15'-16.5': reddish-brown (hematite) staining on fractures in till 15'-16.5': Field dispersion test grade = 2 (intermediate)	
15.0 - 16.5	S-6	17-28-50	1.3	87			P.P. = >4.5 tsf
16.5 - 17.5							
17.5 - 18.5	S-7	45-50	0.0	0		17.5'-18.5': No recovery ML	
18.5 - 20.0						El. 1341.6	
20.0 - 21.5	S-8	18-39-50	1.1	73		20.0'-22.5': Silty SAND with gravel (sm) (GLACIAL TILL), 20% gravel, 35% sand, 45% fines. Gravel is angular to subrounded, Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Dark gray (5Y 4/1), Moist, strong HCl reaction, homogeneous, Gravel consists of clasts of tan dolomite and light gray quartzite, broken by sampling	
21.5 - 22.5						El. 1339.1	
22.5 - 25.0	S-9	10-15-27-40-47	2.3	92			

Purpose: sample auxiliary spillway materials
Drilling Method: Continous split spoon sampling using hollow stem auger, drilled dry to 47.5'; NQ3 coring with Quick Gel to 59.5'.
Termination: 10' of rock or total depth of 35'
Abandonment: Tremie grouted with cement-bentinite grout to full depth.
Additional Remarks: Drilled 6' east of staked location.

DRAFT

Log Checked By: ,

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 2
Driller: Jared Zak	Gannett Fleming	Sheet: 2 of 3
Inspector: W. Roman		Elev. Top of Hole: +1361.6 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
						22.5'-27.0': Sandy SILT (ml) (GLACIOLACUSTRINE), 45% sand, 55% fines. max. particle size: <3/16"; Sand is fine to coarse, subrounded to rounded; Fines: low plasticity, Very dark gray (GLEY 1 N3), Moist, weak HCl reaction, varved structure, alternating light and dark gray; sand is mostly very fine to fine-grained	
25.0 - 27.5	S-10	12-20-24-33-45	2.2	88		22.5'-25': Field dispersion test grade = 3 (dispersive) El. 1334.6	P.P. = >4.5 (in till) tsf Collected two jars: S-10A with varved material from 26'-27'; S-10B with till material from bottom of S-10.
27.5 - 29.5	S-11	18-25-42-50	0.1	5		27.0'-37.5': Clayey SAND (sc) (GLACIAL TILL), 5% gravel, 50% sand, 45% fines. Gravel is subangular to rounded, soft, fine, max. particle size: <1/4"; Sand is fine to coarse, subrounded to rounded; Fines: medium to high plasticity, Very dark gray (GLEY 1 N3), Moist, strong HCl reaction, homogeneous, Gravel consists of fine clasts of tan dolomite, pink quartzite, and gray shale	
29.5 - 30.0							
30.0 - 32.0	S-12	11-19-33-50	2.0	100		Weak HCl reaction 30'-35'	P.P. = >4.5 tsf
32.0 - 32.5						30'-32': Field dispersion test grade = 4 (highly dispersive)	
32.5 - 33.5	S-13	26-50	1.0	100		ML	P.P. = >4.5 tsf
33.5 - 35.0							
35.0 - 37.5	S-14	12-18-25-33-38	1.2	48		El. 1324.1	P.P. = 4 tsf
37.5 - 40.0	S-15	11-23-36-50-50	1.4	56		37.5'-42.5': Sandy SILT (ml) (GLACIAL TILL), 5% gravel, 20% sand, 75% fines. Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Dark gray (GLEY 1 N4), Moist, weak HCl reaction, homogeneous, local shale till (possible ice-thrust rock block); includes broken fragments of light gray (2.5Y 7/1) dolomite; trace pyrite	P.P. = >4.5 tsf
40.0 - 41.5	S-16	13-30-50	1.4	93		37.5'-40': Field dispersion test grade = 4 (highly dispersive)	P.P. = >4.5 tsf
41.5 - 42.5						Top of Rock @ 42.5 ft El. 1319.1	
42.5 - 43.3	S-17	31-50	0.8	100		42.5'-47.5': Clayey SHALE, *[Pierre Fm.]* comprised of clay to silt sized particles, Dark gray, (GLEY 1 N4), very soft, Rock wafers easily broken with fingers and gouged with fingernail; no HCl reaction.	
43.3 - 45.0						MH	
45.0 - 45.9	S-18	29-50	0.9	100		45'-47.5': Field dispersion test grade = 4 (highly dispersive)	
45.9 - 47.5						El. 1314.1	
47.5 - 49.5	R-1	0.8' / 40%	2.0	100		47.5'-59.5': Clayey SHALE, *[Pierre Fm.]* comprised of clay to silt sized particles, Dark gray, (GLEY 1 N4), very soft, Core easily broken by hand and gouged with fingernail; no HCl reaction. Fractures are nearly horizontal, and most appear to be mechanical. Core develops horizontal hairline fractures.	47.5'-49.5': Gray drill water return (DWR); recovered 1.4'; 0.6' core missing.
49.5 - 51.5	R-2	1.6' / 80%	2.0	100		47.5'-54.7': interbedded clayey and silty shale 50.4'-54.7': scattered light gray calcareous nodules	49.5'-51.5': Gray DWR; recovered 2.3', picking up 0.3' missing core.
51.5 - 54.5	R-3	3.0' / 100%	3.0	100			51.5'-54.5': Gray DWR; recovered 3.3', picking up remaining missing core; all breaks mechanical.
54.5 - 59.5	R-4	2.9' / 58%	4.5	90		54.7'-57': mostly clay shale 57'-58.5': interbedded clayey and silty shale with scattered calcareous nodules	54.5'-59.5': Gray DWR; 0.5' core missing. NQ3 coring completed at 59.5' at 1710 15-Feb-2019. Boring grouted 1300 on 16-Feb-2019.

DRAFT

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 2
Driller: Jared Zak		Sheet: 3 of 3
Inspector: W. Roman	Gannett Fleming	Elev. Top of Hole: +1361.6 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
						58.5'-59': clayey shale El. 1302.1	

Bottom of Borehole at 59.5 feet.
Total Core Recovery: 96%
Total RQD: 69%

DRAFT

Ref. 5

Hvorslev & Jull 1965 → Subsurface Exploration for Civil Engineering

data only provide a rough, not always dependable indication of the consistency or relative density of the soil, and that the penetration resistance depends on many other factors discussed below in groups pertaining to equipment, procedure, and soil conditions.

TABLE 6 - SOME PROPOSED CORRELATIONS OF PENETRATION RESISTANCE AND SOIL PROPERTIES

Extreme caution should be exercised in using any table of correlations outside the areas or for other conditions than those for which the correlations have been established; even then large deviations from such correlations have been reported. The penetration resistance depends not only on dimensions of the equipment and the consistency or relative density of the soil, but it may also vary with the method of operation, depth below ground surface, and other factors not yet fully investigated.

AUTHOR	H. A. MOHR		TERZAGHI AND PECK		NEW YORK CITY CODE		NEW ENGLAND DIV., C.E.	
SAMPLER	1-in. Extra Heavy Pipe 1.315-in. OD, 0.957-in. ID		Raymond - Fig. 178 2.0-in. OD, 1.375-in. ID		2.50-in. OD		3.00-in. OD	
HAMMER	140 lb ±, 30-in. ± Fall		140 lb, 30-in. Fall		300 lb, 18-in. Fall		300 lb, 18-in. Fall	
SOIL	Designation	Blows/Ft.	Designation	Blows/Ft.	Designation	Blows/Ft.	Designation	Blows/Ft.
SAND and SILT — Rel. Density	Loose	Less 9	Very loose	Less 4	Loose	0 - 15	Very loose	Less 8
	Firm	9 - 13	Loose	4 - 10			Loose	8 - 16
	Hard	14 - 49	Medium	10 - 30	Compact	16 - 50	Medium	16 - 55
	Hardpan	Over 50	Dense	30 - 50			Compact	55 - 110
			Very dense	Over 50	Very compact	Over 50	Very compact	Over 110
CLAY — Consistency	Soft	Less 5	Very soft	Less 2	Very soft	0 - 2	Very soft	Less 8
			Soft	2 - 4	Soft	3 - 10	Soft	8 - 16
	Medium	5 - 10	Medium	4 - 8			Medium stiff	16 - 55
			Stiff	8 - 15	Stiff	11 - 30	Stiff to Medium hard	55 - 110
	Hard	11 - 30	Very stiff	15 - 30				
			Hard	Over 30	Hard	Over 30	Very hard	Over 110

Carl, call me Jack x-2391

The factors related to

Ref. 3

Bowles, J.E. 1996. Foundation Analysis & Design, 5th Ed

TABLE 3-4
Empirical values for ϕ, D_r, and unit weight of granular soils based on the SPT at about 6 m depth and normally consolidated [approximately, $\phi = 28° + 15°D_r$ (±2°)]

Description	Very loose	Loose	Medium	Dense	Very dense
Relative density D_r	0	0.15	0.35	0.65	0.85
SPT N'_{70}: fine	1–2	3–6	7–15	16–30	?
medium	2–3	4–7	8–20	21–40	> 40
coarse	3–6	5–9	10–25	26–45	> 45
ϕ: fine	26–28	28–30	30–34	33–38	
medium	27–28	30–32	32–36	36–42	< 50
coarse	28–30	30–34	33–40	40–50	
γ_{wet}, kN/m³	11–16*	14–18	17–20	17–22	20–23
γ_{wet} pcf	70 - 102	90 - 114	108 - 127	108 - 140	127 - 146

* Excavated soil or material dumped from a truck has a unit weight of 11 to 14 kN/m³ and must be quite dense to weigh much over 21 kN/m³. No existing soil has a D_r = 0.00 nor a value of 1.00. Common ranges are from 0.3 to 0.7.

$$\gamma_{dry} = \frac{\gamma_{wet}}{1+w}$$

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-4	44	110.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 2

DISPERSIVE CLASSIFICATION: Intermediate (I)

6 HOUR

GRADE: 3

DISPERSIVE CLASSIFICATION: Dispersive (D)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

Gannett Fleming

Excellence Delivered As Promised

By: EJB Date: May 2019
Chkd by: KEC Date: July 2019

Title: Filter Compatibility of Site Soils

Project: Matejcek Dam, Walsh County, ND
Project No.: 64799

Objective: The existing embankment drain consists of a single coarse aggregate material. No gradation limits are specified. The record drawings state a requirement for pit run sand and gravel. The use of drain materials without specified gradation limits for drains is problematic with respect to compatibility with adjacent embankment and foundation soils.

The existing auxiliary drain, located on the right abutment and downstream of the embankment, is also comprised of a single coarse aggregate material. Record drawings indicate this material is a poorly-graded gravel with a maximum particle size of 3-inches and a minimum particle size equivalent to the No. 4 sieve (4.75 mm). The drain extends below the bentonite layer, so it is assumed that the drainfill is in contact with the clayey shale.

By inspection, neither one of these materials meets state-of-the-practice drainfill gradation criteria for seepage control/conveyance (existing filter materials are too coarse or too broadly graded). Determine acceptable aggregate for use as drainfill at Matejcek Dam.

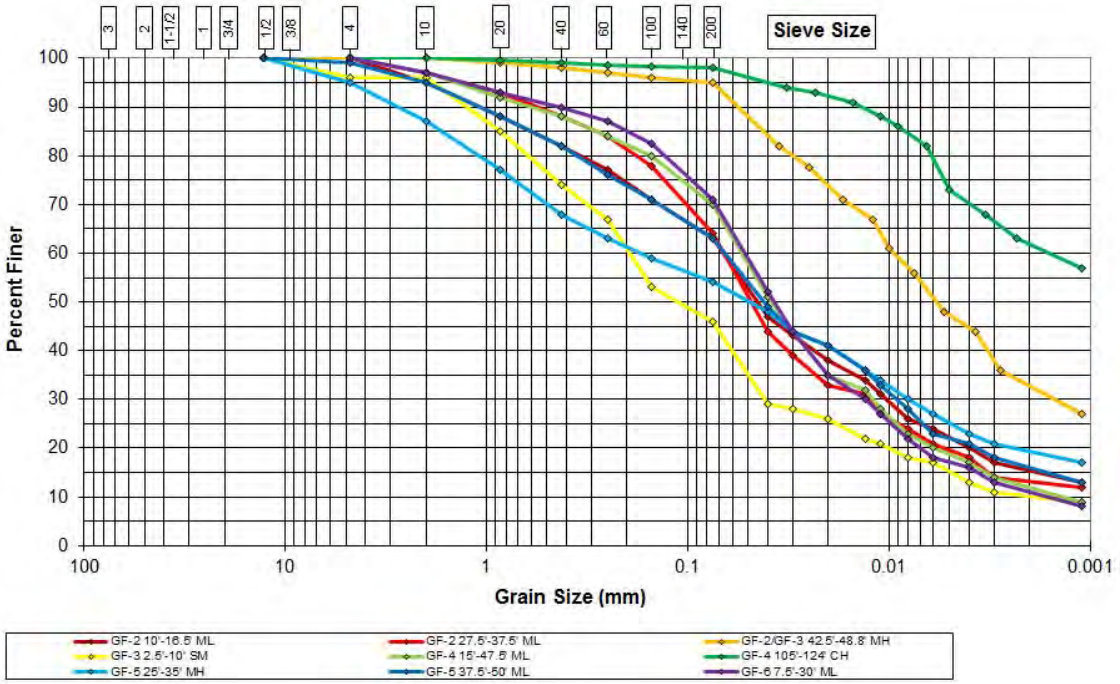
References:

1. NRCS Part 633, Chapter 26, Appendix 26A, Aug 2017.
2. U.S. Army Corps of Engineers, (1995). Appendix C: Summary of CE Dams Containing Broadly Graded Core Materials. Copy of Correspondence from Arthur H. Walz, Jr to Gannett Fleming, Inc.
3. Terracon. 2019. Laboratory Testing Reports.
4. ASTM C33 / C33M. Standard Specification for Concrete Aggregates
5. ASTM C144. Standard Specification for Aggregate for Masonry Mortar
6. ASTM D1073. Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.

Methodology: Use NRCS design criteria to determine a gradation band of suitable drain material. This material will be required to act primarily as a drain, but also as a filter to prevent piping. The computed band will be compared with readily available aggregates. For conservatism, this calculation utilizes the clayey shale (CH) as the base soil as it is the finest site material

Step 1: Plot the gradation curves. All embankment and foundation soils, including the clayey shale are plotted below. **Per field and lab testing, the clayey shale (CH) is dispersive.**

Figure 1. Laboratory Classified Embankment and Foundation Soils



Step 2: Determine if base soils have particles larger than the No. 4 sieve and determine if base soils are gap-graded or potentially internally unstable.

Four of the base soils contain a small fraction of gravel, up to 5.2% per lab testing. Based on the laboratory gradation curves, the base soils do not appear to be gap-graded or internally unstable. Internally unstable soils are generally characterized by the Cu approaching 200 (Ref. 2). Per Ref. 3, all soils have a Cu less than 118.

Step 3: Prepare adjusted gradation curve for base soils that have particles larger than the No. 4 sieve.

a) Obtain a correction factor by dividing 100% by the percent passing the No. 4 sieve. Then multiply the correction factor by the original % passing gradations.

For example, gradation for GF-5 25'-35' MH

$$\%_{passing4sieve} := 95$$

$$Correction_{factor} := \frac{100}{\%_{passing4sieve}}$$

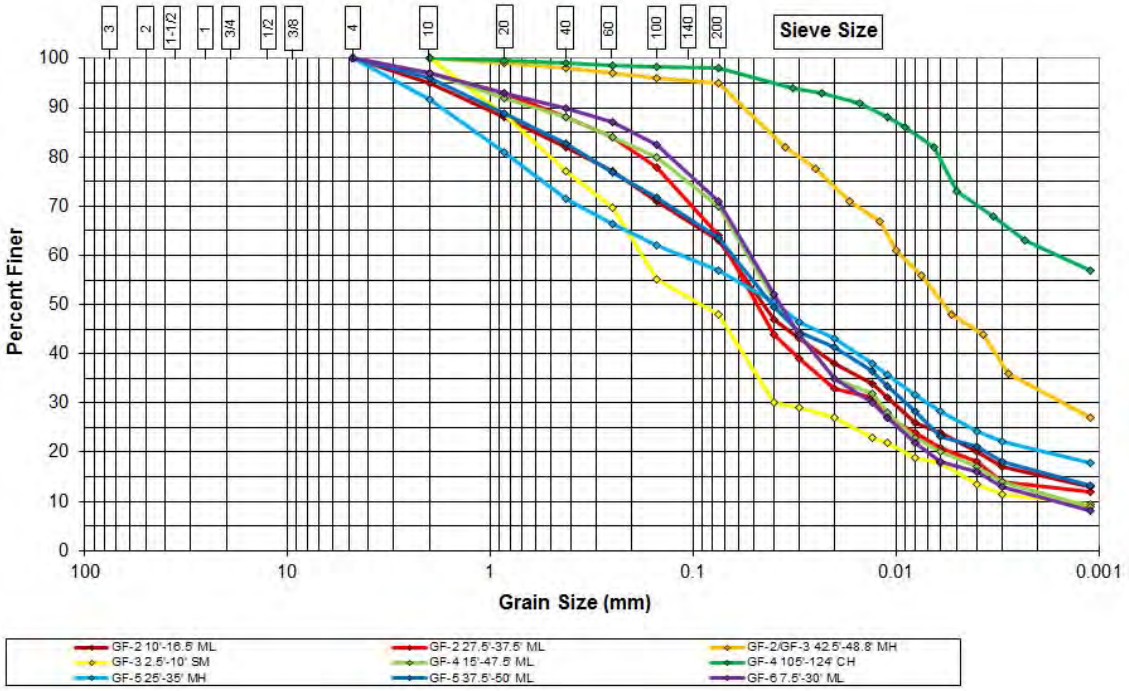
$$Sieve := \begin{pmatrix} "No.\ 4" \\ "No.\ 10" \\ "No.\ 20" \\ "No.\ 40" \\ "No.\ 60" \\ "No.\ 100" \\ "No.\ 200" \end{pmatrix} \qquad GF5 := \begin{pmatrix} 95 \\ 87 \\ 77 \\ 68 \\ 63 \\ 59 \\ 55 \end{pmatrix}$$

Adjusted Gradations
GF-5 25'-35' MH:

$$GF5_{adj} := GF5 \cdot Correction_{factor}$$

$$\text{Sieve} = \begin{pmatrix} \text{"No. 4"} \\ \text{"No. 10"} \\ \text{"No. 20"} \\ \text{"No. 40"} \\ \text{"No. 60"} \\ \text{"No. 100"} \\ \text{"No. 200"} \end{pmatrix} \qquad GF5_{adj} = \begin{pmatrix} 100 \\ 92 \\ 81 \\ 72 \\ 66 \\ 62 \\ 58 \end{pmatrix}$$

Figure 2. Regraded Embankment and Foundation Soils



Step 4: Place the base soil in a Category determined by the percent passing the No. 200 sieve from the regraded gradation curve data according to Ref. 1 Table 26-1.

Table 26–1 Regraded gradation curve data

Base soil category	% finer than No. 200 sieve (0.075 mm) (after regrading, where applicable)	Base soil description
1	> 85	Fine silt and clays
2	40 – 85	Sands, silts, clays, and silty & clayey sands
3	15 – 39	Silty & clayey sands and gravel
4	< 15	Sands and gravel

Seven of the nine soils are Category 2, while two are Category 1.

The most critical soil is the clayey shale, which is a Category 1, dispersive soil.

Step 5: To satisfy filtration requirements, determine the maximum allowable D_{15} size for the filter/drain in accordance with Ref. 1 Table 26-2.

Table 26–2 Filtering criteria

Base soil category	Filtering—maximum D_{15}
1	The maximum D_{15} should be $\le 9 \times d_{85}$ of the base soil, but not less than 0.2 mm, unless the soils are dispersive. Dispersive soils in category 1 require a filter with a maximum D_{15} that is ≤ 6.5 times the d_{85} of the base soil size, but not less than 0.2 mm.
2	The maximum D_{15} should be ≤ 0.7 mm unless soil is dispersive, in which case the maximum D_{15} should be < 0.5 mm.
3	The maximum D_{15} should be: $\le \left(\frac{40-A}{40-15}\right)\left[(4 \times d_{85}) - 0.7\ \text{mm}^*\right] + 0.7\ \text{mm}^*$ A = percent passing No. 200 sieve after regrading (when $4 \times d_{85}$ is less than 0.7 mm*, use 0.7 mm*).
4	The maximum D_{15} should be $\le 4 \times d_{85}$ of base soil after regrading.

* If fines are dispersive, use 0.5 mm rather than 0.7 mm.

For the clayey shale (recall this soil is dispersive):

$d_{85} := 0.008\text{mm}$ $\quad D_{15_max} := \text{if}\left(6.5 d_{85} \le 0.2\text{mm}, 0.2\text{mm}, 6.5 \cdot d_{85}\right) = 0.2 \cdot \text{mm}$

Note: *Even if the clayey shale base soil was not dispersive, the max D_{15} would still be 0.2 mm as 0.009 x 9 = 0.08 < 0.2 mm.*

Conversely, if GF-2/GF-3 MH was utilized as the base soil for design (e.g., in the event that we can be confident that the the clayey shale is not in contact with the drain fill), the max D_{15} would be d_{85} = 0.045 x 9 = 0.4 mm.

Step 6: Establish a minimum D_{15} as the greater of:

- 0.1 mm
- a fifth of the maximum D_{15} size established in step 5
- In some cases, this minimum D_{15} size may be too fine for adequate permeability, and the preliminary design band may need to be narrowed at this step by shifting the minimum D_{15} to be slightly coarser.

$$D_{15_min} := \text{if}\left(\frac{D_{15_max}}{5} \le 0.1\text{mm}, 0.1\text{mm}, \frac{D_{15_max}}{5}\right) = 0.1\cdot\text{mm}$$

Step 7: Establish the minimum and maximum D_{60} sizes of the filter band. Preliminarily assume C_U = 6 and band width of 5 per recommendations in Ref. 1.

$$D_{60_min} := D_{15_max} = 0.2\cdot\text{mm} \qquad D_{60_max} := 5\cdot D_{60_min} = 1\cdot\text{mm}$$

Step 8: Establish the maximum particle size and maximum percentage passing No. 200 sieve.

$$D_{100_max} := 2\text{in} = 50.8\cdot\text{mm} \qquad D_{5_min} := 0.075\text{mm}$$

Step 9: Check segregation potential, determin minimum D_{10} and maximum D_{90}.

Table 26–3 Segregation criteria

Base soil category	If D_{10} is: (mm)	Then, maximum D_{90} is: (mm)
ALL categories	< 0.5	20
	0.5-1.0	25
	1.0-2.0	30
	2.0-5.0	40
	5.0-10	50
	> 10	60

$$D_{10_min} := \frac{D_{15_min}}{1.2} = 0.1\cdot\text{mm}$$

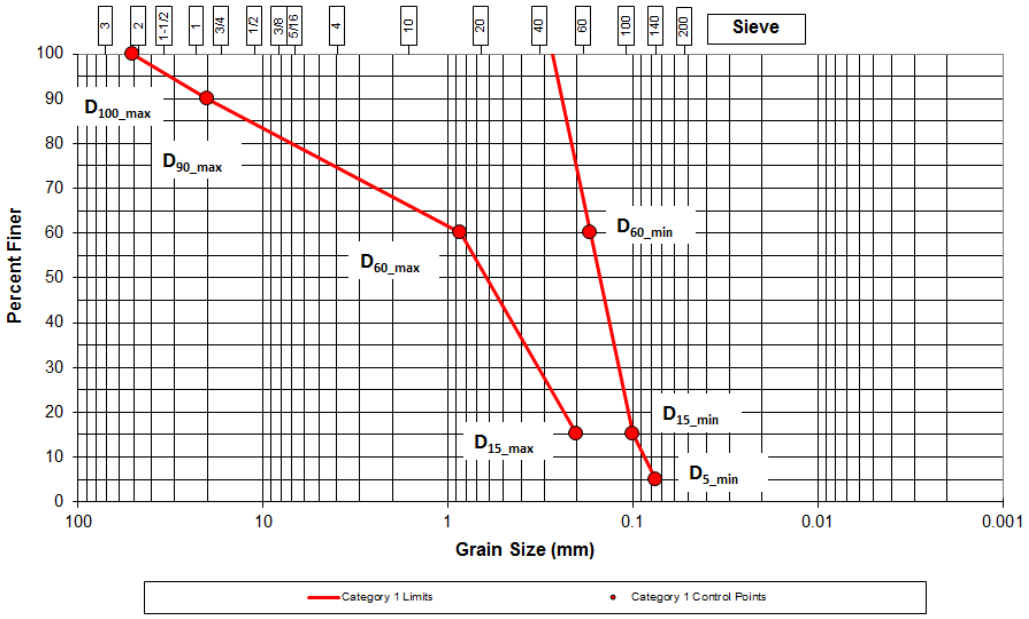
$$D_{90_max} := 20\text{mm}$$

Control Points:

$$\text{Fine}_{CP} := \begin{pmatrix} D_{60_min} \\ D_{15_min} \\ D_{5_min} \end{pmatrix} \qquad \text{Fine}_{CP} = \begin{pmatrix} 0.2 \\ 0.1 \\ 0.08 \end{pmatrix}\cdot\text{mm}$$

$$Coarse_{CP} := \begin{pmatrix} D_{100_max} \\ D_{90_max} \\ D_{60_max} \\ D_{15_max} \end{pmatrix} \qquad Coarse_{CP} = \begin{pmatrix} 50.8 \\ 20.0 \\ 1.0 \\ 0.2 \end{pmatrix} \cdot mm$$

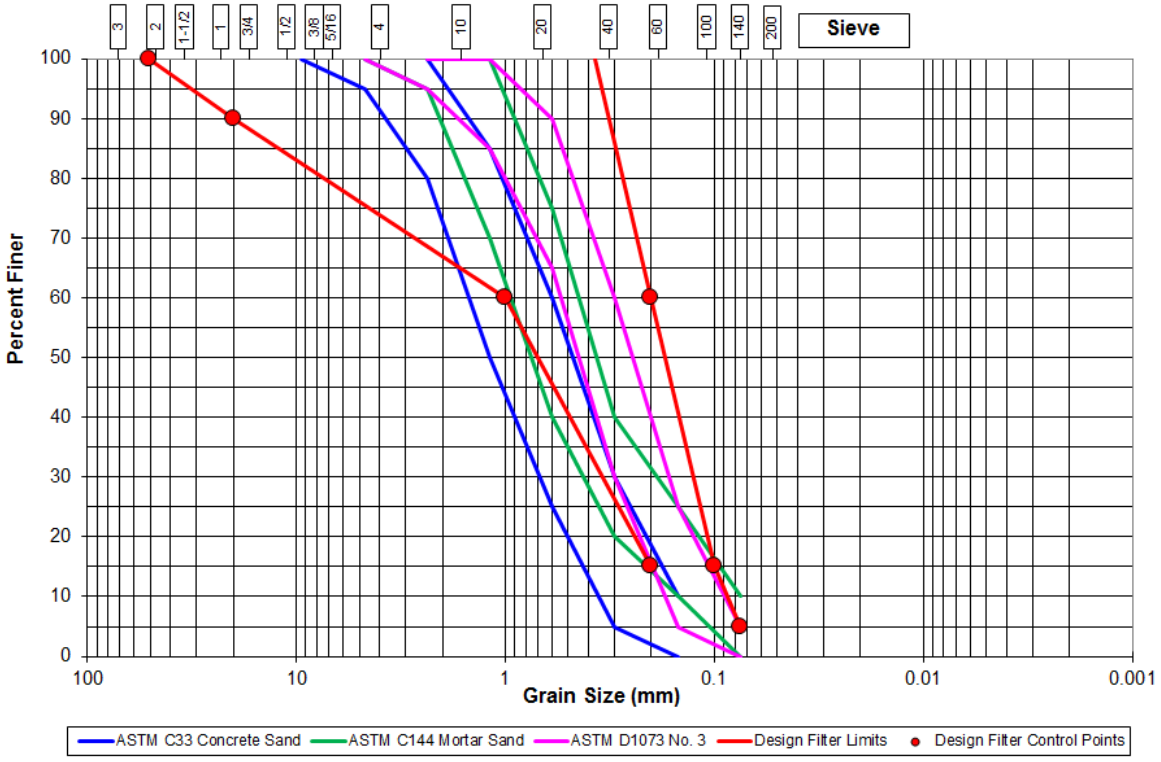
Figure 3. Preliminary Design Filter/Drain Gradation Criteria



The control points of the clayey shale base soil are presented in Figure 3. Per Ref. 1, the control points can be somewhat modified by revising previous assumptions, e.g., the assumed C_u = 6 can be revised such that filter C_u is less than 6, but greater than 2 such that a commercially available aggregate will fit within the control points. However, the minimum and maximum D_{15} are the critical control points and manipulation of these points is not generally recommended. Due to the fine gradation and dispersive potential of the clayey shale base soil the design filter band width at the D_{15} is extremely narrow ($D_{15\ max}$ = 0.2 mm and $D_{15\ min}$ = 0.1 mm). Per Ref. 1, the maximum D_{15} is most critical as this point controls filtration and "filtering should always outweigh permeability", particularly so with dispersive soils. Therefore, the minimum D_{15} could be moved to a finer diameter, but wouldn't necessarily allow for greater availability of commercial aggregates.

Three commercially available aggregates are plotted on Figure 4 for comparison with the computed control points - ASTM C33 fine aggregate (concrete sand), ASTM C 144 Mortar Sand, and ASTM D 1073 Grading No. 3 (fine aggregate for bituminous mixtures).

Figure 4. Design Filter/Drain Gradation Bounds with Commercial Sand Gradations



Per Figure 4, concrete sand, which is commonly used for fine drainfill in dam embankments is too coarse based on the fitler design criteria. ***GF Commentary:*** *ND DOT fine concrete aggregate (maximum D_{15} = 0.36 mm) has a gradation slightly finer than ASTM C 33 fine aggregate (maximum D_{15} = 0.42 mm). If it could be established that the embankment drain will not be in contact with the clayey shale, ND DOT fine concrete aggregate is a viable option for use.*

Mortar sand is an option that meets the D_{15} criteria. The maximum bound between the D_{60} and D_{15} is technically not met, but the use of mortar sand would be permissible in that filtration and permeability (based on maximum and minimum D_{15} criteria) would not be compromised.

ASTM D 1073 Grading No. 3 meets the limits of the design filter band, but may not be readily available local to Matejcek Dam. ND DOT specifications list two fine aggregate gradations for bituminous mixtures but both of these are more coarse than ASTM D 1073 Grading No. 3.

Conclusion:

It is recommended that mortar sand meeting the gradation requirements of ASTM C 144 be used as the drain fill aggregate at Matejcek Dam based on the field and laboratory investigations completed to date.

Ref. 2

APPENDIX C: SUMMARY OF CE DAMS CONTAINING BROADLY GRADED CORE MATERIALS

Background

According to Sherard (1979) there have been a number of incidents in recent years in which sinkholes or craters have appeared on the crest or slopes of dams generally associated with piping in the form of concentrated erosive leaks at the downstream toe. Each of the dams was constructed of a broadly graded soil, generally of glacial origin ranging from a maximum particle size of about 3 in. (75 mm) down to about 10 to 50 percent passing the No. 200 sieve. For such soil, the grain size distribution curve on a semilogarithmic plot is a straight line or is slightly convex upward i.e., in the direction of increasing grain size. The range of grain size curves for these soils in dams which have experienced seepage distress is shown in Figure 1. The fines are either nonplastic or of low to medium plasticity. The piping which occurs, tends to remove the fine fraction of the soil, leaving a granular residue or cavities which are subject to further collapse.

An incident similar to those reported above was reported by Talbot and Ralston (1985). A large sinkhole developed near the crest of Brodhead Dam in 1984. The dam located in Pennsylvania is an earthfill structure, 88 ft. high, constructed of broadly graded glacial soils. Subsequent excavations in the dam, exposed numerous large cavities including vertical holes as much as 8 ft. in diameter and 28 ft. deep. Some pockets of coarse gravel were found near the lower elevations of the cavities. The embankment soils were classified as a silty sand with gravel. The gradation curve is shown in Figure 2 together with the range of gradation curves involved in incidents reported by Sherard (1979).

Recent investigations described by Graybeal (1988) at Mud Mountain Dam, a 420 ft. high earth and rock silt dam in Washington, have also disclosed extensive core deterioration presumably due to seepage. Investigations indicated the presence of interconnected cracks and zones where most of the fines have apparently been washed out of the broadly graded impervious core materials. The lower portion of the dam where the fines have been washed out consisted primarily of a gravelly silty or clayey sand. The range of grain size curves for the embankment soils is also shown on Figure 2.

The dams involved in the above incidents have required extensive and costly remedial treatment. Although the presence of broadly graded glacial soils is a common factor in the incidents, it should be emphasized as indicated by Sherard (1979) that other contributing factors play an important role. Broadly graded soils have been widely used for many years in a wide variety of earth dams with no apparent problems, and the reported incidents reflect a very small fraction of these dams. Nevertheless, it appears prudent to review the use of broadly graded soils in CE earth dams and to identify those dams in which they have been used to provide a basis for further investigation regarding their stability with respect to seepage erosion.

Soil Characteristics

The broadly graded core materials involved in the dam incidents are generally of glacial origin under the category of glacial till. From a geologic standpoint glacial till consists of debris laid down directly by glacier ice. The debris carried along by a glacier is eventually deposited either as the ice melts, or less commonly because the ice smears the debris across the land surface. The material is composed of rock fragments of all sizes mixed together in a random fashion, ranging from boulders to colloidal clays.

The type of till varies from one glacier to another depending on a wide range of variables including nature of the parent rock, bed roughness, glacier thickness, distance the material has been transported and the nature of included local deposits. Some tills, for instance, contain predominantly clay size particles with only a scattering of larger particles and are known as clay tills. The broadly graded materials involved in the incidents reported by Sherard and Talbot, et al. are generally known as boulder tills or stony tills.

According to the Unified Soil Classification System (USCS) the broadly graded soils are classified as a silty sand with gravel although this description is by no means precise. A distinction should be made between broadly graded cohesionless soils which are well graded and those that are poorly graded. The USCS defines a well graded soil as one having coefficients of curvature, C_c, between 1 and 3 and a coefficient of uniformity, C_u, greater than 4. The coefficient C_c defines the general shape of the grain size curve between the D_{60} and D_{10} sizes. The limits $3 > C_c > 1$ ensure

that well graded soils have gradation curves which are concave upward. The broadly graded soils shown in Figure 2, in contrast, have coefficients of uniformity greatly in excess of 4 and C_c vaules less than 1 and are therefore classified as poorly graded.

Standard semilog plots of gradation curves tend to accentuate the finer fractions of the gradation curves and arithmetic plots can often present a more meaningful description of the gradation curve. Well graded soils as defined above are characterized by essentially straight line gradation curves on arithmetic plots. For example the ideal gradation for optimum density commonly known as Fuller's curve, see Fuller and Thompson (1907), is also a straight line curve on an arithmetic plot with the origin at zero. The value of C_u for Fuller's curve is independent of maximum grain size and is equal to 6. A comparison of standard semilog plots of gradation curves for 3-in. max size material covering at least 3 log cycles of grain size with corresponding arithmetic plots are shown in Figures 3 and 4 respectively for (1) Fuller's curve, (2) straight line gradation curve on semilog plot, (3) intermediate gradation curve, and (4) concave downward gradation curve on semilog plot. It may be seen that broadly graded soils that have a straight line gradation on a semilog plot as well as similar nonlinear gradation curves are characterized by a preponderance of finer sizes which can affect the behavior of the material with respect to internal instability and filter requirements.

As noted by Sherard (1979) the straight line semilog distribution curve as shown on Figure 3 implies that the volume of fine particles is greater than the volume of voids in the coarse sand and gravel fraction and the coarser particles therefore are floating in a matrix of the fines. The coarser fraction therefore does not function as a filter for the fines which can move freely between the larger particles under the action of seepage. This behavior is more likely to occur when the fines are relatively nonplastic. Laboratory tests by Sanchez et al. (1983) attest to the high erodibility of silty materials compared to more plastic soils. Generally the permeability of most broadly graded soils used in embankment construction is so small that internal particle movement is negligible unless a crack develops or an adequate filter is not provided at the exit face. Removal of the fines if an

adequate filter is not provided eventually results in cavities filled with loose deposits of coarse sands and gravels as noted at Mud Mountain Dam, at Boulderhead Dam by Vaughn et al. (1979) and at Broadhead Dam by Talbot and Ralston (1985).

Internal instability of soils such as that shown as curves on Figure 4 can also be demonstrated using a procedure proposed by DeMello (1975) in which it assumed that the material is divided into two parts and examining the grain size curves of the two parts with respect to accepted filter criteria such as the requirement that the 15 percent size of the filter should be equal to or less than 5 times the 85 percent size of the base. The method has been found to be very useful for determining the internal instability of gap-graded materials. In the case of materials with straight line gradation curves, if separated into two parts, the ratio of the 15 percent of the coarser fraction to the 85 percent size of the finer fraction is a constant independent of the grain size at which the separation is made. The D_{15}/D_{85} stability ratio for the two fractions is thus only a function of the slope of the gradation curve defined by the coefficient of uniformity. The coefficient of uniformity is defined as the ratio of the 60 percent size to the 10 percent size of the matierla. The 10 percent size is normally not specifically defined for broadly graded soils but for straight line (semilog) gradation curves can be determined from an extension of the curves to the 10 percent size. The relation between the D_{15}/D_{85} ratio and the coefficient of uniformity for straight line gradation curves is given in Figure 5. If it is assumed that filter instability occurs when the D_{15}/D_{85} ratio approaches 5, internal instability should occur at a coefficient of uniformity greater than 200. The coefficient of uniformity of broadly graded core materials in damaged dams (Figure 2) is in the order of 400 or more therefore attesting to the lack of internal instability of these materials.

Probably the most important aspect of broadly graded materials is their tendency to segregate during handling and placement. The amount and nature of the fines influence the tendency to some degree; however the chief factor is the range of grain sizes present defined generally in terms of the coefficient of uniformity. Perry (1987) determined the segregation of coarse grained soils during laboratory placement of these materials can occur when the coefficient of uniformity exceeds a value of 10. It would be expected that

Ref 3

CRUMB TEST D6572

Matejcek Dam

M5191000

GF-4 44 110.0

2 MIN

GRADE: 1

DISPERSIVE CLASSIFICATION: Non-Dispersive (ND)

1 HOUR

GRADE: 2

DISPERSIVE CLASSIFICATION: Intermediate (I)

6 HOUR

GRADE: 3

DISPERSIVE CLASSIFICATION: Dispersive (D)

Photo



Grade 1 - Nondispersive

Grade 2 - Intermediate

Grade 3 - Dispersive

Grade 4 - Highly Dispersive

Terracon

aggregate to obtain a desired grading, provided that the gradings are not otherwise restricted by the project specifier and the nominal maximum size indicated by the size number is not exceeded,

4.3.3.2 The class designation (see 11.1 and Table 3),

4.3.3.3 Whether the restriction on reactive materials in 11.2 applies,

4.3.3.4 In the case of the sulfate soundness test (see Table 3), which salt is to be used. If none is stated, either sodium sulfate or magnesium sulfate shall be used, and

4.3.4 The person responsible for selecting the concrete proportions if other than the concrete producer.

4.3.5 Any exceptions or additions to this specification (see Note 1).

FINE AGGREGATE

5. General Characteristics

5.1 Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof.

6. Grading

6.1 *Sieve Analysis*—Fine aggregate, except as provided in 6.2 and 6.3 shall be graded within the following limits:

Sieve (Specification E 11)	Percent Passing
9.5-mm (⅜-in.)	100
4.75-mm (No. 4)	95 to 100
2.36-mm (No. 8)	80 to 100
1.18-mm (No. 16)	50 to 85
600-µm (No. 30)	25 to 60
300-µm (No. 50)	5 to 30
150-µm (No. 100)	0 to 10

NOTE 2—Concrete with fine aggregate gradings near the minimums for percent passing the 300 µm (No.50) and 150 µm (No.100) sometimes have difficulties with workability, pumping or excessive bleeding. The addition of entrained air, additional cement, or the addition of an approved mineral admixture to supply the deficient fines, are methods used to alleviate such difficulties.

6.2 The fine aggregate shall have not more than 45 % passing any sieve and retained on the next consecutive sieve of those shown in 6.1, and its fineness modulus shall be not less than 2.3 nor more than 3.1.

6.3 Fine aggregate failing to meet these grading requirements shall meet the requirements of this section provided that the supplier can demonstrate to the purchaser or specifier that concrete of the class specified, made with fine aggregate under consideration, will have relevant properties (see Note 4) at least equal to those of concrete made with the same ingredients, with the exception that the reference fine aggregate shall be selected from a source having an acceptable performance record in similar concrete construction.

NOTE 3—Fine aggregate that conforms to the grading requirements of a specification, prepared by another organization such as a state transportation agency, which is in general use in the area, should be considered as having a satisfactory service record with regard to those concrete properties affected by grading.

NOTE 4—Relevant properties are those properties of the concrete that are important to the particular application being considered. STP 169C[8] provides a discussion of important concrete properties.

6.4 For continuing shipments of fine aggregate from a given source, the fineness modulus shall not vary more than 0.20 from the base fineness modulus. The base fineness modulus shall be that value that is typical of the source. The purchaser or specifier has the authority to approve a change in the base fineness modulus.

NOTE 5—The base fineness modulus should be determined from previous tests, or if no previous tests exist, from the average of the fineness modulus values for the first ten samples (or all preceding samples if less than ten) on the order. The proportioning of a concrete mixture may be dependent on the base fineness modulus of the fine aggregate to be used. Therefore, when it appears that the base fineness modulus is considerably different from the value used in the concrete mixture, a suitable adjustment in the mixture may be necessary.

7. Deleterious Substances

7.1 The amount of deleterious substances in fine aggregate shall not exceed the limits prescribed in Table 1.

7.2 *Organic Impurities*:

7.2.1 Fine aggregate shall be free of injurious amounts of organic impurities. Except as herein provided, aggregates subjected to the test for organic impurities and producing a color darker than the standard shall be rejected.

7.2.2 Use of a fine aggregate failing in the test is not prohibited, provided that the discoloration is due principally to the presence of small quantities of coal, lignite, or similar discrete particles.

7.2.3 Use of a fine aggregate failing in the test is not prohibited, provided that, when tested for the effect of organic impurities on strength of mortar, the relative strength at 7 days, calculated in accordance with Test Method C 87, is not less than 95 %.

7.3 Fine aggregate for use in concrete that will be subject to wetting, extended exposure to humid atmosphere, or contact with moist ground shall not contain any materials that are deleteriously reactive with the alkalies in the cement in an amount sufficient to cause excessive expansion of mortar or concrete, except that if such materials are present in injurious amounts, use of the fine aggregate is not prohibited when used with a cement containing less than 0.60 % alkalies calculated as sodium oxide equivalent ($Na_2O + 0.658K_2O$) or with the addition of a material that has been shown to prevent harmful expansion due to the alkali-aggregate reaction. (See Appendix X1.)

8. Soundness

8.1 Except as provided in 8.2 and 8.3, fine aggregate subjected to five cycles of the soundness test shall have a weighted average loss not greater than 10 % when sodium sulfate is used or 15 % when magnesium sulfate is used.

8.2 Fine aggregate failing to meet the requirements of 8.1 shall be regarded as meeting the requirements of this section provided that the supplier demonstrates to the purchaser or

[8] *Significance of Tests and Properties of Concrete and Concrete Making Materials, STP 169C*, ASTM, 1994.

Designation: C 144 – 03

American Association State Highway and Transportation Officials Standard
AASHTO No.: M45-70 (1974)

Standard Specification for Aggregate for Masonry Mortar[1]

This standard is issued under the fixed designation C 144; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers aggregate for use in masonry mortar.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 The following precautionary caveat pertains only to the test methods portion, Section 7, of this standard. *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 40 Test Method for Organic Impurities in Fine Aggregates for Concrete[2]

C 87 Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar[2]

C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate[2]

C 117 Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing[2]

C 123 Test Method for Lightweight Pieces in Aggregate[2]

C 128 Test Method for Specific Gravity and Absorption of Fine Aggregate[2]

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates[2]

C 142 Test Method for Clay Lumps and Friable Particles in Aggregates[2]

C 270 Specification for Mortar for Unit Masonry[3]

C 404 Specification for Aggregates for Masonry Grout[3]

D 75 Practice for Sampling Aggregates[4]

3. Materials and Manufacture

3.1 Aggregate for use in masonry mortar shall consist of natural sand or manufactured sand. Manufactured sand is the product obtained by crushing stone, gravel, or air-cooled iron blast-furnace slag specially processed to ensure suitable gradation.

NOTE 1—Care should be taken to ensure a suitable particle shape, since excessive quantities of flat and elongated particles have historically caused problems with workability.

4. Grading

4.1 Aggregate for use in masonry mortar shall be graded within the following limits, depending upon whether natural sand or manufactured sand is to be used:

Sieve Size		Percent Passing	
		Natural Sand	Manufactured Sand
4.75-mm	(No. 4)	100	100
2.36-mm	(No. 8)	95 to 100	95 to 100
1.18-mm	(No. 16)	70 to 100	70 to 100
600-µm	(No. 30)	40 to 75	40 to 75
300-µm	(No. 50)	10 to 35	20 to 40
150-µm	(No. 100)	2 to 15	10 to 25
75-µm	(No. 200)	0 to 5	0 to 10

4.2 The aggregate shall not have more than 50 % retained between any two consecutive sieves of those listed in 4.1 nor more than 25 % between 300-µm (No. 50) and the 150-µm (No. 100) sieve.

4.3 If the fineness modulus varies by more than 0.20 from the value assumed in selecting proportions for the mortar, the aggregate shall be rejected unless suitable adjustments are made in proportions to compensate for the change in grading.

NOTE 2—For heavy construction employing joints thicker than 12.5 mm (½ in.), a coarser aggregate may be desirable; for such work a fine aggregate conforming to Specification C 404 is satisfactory.

4.4 When an aggregate fails the gradation limits specified in 4.1 and 4.2, it may be used provided the mortar can be prepared

[1] This specification is under the jurisdiction of ASTM Committee C12 on Mortars for Unit Masonry and is the direct responsibility of Subcommittee C12.04 on Specifications for Aggregates for Mortar.

Current edition approved January 10, 2003. Published June 2003. Originally published as C 144 – 39T. Last previous edition C 144 – 01.

[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.05.

[4] *Annual Book of ASTM Standards*, Vol 04.03.

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TABLE 1 Grading Requirements for Fine Aggregates

Sieve Size	Amounts Finer than Each Laboratory Sieve (Square Openings), mass %				
	Grading No. 1	Grading No. 2	Grading No. 3	Grading No. 4	Grading No. 5
9.5-mm (⅜-in.)	100	....	....	100	100
4.75-mm (No. 4)	95 to 100	100	100	80 to 100	80 to 100
2.36-mm (No. 8)	70 to 100	75 to 100	95 to 100	65 to 100	65 to 100
1.18-mm (No. 16)	40 to 80	50 to 74	85 to 100	40 to 80	40 to 80
600-µm (No. 30)	20 to 65	28 to 52	65 to 90	20 to 65	20 to 65
300-µm (No. 50)	7 to 40	8 to 30	30 to 60	7 to 40	7 to 46
150-µm (No. 100)	2 to 20	0 to 12	5 to 25	2 to 20	2 to 30
75-µm (No. 200)	0 to 10	0 to 5	0 to 5	0 to 10	....

be rounded to the nearest 1 %, and each value for the plasticity index shall be rounded to the nearest 0.1 unit, both in accordance with the rounding-off method of Practice E 29.

6.2 *Grading*—Grading of fine aggregate shall conform to the grading in Table 1 for the Grading Number specified in the order, or other grading designated by the purchaser.

6.3 *Grading Variability Limits*—For continuing shipments of fine aggregate from a given source, the fineness modulus shall not vary more than 0.25 from the base fineness modulus. The base fineness modulus shall be that value that is typical of the source, and shall be determined from previous tests, or if no previous tests exist, from the average of the fineness modulus values for the first ten samples (or all preceding samples if less than ten) on the order. The base fineness modulus shall not be changed except when approved by the purchaser.

NOTE 2—The proportioning of a bituminous mixture may be dependent on the base fineness modulus of the fine aggregate to be used. Therefore, when it appears that the base fineness modulus is considerably different from the value used in the bituminous mixture, a suitable adjustment in the mixture may be necessary.

6.4 *Plasticity Index*—The plasticity index of the fraction passing the 425-µm (No. 40) sieve shall not exceed 4.0.

7. Methods of Sampling and Testing

7.1 The aggregate shall be sampled and the properties enumerated in this specification shall be determined in accordance with the following ASTM methods:

7.1.1 *Sampling*—Practice D 75,

7.1.2 *Random Sampling*—Practice D 3665,

7.1.3 *Grading*—Test Method C 136 and Test Method C 117, Procedure A,

7.1.4 *Fineness Modulus*—Test Method C 136, and

7.1.5 *Plasticity Index*—Test Method D 4318.

8. Keywords

8.1 aggregate; fine aggregate; bituminous paving; paving mixtures

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirement shall apply only when specified by the purchaser in the contract or order.

S1. Sulfate Soundness

S1.1 The fine aggregate, when subjected to 5 cycles of the soundness test in accordance with Test Method C 88, shall have a weighted loss of not more than 15 % when sodium sulfate is used or 20 % when magnesium sulfate is used. If the salt to be used is not stated by the purchaser, the fine aggregate shall be acceptable if it meets the requirements when tested with either salt.

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Title: Shear Strength Calculation
Project: Matejcek Dam
GF Job #: 064799

By: EJB 5/19
Checked by: CRB 10/19

Purpose: Determine shear strength parameters of samples site soils for use in slope stability analysis.

References:

1. Terracon. 2019. Laboratory testing results for Matejcek Dam
2. Terzahi & Peck. 1967. Soil Mechanics in Engineer Practice. Wiley, 2nd ed.
3. Transportation Research Board. 1996. Landslides Investigation and Mitigation. Special Report 247.

Assumptions:

1. Neglect apparent cohesion for effective stress parameters.

Calculation:
Mohr circles are replotted in Microsoft excel using data from Ref. 1. Failure is determined to occur at the maximum principal stress ratio. See attached plots for total and effective mohr circles for individual strata. Mohr circles are plotted in units of psi to check against Ref. 1. Parameters are presented in the summary table below with units of psf for easier input into slope stability software. Friction angles are rounded to the nearest whole degree.

Stratum	Total Stress Parameters		Effective Stress Parameters	
	c (psf)	ϕ (deg)	c' (psf)	ϕ' (deg)
Embankment	430	25	0	34
Foundation Till	185	24	0	36
Colluvial/Residual	490	25	0	32
Clayey Shale	865	7	0	13

Remarks:
Regarding the low shear strength parameters for the clayey shales - engineering properties of shales "may range between those of a soil and those of a real rock" (Ref. 2) and shales with a low slake durability index and high PI (such as the clayey shale encountered at Matejcek Dam) yield a low shale rating, R, which generally require flatter slopes to meet stability requirements.

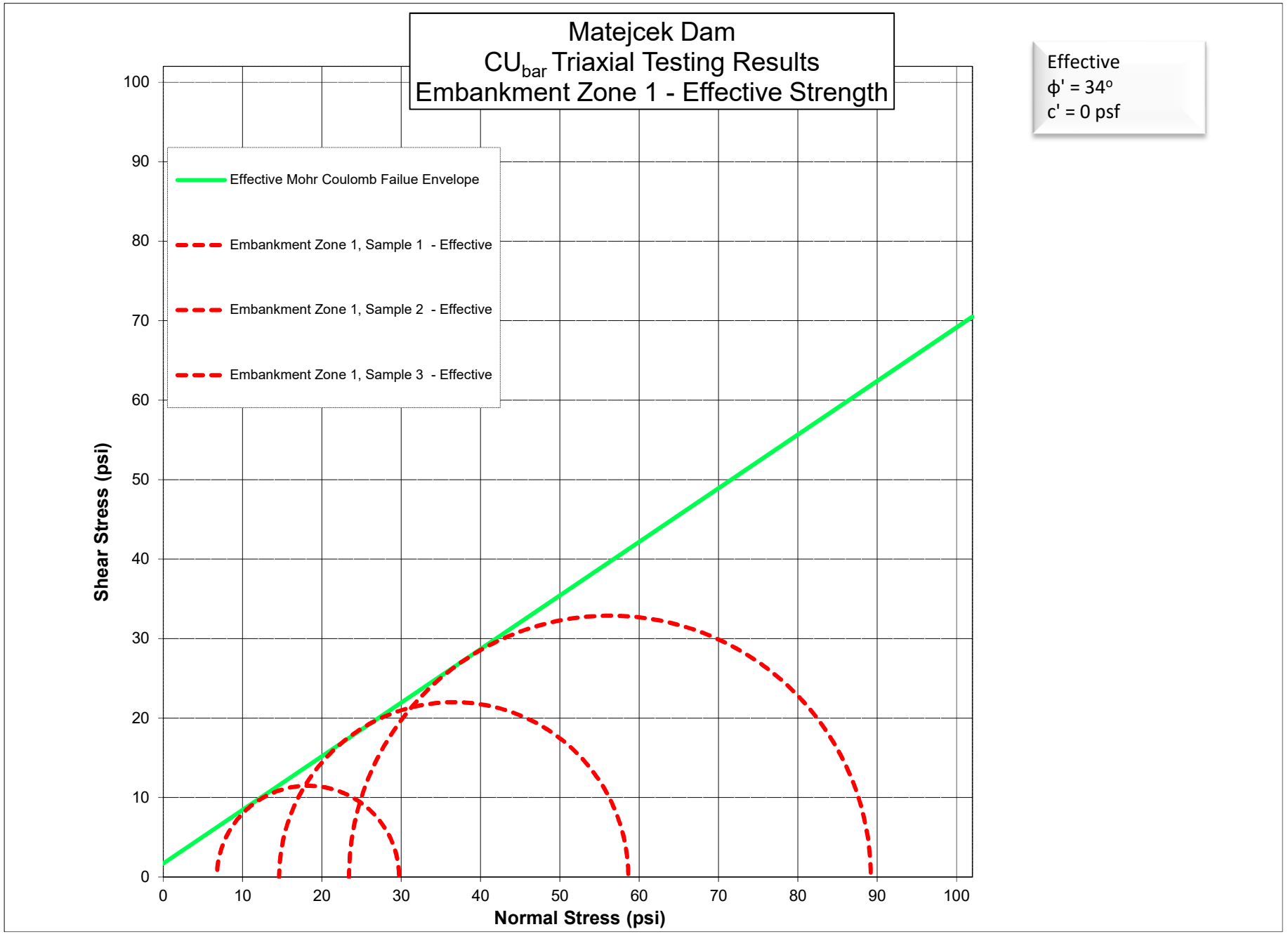
Gannett Fleming

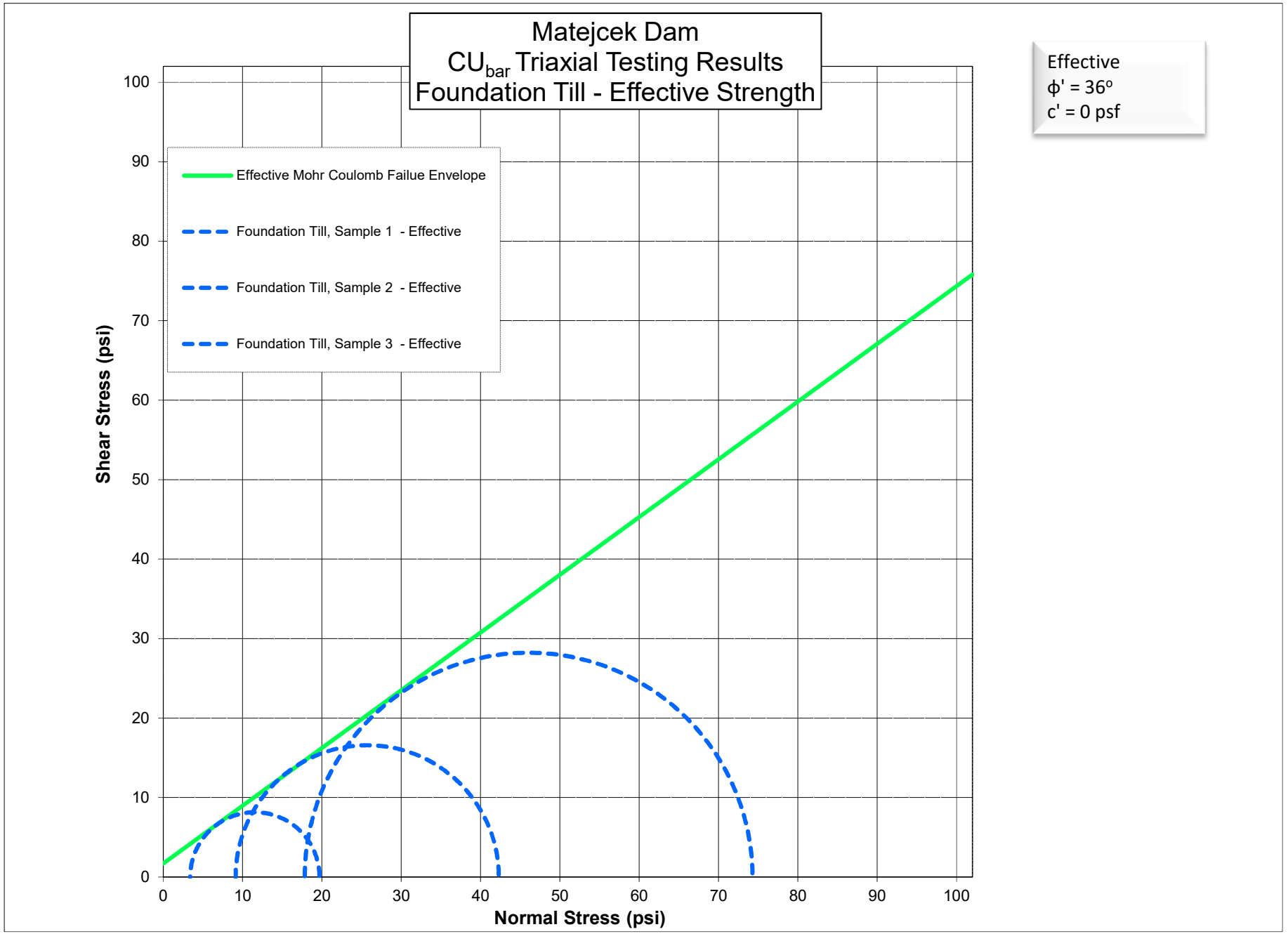
Matejcek Dam
Triaxial Shear Strength Testing Results
CU_{bar} Testing

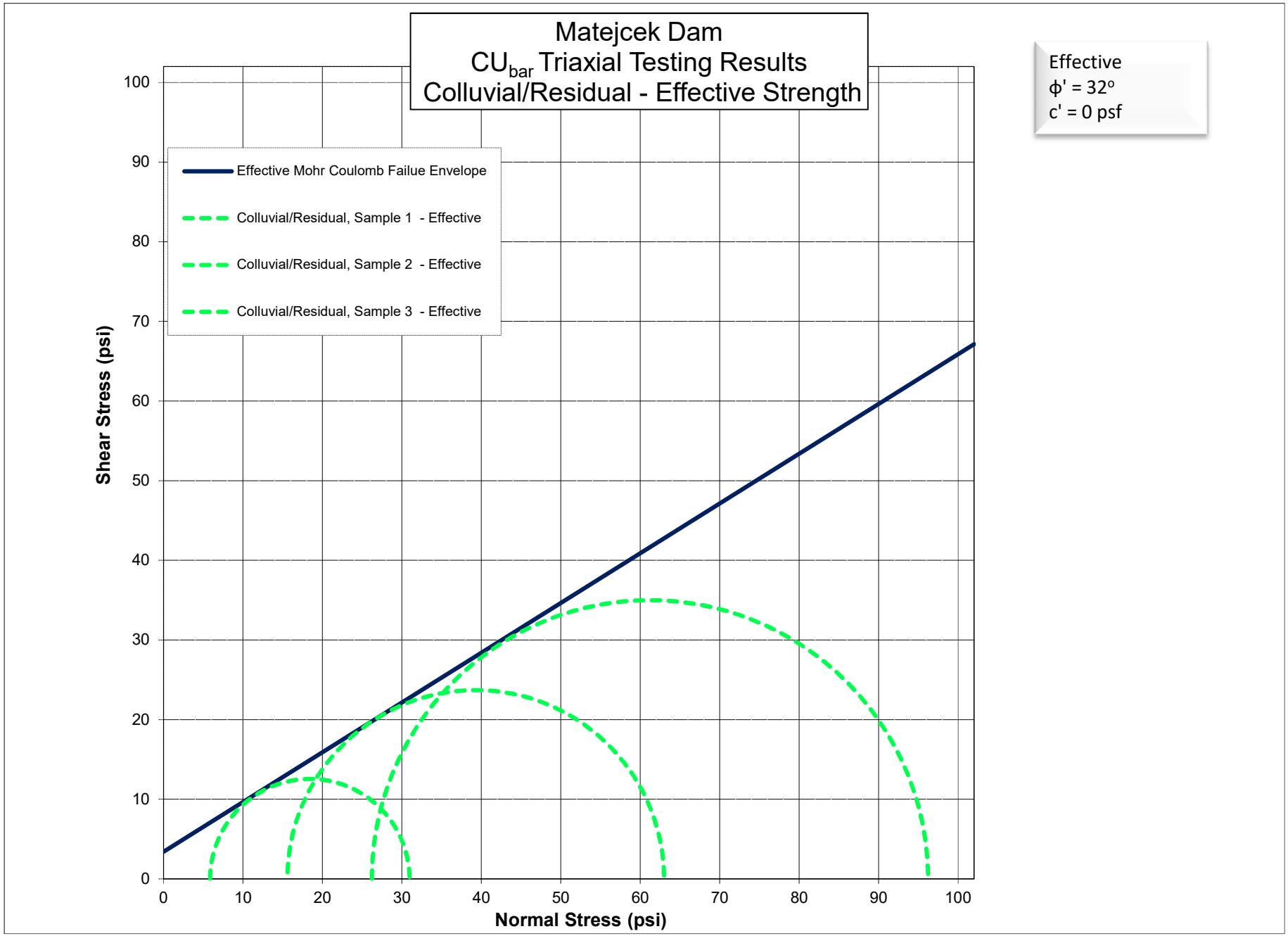
By: EJB, 5/19
checked by: CRB 10/19

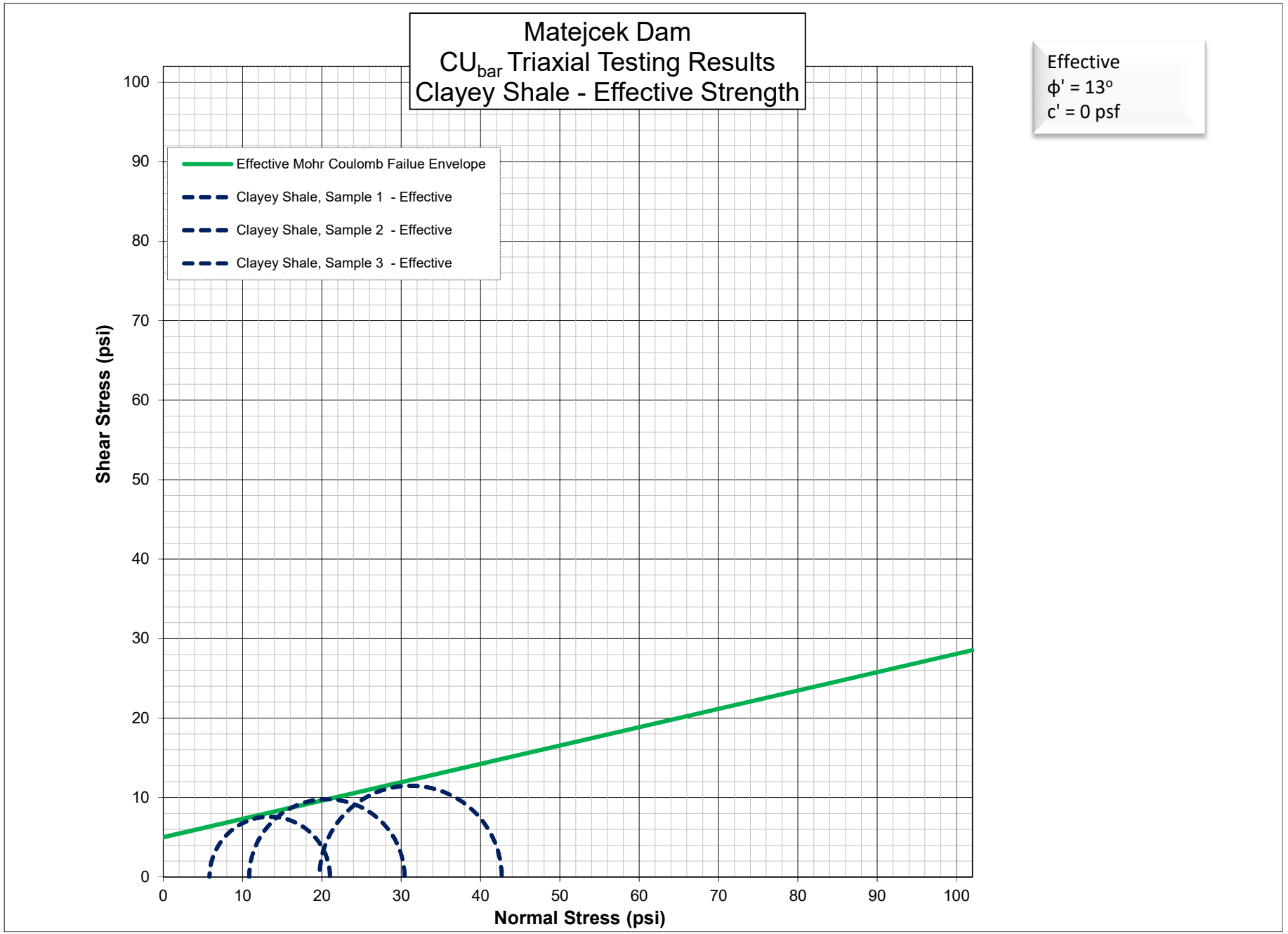
Boring	Sample	Sample Type	Depth (ft)	USCS	Stratum	Specimen ID	Consolidation Effective Confining Stress (ksf)	Consolidation Effective Confining Stress (psi)	Failure Stress or Deviator Stress (ksf)	Failure Stress or Deviator Stress (psi)	Pore Pressure at Failure Reading (ksf)	Pore Pressure at Failure Reading (psi)	ΔPore Pressure (psi)	Total σ_3 (psi)	Total σ_1 (psi)	Effective σ'_3 (psi)	Effective σ'_1 (psi)
GF-4	S-6 to S-18	Remold	15.0-47.5	ML	Embankment (Zone 1)	1	1.4	10.0	3.3	23.0	0.5	3.23	3.23	10.0	33.0	6.8	29.7
						2	2.9	20.0	6.3	44.0	0.8	5.38	5.38	20.0	64.0	14.6	58.6
						3	5.8	40.0	9.5	65.8	2.4	16.6	16.6	40.0	106	23.4	89.2
GF-5	S-15 to S-19	Remold	37.5-50.0	ML	Foundation Till	1	1.4	10.0	2.3	16.3	1.0	6.60	6.60	10.0	26.3	3.4	19.7
						2	2.9	20.0	4.8	33.2	1.6	10.9	10.9	20.0	53.2	9.1	42.3
						3	5.8	40.0	8.1	56.4	3.2	22.2	22.2	40.0	96.4	17.8	74.3
GF-6	S-3 to S-10	Remold	7.5-30.0	ML	Colluvial / Residual	1	1.4	10.0	3.6	25.1	0.6	4.13	4.13	10.0	35.1	5.9	31.0
						2	2.9	20.0	6.8	47.4	0.6	4.41	4.41	20.0	67.4	15.6	63.0
						3	5.8	40.0	10.1	70.0	2.0	13.8	13.8	40.0	110	26.2	96.2
GF-4	S-42 to S-49	Remold	105.0-124.0	CH	Clayey Shale	1	1.4	10.0	2.2	15.2	0.6	4.16	4.16	10.0	25.2	5.8	21.0
						2	2.9	20.0	2.8	19.6	1.3	9.16	9.16	20.0	39.6	10.8	30.4
						3	5.8	40.0	3.3	23.0	2.9	20.3	20.3	40.0	63.0	19.7	42.7

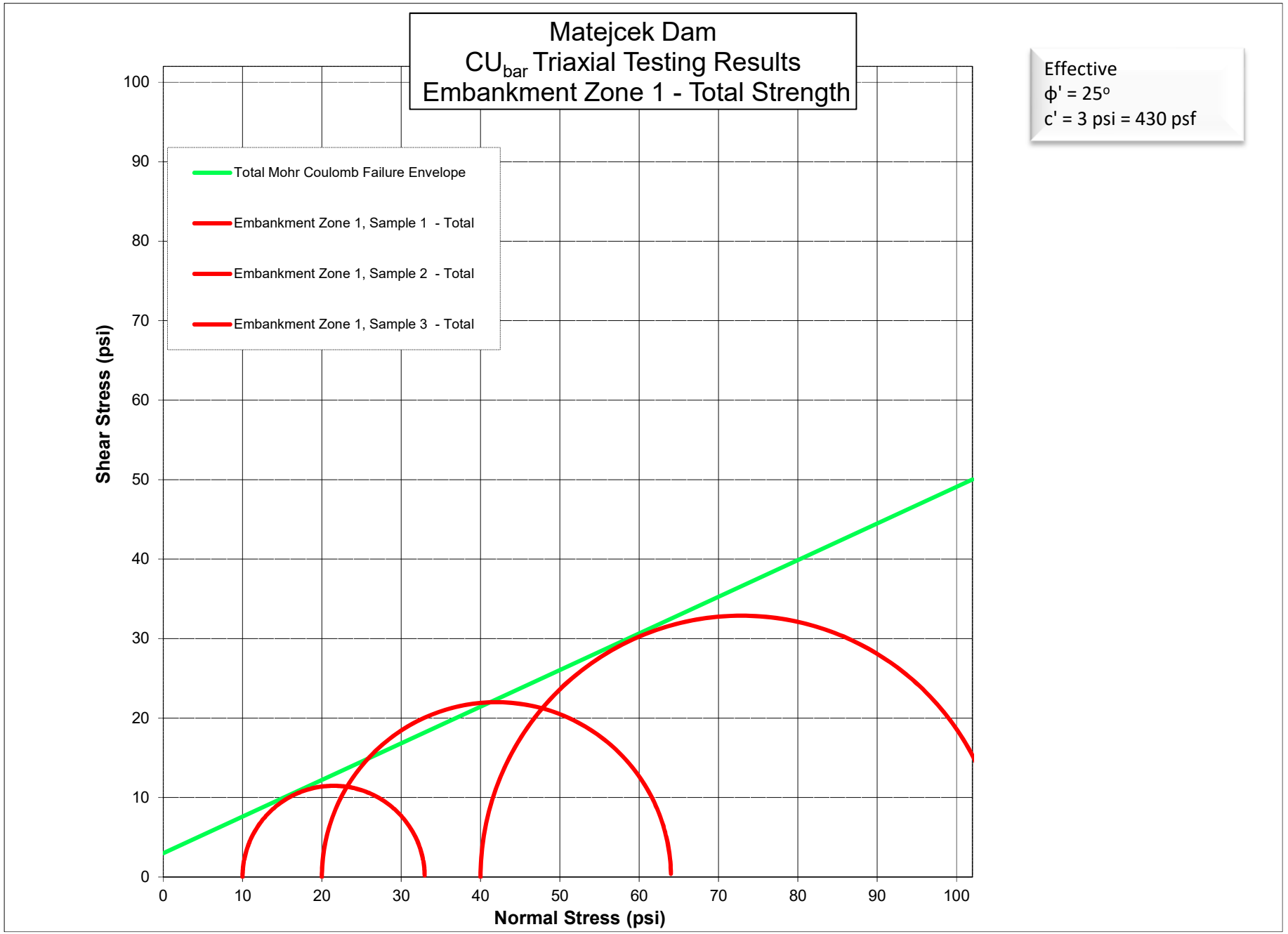
This table summarizes the failure conditions of the CU triaxial shear strength test specimens. Failure Stresses in this table are taken at Maximum Principal Stress Ratio.

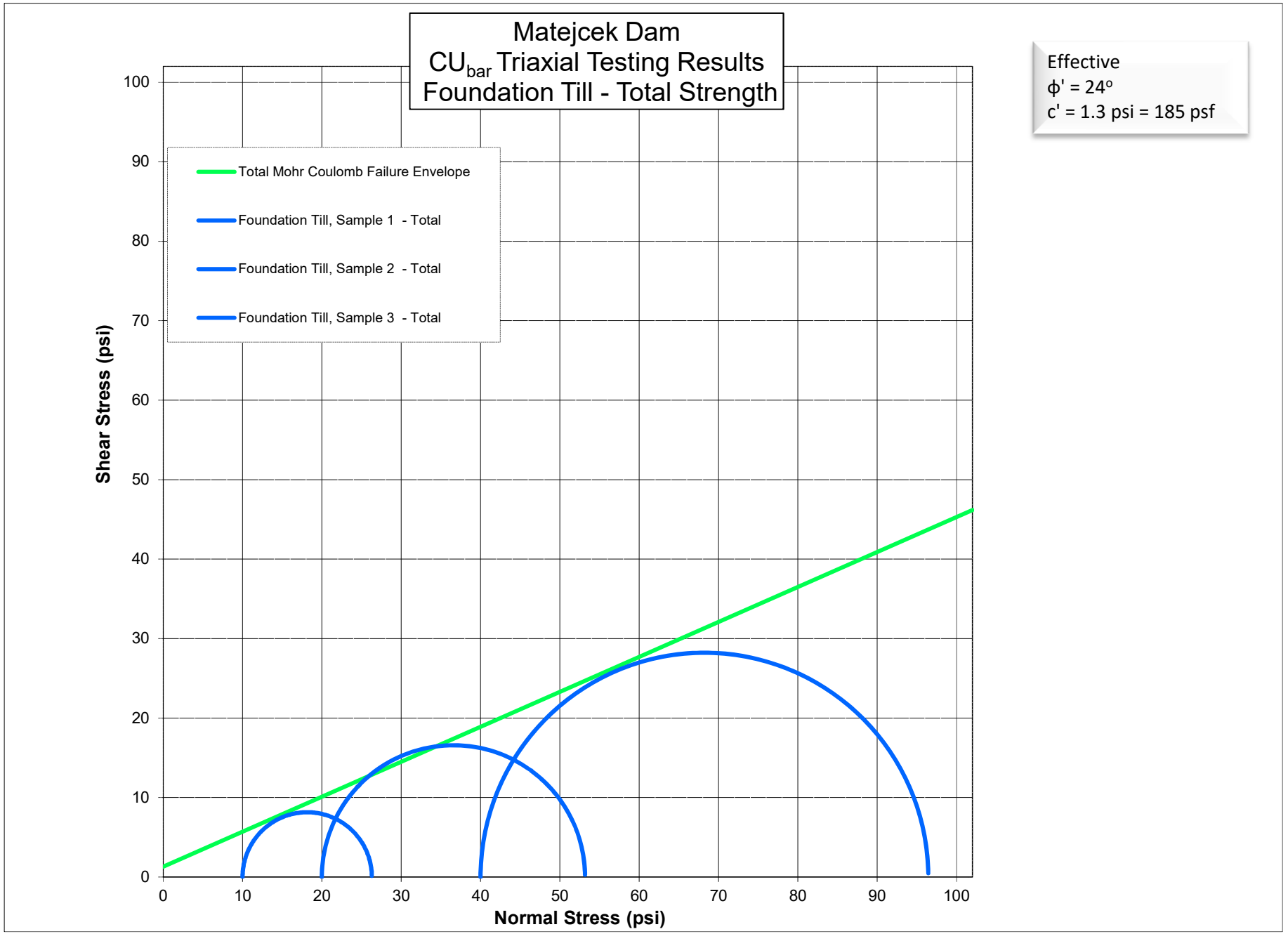

Matejcek Dam
CU bar Triaxial Testing Results
Embankment Zone 1 - Effective Strength
Effective
ϕ' = 34°
c' = 0 psf
Effective Mohr Coulomb Failue Envelope
Embankment Zone 1, Sample 1 - Effective
Embankment Zone 1, Sample 2 - Effective
Embankment Zone 1, Sample 3 - Effective
Shear Stress (psi)
Normal Stress (psi)
0
10
20
30
40
50
60
70
80
90
100

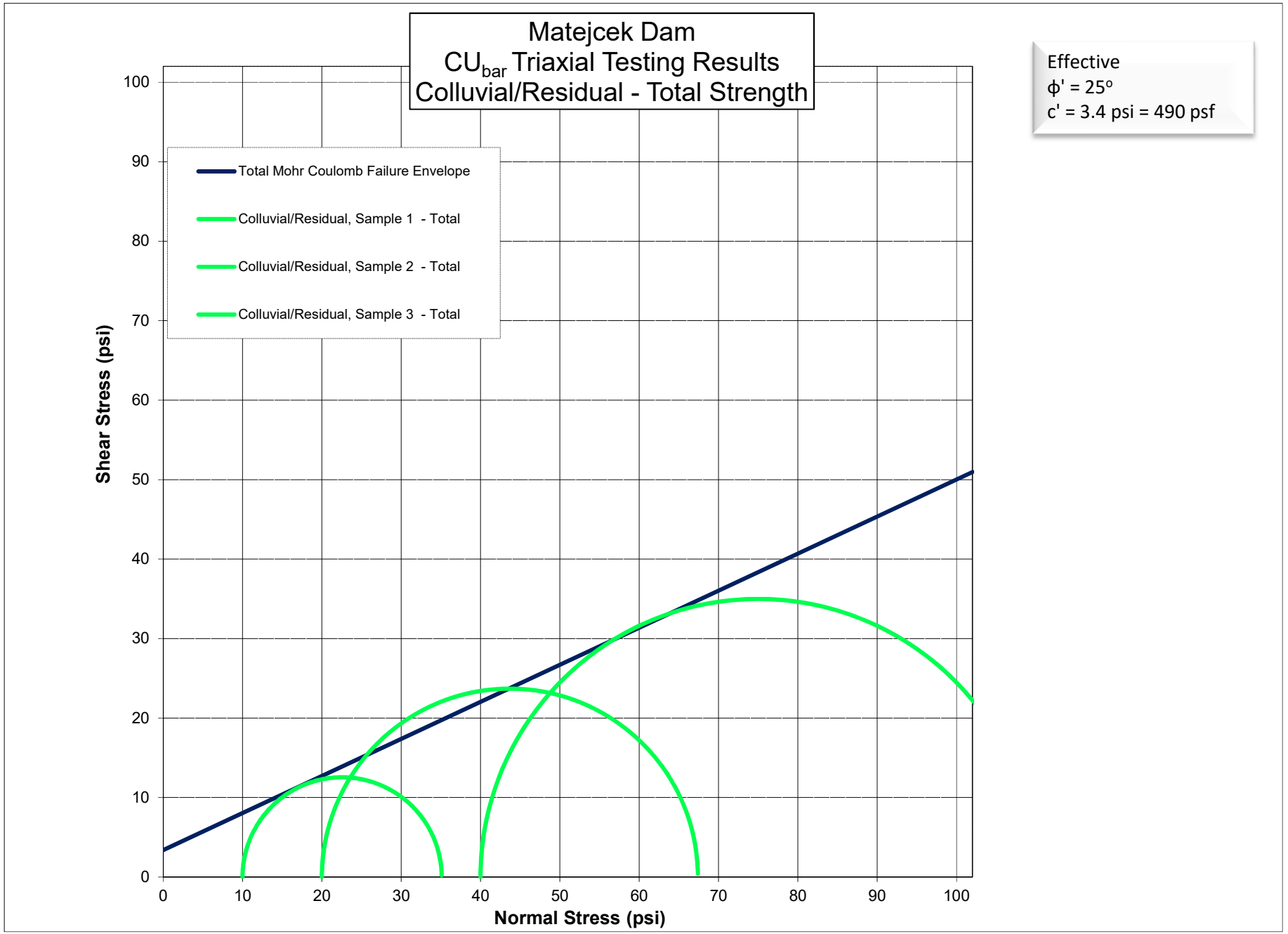

Matejcek Dam
CU$_{bar}$ Triaxial Testing Results
Foundation Till - Effective Strength
Effective
ϕ' = 36°
c' = 0 psf
Effective Mohr Coulomb Failue Envelope
Foundation Till, Sample 1 - Effective
Foundation Till, Sample 2 - Effective
Foundation Till, Sample 3 - Effective
Shear Stress (psi)
Normal Stress (psi)
0
10
20
30
40
50
60
70
80
90
100

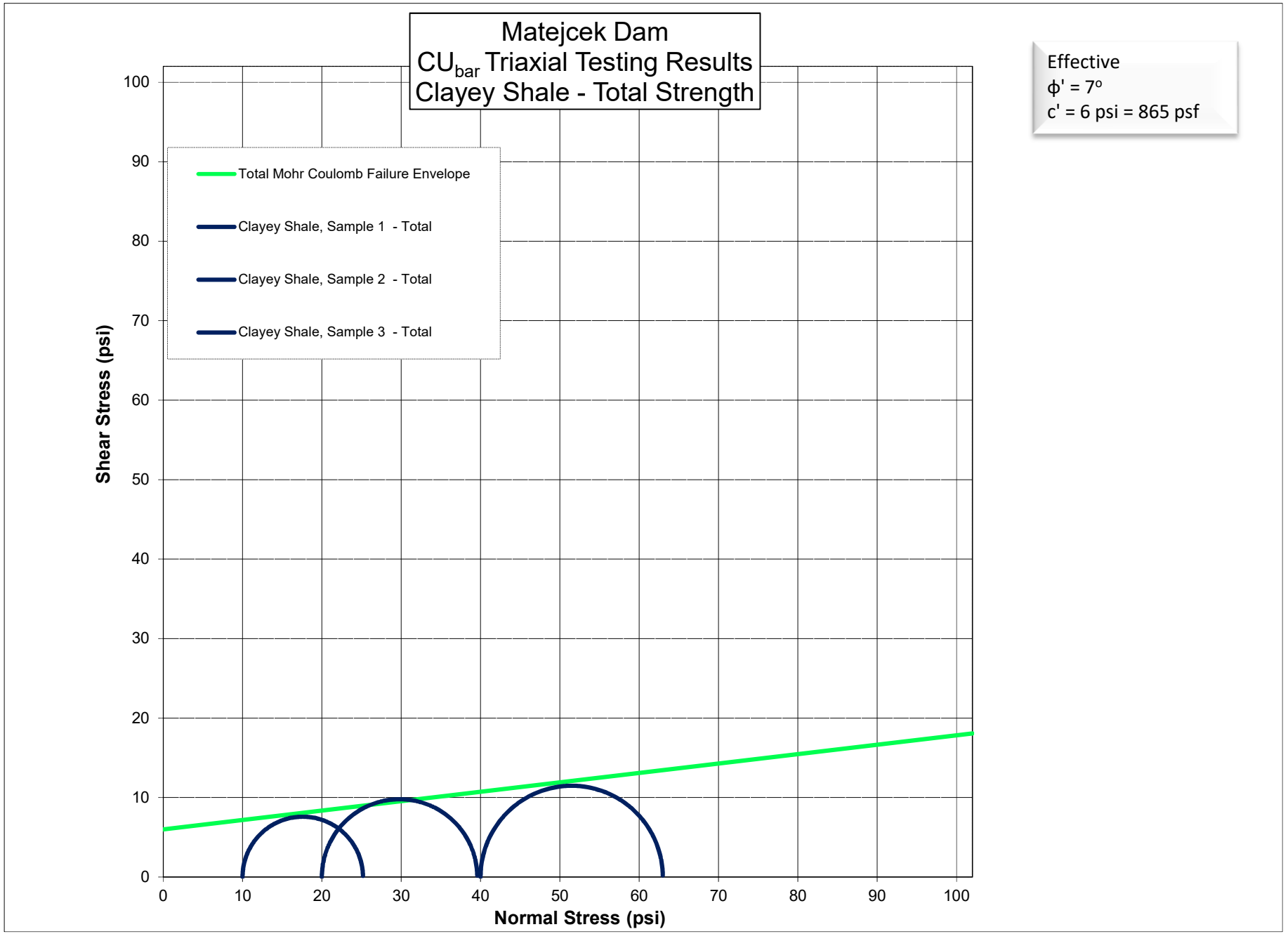

Matejcek Dam
CU bar Triaxial Testing Results
Colluvial/Residual - Effective Strength
Effective
ϕ' = 32°
c' = 0 psf
Effective Mohr Coulomb Failue Envelope
Colluvial/Residual, Sample 1 - Effective
Colluvial/Residual, Sample 2 - Effective
Colluvial/Residual, Sample 3 - Effective
Shear Stress (psi)
Normal Stress (psi)
0
10
20
30
40
50
60
70
80
90
100

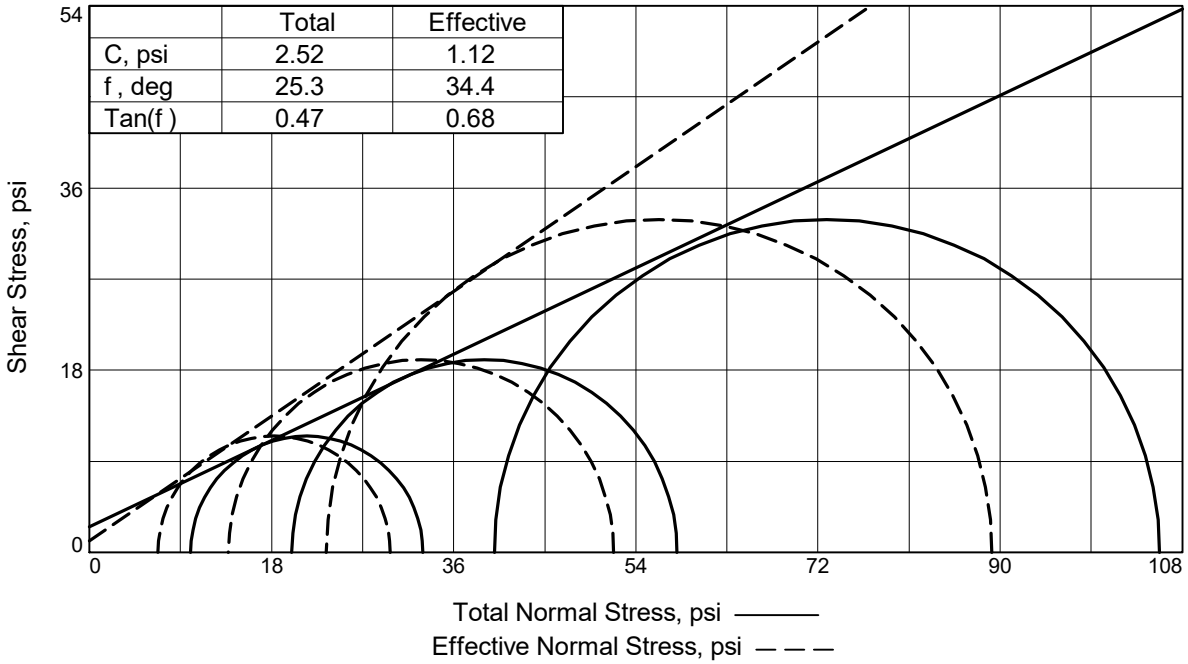

Matejcek Dam
CU bar Triaxial Testing Results
Clayey Shale - Effective Strength
Effective
ϕ' = 13°
c' = 0 psf
Effective Mohr Coulomb Failue Envelope
Clayey Shale, Sample 1 - Effective
Clayey Shale, Sample 2 - Effective
Clayey Shale, Sample 3 - Effective
Shear Stress (psi)
Normal Stress (psi)
0
10
20
30
40
50
60
70
80
90
100

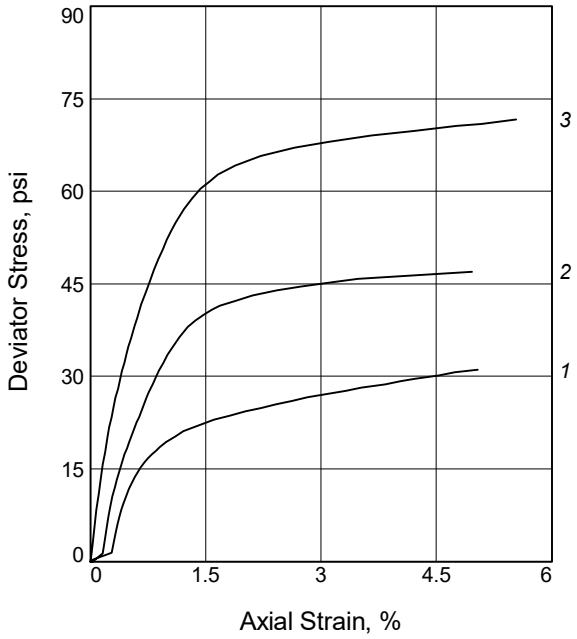

Matejcek Dam
CU bar Triaxial Testing Results
Embankment Zone 1 - Total Strength
Effective
ϕ' = 25°
c' = 3 psi = 430 psf
Total Mohr Coulomb Failure Envelope
Embankment Zone 1, Sample 1 - Total
Embankment Zone 1, Sample 2 - Total
Embankment Zone 1, Sample 3 - Total
Shear Stress (psi)
Normal Stress (psi)
0
10
20
30
40
50
60
70
80
90
100


Matejcek Dam
CU bar Triaxial Testing Results
Foundation Till - Total Strength
Total Mohr Coulomb Failure Envelope
Foundation Till, Sample 1 - Total
Foundation Till, Sample 2 - Total
Foundation Till, Sample 3 - Total
Effective
ϕ' = 24°
c' = 1.3 psi = 185 psf
Shear Stress (psi)
Normal Stress (psi)
0
10
20
30
40
50
60
70
80
90
100


Matejcek Dam
CU bar Triaxial Testing Results
Colluvial/Residual - Total Strength
Effective
ϕ' = 25°
c' = 3.4 psi = 490 psf
Total Mohr Coulomb Failure Envelope
Colluvial/Residual, Sample 1 - Total
Colluvial/Residual, Sample 2 - Total
Colluvial/Residual, Sample 3 - Total
Shear Stress (psi)
Normal Stress (psi)
0
10
20
30
40
50
60
70
80
90
100


Matejcek Dam
CU bar Triaxial Testing Results
Clayey Shale - Total Strength
Effective
ϕ' = 7°
c' = 6 psi = 865 psf
Total Mohr Coulomb Failure Envelope
Clayey Shale, Sample 1 - Total
Clayey Shale, Sample 2 - Total
Clayey Shale, Sample 3 - Total
Shear Stress (psi)
Normal Stress (psi)
0
10
20
30
40
50
60
70
80
90
100





Sample No.		1	2	3
Initial	Water Content, %	26.0	26.0	26.0
	Dry Density, pcf	92.0	92.0	92.0
	Saturation, %	84.4	84.4	84.4
	Void Ratio	0.8313	0.8313	0.8313
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	28.7	28.1	27.3
	Dry Density, pcf	93.8	94.7	95.8
	Saturation, %	97.1	97.1	97.0
	Void Ratio	0.7970	0.7808	0.7594
	Diameter, in.	2.783	2.835	2.886
	Height, in.	5.563	5.313	5.063
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.0	50.0	50.0
Cell Pressure, psi		60.0	70.0	90.0
Fail. Stress, psi		23.0	38.1	65.8
Excess Pore Pr., psi		3.2	6.3	16.6
Ult. Stress, psi				
Excess Pore Pr., psi				
$\bar{s}_1$ Failure, psi		29.7	51.8	89.2
$\bar{s}_3$ Failure, psi		6.8	13.7	23.4

Type of Test:
CU with Pore Pressures

Sample Type: Remold

Description: gray sandy clay

LL= X **PI=** X

Assumed Specific Gravity= 2.7

Remarks: Specimen remolded to 92.0 pcf dry denisty at 26.0% moisture.

Embankment Zone 1 (ML)

Client: Gannet Fleming, Inc

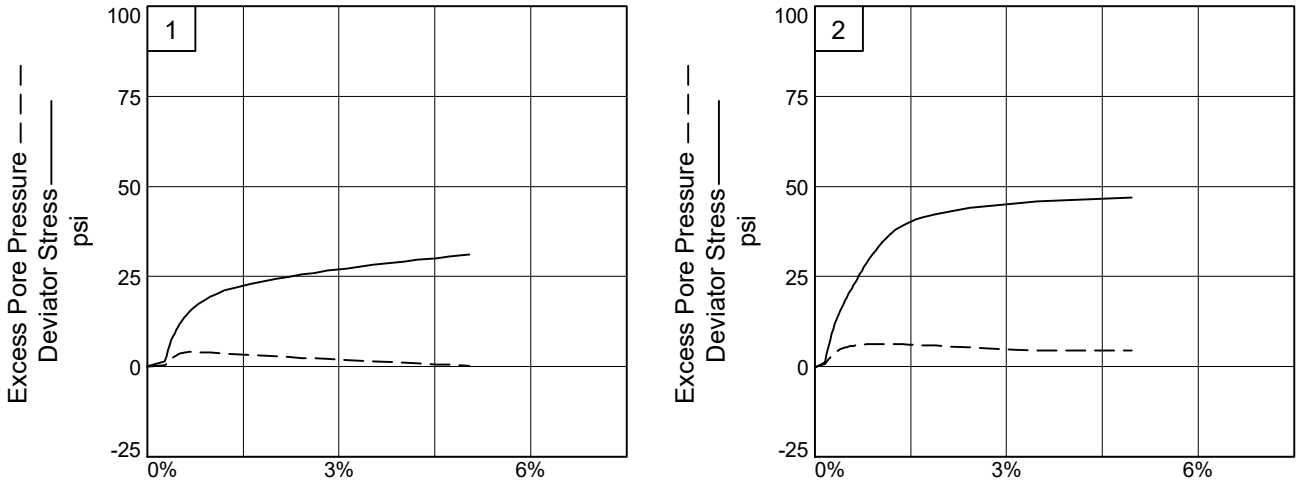
Project: Matejcek Dam

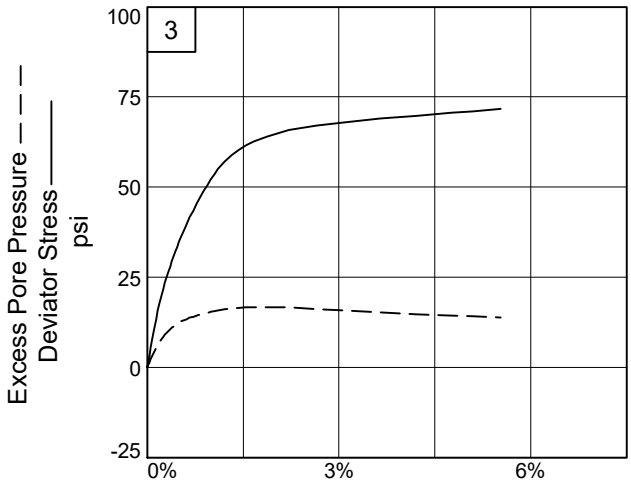
Source of Sample: GF-4 **Depth:** 15.0-47.5 ft

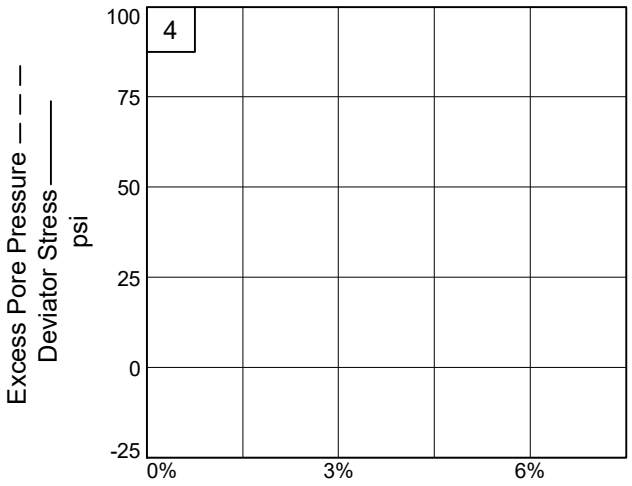
Sample Number: S6-S18

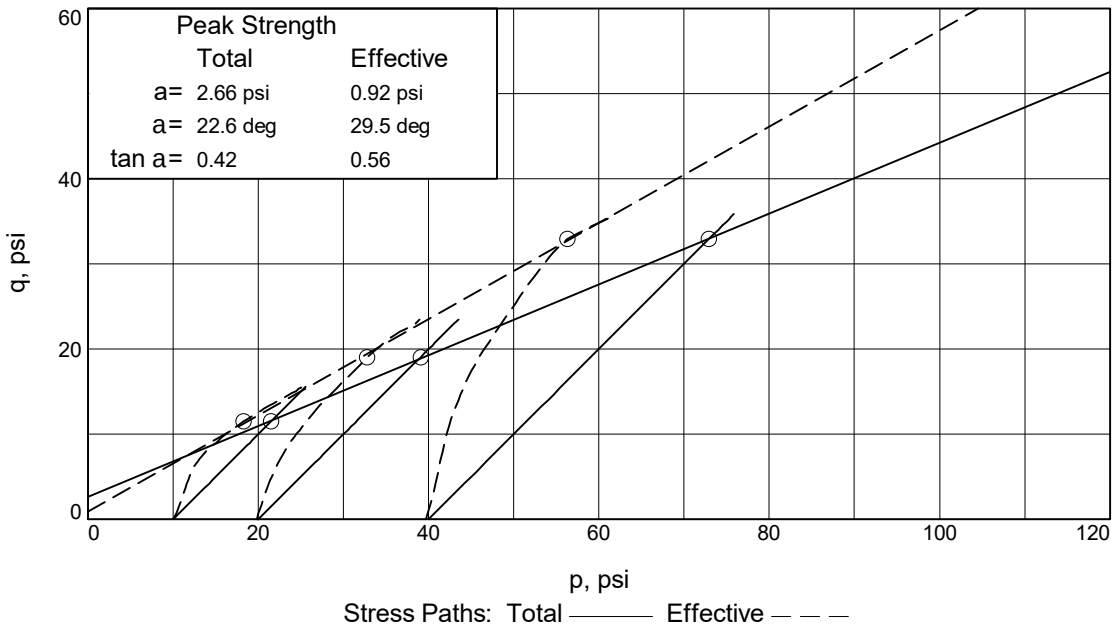
Proj. No.: M5191000 **Date Sampled:** N/A

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN









Client: Gannet Fleming, Inc
Project: Matejcek Dam
Source of Sample: GF-4 **Depth:** 15.0-47.5 ft **Sample Number:** S6-S18
Project No.: M5191000

Terracon Consultants, Inc.

TRIAXIAL COMPRESSION TEST 5/16/2019

CU with Pore Pressures 9:22 AM

Date: N/A
Client: Gannet Fleming, Inc
Project: Matejcek Dam
Project No.: M5191000
Location: GF-4
Depth: 15.0-47.5 ft **Sample Number:** S6-S18
Description: gray sandy clay
Remarks: Specimen remolded to 92.0 pcf dry denisty at 26.0% moisture.
Type of Sample: Remold
Assumed Specific Gravity=2.7 **LL=**X **PL=** **PI=**X
Test Method: ASTM D 4767 Method A (staged method triaxial test)

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	126.000			1060.410
Moisture content: Dry soil+tare, gms.	100.000			833.100
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	26.0	28.8	28.7	27.3
Moist specimen weight, gms.	1049.70			
Diameter, in.	2.800	2.784	2.783	
Area, in.²	6.158	6.087	6.082	
Height, in.	5.600	5.568	5.563	
Net decrease in height, in.		0.032	0.005	
Net decrease in water volume, cc.			0.900	
Wet density, pcf	116.0	120.6	120.7	
Dry density, pcf	92.0	93.6	93.8	
Void ratio	0.8313	0.7999	0.7970	
Saturation, %	84.4	97.2	97.1	

Test Readings for Specimen No. 1

Consolidation cell pressure = 60.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 10.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 22.96 psi **at reading no.** 26

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.9353	3.940	0.0	0.0	0.00	9.93	9.93	1.00	50.07	9.93	0.00
1	-0.9339	5.619	1.7	0.0	0.28	9.94	10.22	1.03	50.06	10.08	0.14
2	-0.9199	12.400	8.5	0.3	1.39	9.69	11.08	1.14	50.31	10.38	0.69
3	-0.9185	21.886	17.9	0.3	2.94	9.22	12.16	1.32	50.78	10.69	1.47
4	-0.9171	31.647	27.7	0.3	4.54	8.70	13.24	1.52	51.30	10.97	2.27
5	-0.9157	40.617	36.7	0.4	6.01	8.21	14.22	1.73	51.79	11.21	3.00
6	-0.9143	48.205	44.3	0.4	7.25	7.79	15.04	1.93	52.21	11.41	3.63
7	-0.9129	54.777	50.8	0.4	8.32	7.43	15.75	2.12	52.57	11.59	4.16
8	-0.9115	60.525	56.6	0.4	9.26	7.14	16.40	2.30	52.86	11.77	4.63
9	-0.9101	65.979	62.0	0.5	10.15	6.85	17.01	2.48	53.15	11.93	5.08
10	-0.9087	71.180	67.2	0.5	11.00	6.61	17.61	2.67	53.39	12.11	5.50
11	-0.9073	76.119	72.2	0.5	11.81	6.40	18.20	2.85	53.60	12.30	5.90
12	-0.9059	79.934	76.0	0.5	12.43	6.25	18.68	2.99	53.75	12.47	6.21
13	-0.9045	83.737	79.8	0.6	13.05	6.15	19.19	3.12	53.85	12.67	6.52
14	-0.9031	87.382	83.4	0.6	13.64	6.07	19.71	3.25	53.93	12.89	6.82
15	-0.9017	90.485	86.5	0.6	14.14	6.02	20.16	3.35	53.98	13.09	7.07
16	-0.8989	97.042	93.1	0.7	15.21	5.93	21.14	3.56	54.07	13.54	7.60
17	-0.8961	102.030	98.1	0.7	16.01	5.91	21.92	3.71	54.09	13.92	8.01
18	-0.8933	106.809	102.9	0.8	16.78	5.93	22.72	3.83	54.07	14.33	8.39
19	-0.8905	110.843	106.9	0.8	17.43	5.96	23.40	3.92	54.04	14.68	8.72
20	-0.8877	114.023	110.1	0.9	17.94	6.02	23.97	3.98	53.98	14.99	8.97
21	-0.8849	118.027	114.1	0.9	18.59	6.08	24.66	4.06	53.92	15.37	9.29
22	-0.8807	122.739	118.8	1.0	19.34	6.13	25.47	4.16	53.87	15.80	9.67
23	-0.8737	129.058	125.1	1.1	20.34	6.23	26.57	4.27	53.77	16.40	10.17
24	-0.8681	133.804	129.9	1.2	21.09	6.37	27.46	4.31	53.63	16.91	10.55
25	-0.8569	139.787	135.8	1.4	22.02	6.63	28.65	4.32	53.37	17.64	11.01
26	-0.8457	145.857	141.9	1.6	22.96	6.77	29.73	4.39	53.23	18.25	11.48
27	-0.8345	149.977	146.0	1.8	23.57	7.01	30.59	4.36	52.99	18.80	11.79
28	-0.8233	154.945	151.0	2.0	24.33	7.20	31.53	4.38	52.80	19.36	12.16
29	-0.8121	158.550	154.6	2.2	24.86	7.35	32.20	4.38	52.65	19.77	12.43
30	-0.8009	163.102	159.2	2.4	25.54	7.57	33.10	4.37	52.43	20.34	12.77
31	-0.7897	166.464	162.5	2.6	26.02	7.67	33.69	4.39	52.33	20.68	13.01
32	-0.7785	170.561	166.6	2.8	26.62	7.90	34.52	4.37	52.10	21.21	13.31
33	-0.7616	174.995	171.1	3.1	27.25	8.15	35.40	4.34	51.85	21.78	13.62
34	-0.7504	178.060	174.1	3.3	27.68	8.33	36.01	4.32	51.67	22.17	13.84
35	-0.7392	181.750	177.8	3.5	28.20	8.55	36.75	4.30	51.45	22.65	14.10
36	-0.7224	185.609	181.7	3.8	28.73	8.77	37.49	4.28	51.23	23.13	14.36
37	-0.7112	188.833	184.9	4.0	29.17	8.96	38.13	4.26	51.04	23.55	14.59
38	-0.7000	192.178	188.2	4.2	29.64	9.05	38.69	4.28	50.95	23.87	14.82
39	-0.6832	195.821	191.9	4.5	30.12	9.36	39.47	4.22	50.64	24.42	15.06
40	-0.6720	199.533	195.6	4.7	30.64	9.44	40.07	4.25	50.56	24.75	15.32
41	-0.6552	203.061	199.1	5.0	31.09	9.73	40.82	4.19	50.27	25.28	15.54
42	-0.6551	202.994	199.1	5.0	31.08	9.74	40.82	4.19	50.26	25.28	15.54

Parameters for Specimen No. 2

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	126.000			1060.410
Moisture content: Dry soil+tare, gms.	100.000			833.100
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	26.0		28.1	27.3
Moist specimen weight, gms.	1049.70			
Diameter, in.	2.800		2.835	
Area, in.²	6.158		6.311	
Height, in.	5.600		5.313	
Net decrease in height, in.		0.317	-0.030	
Net decrease in water volume, cc.			5.000	
Wet density, pcf	116.0		121.2	
Dry density, pcf	92.0		94.7	
Void ratio	0.8313		0.7808	
Saturation, %	84.4		97.1	

Test Readings for Specimen No. 2

Consolidation cell pressure = 70.00 psi

Consolidation back pressure = 50.00 psi

Consolidation effective confining stress = 20.00 psi

Strain rate, in./min. = 0.001

Fail. Stress = 38.08 psi **at reading no.** 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.9337	3.117	0.0	0.0	0.00	19.93	19.93	1.00	50.07	19.93	0.00
1	-0.9323	2.796	-0.3	0.0	-0.05	19.88	19.83	1.00	50.12	19.86	-0.03
2	-0.9253	11.155	8.0	0.2	1.27	19.32	20.60	1.07	50.68	19.96	0.64
3	-0.9239	24.247	21.1	0.2	3.34	18.65	22.00	1.18	51.35	20.33	1.67
4	-0.9225	37.017	33.9	0.2	5.36	18.00	23.36	1.30	52.00	20.68	2.68
5	-0.9211	49.297	46.2	0.2	7.30	17.40	24.70	1.42	52.60	21.05	3.65
6	-0.9197	60.181	57.1	0.3	9.02	16.87	25.88	1.53	53.13	21.38	4.51
7	-0.9183	69.968	66.9	0.3	10.56	16.42	26.98	1.64	53.58	21.70	5.28
8	-0.9169	78.837	75.7	0.3	11.96	16.03	27.99	1.75	53.97	22.01	5.98
9	-0.9155	86.711	83.6	0.3	13.20	15.71	28.91	1.84	54.29	22.31	6.60
10	-0.9140	93.926	90.8	0.4	14.34	15.45	29.78	1.93	54.55	22.61	7.17
11	-0.9126	100.527	97.4	0.4	15.37	15.22	30.60	2.01	54.78	22.91	7.69
12	-0.9112	106.948	103.8	0.4	16.38	15.02	31.40	2.09	54.98	23.21	8.19
13	-0.9098	113.209	110.1	0.4	17.37	14.85	32.21	2.17	55.15	23.53	8.68
14	-0.9084	119.189	116.1	0.5	18.30	14.69	33.00	2.25	55.31	23.84	9.15
15	-0.9070	125.122	122.0	0.5	19.23	14.56	33.79	2.32	55.44	24.18	9.62
16	-0.9056	130.657	127.5	0.5	20.10	14.45	34.55	2.39	55.55	24.50	10.05
17	-0.9042	136.086	133.0	0.6	20.95	14.36	35.31	2.46	55.64	24.83	10.48
18	-0.9028	141.383	138.3	0.6	21.78	14.28	36.06	2.53	55.72	25.17	10.89
19	-0.9014	146.719	143.6	0.6	22.61	14.20	36.82	2.59	55.80	25.51	11.31
20	-0.9000	151.628	148.5	0.6	23.38	14.14	37.52	2.65	55.86	25.83	11.69
21	-0.8986	157.133	154.0	0.7	24.24	14.05	38.30	2.73	55.95	26.17	12.12
22	-0.8972	162.731	159.6	0.7	25.12	13.97	39.09	2.80	56.03	26.53	12.56
23	-0.8958	167.710	164.6	0.7	25.89	13.91	39.81	2.86	56.09	26.86	12.95
24	-0.8944	172.762	169.6	0.7	26.68	13.88	40.56	2.92	56.12	27.22	13.34
25	-0.8930	177.971	174.9	0.8	27.49	13.86	41.35	2.98	56.14	27.61	13.75

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
26	-0.8902	186.799	183.7	0.8	28.87	13.83	42.70	3.09	56.17	28.27	14.43
27	-0.8888	191.785	188.7	0.8	29.64	13.82	43.46	3.14	56.18	28.64	14.82
28	-0.8860	200.454	197.3	0.9	30.99	13.81	44.80	3.24	56.19	29.30	15.49
29	-0.8832	208.581	205.5	0.9	32.25	13.82	46.06	3.33	56.18	29.94	16.12
30	-0.8804	216.482	213.4	1.0	33.47	13.81	47.28	3.42	56.19	30.55	16.73
31	-0.8776	222.897	219.8	1.1	34.46	13.81	48.26	3.50	56.19	31.04	17.23
32	-0.8720	235.337	232.2	1.2	36.37	13.81	50.18	3.63	56.19	32.00	18.18
33	-0.8664	246.540	243.4	1.3	38.08	13.74	51.82	3.77	56.26	32.78	19.04
34	-0.8608	253.438	250.3	1.4	39.12	13.80	52.92	3.83	56.20	33.36	19.56
35	-0.8552	259.540	256.4	1.5	40.03	13.88	53.91	3.88	56.12	33.90	20.01
36	-0.8496	264.714	261.6	1.6	40.79	13.96	54.75	3.92	56.04	34.36	20.40
37	-0.8440	269.304	266.2	1.7	41.46	14.06	55.52	3.95	55.94	34.79	20.73
38	-0.8328	275.359	272.2	1.9	42.32	14.16	56.48	3.99	55.84	35.32	21.16
39	-0.8216	280.929	277.8	2.1	43.09	14.40	57.49	3.99	55.60	35.95	21.54
40	-0.8048	287.695	284.6	2.4	44.00	14.62	58.61	4.01	55.38	36.62	22.00
41	-0.7880	292.549	289.4	2.7	44.60	14.94	59.54	3.98	55.06	37.24	22.30
42	-0.7656	298.640	295.5	3.2	45.34	15.30	60.65	3.96	54.70	37.97	22.67
43	-0.7488	302.599	299.5	3.5	45.80	15.47	61.27	3.96	54.53	38.37	22.90
44	-0.6700	315.000	311.9	5.0	46.96	15.47	62.43	4.04	54.53	38.95	23.48

Parameters for Specimen No. 3

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	126.000			1060.410
Moisture content: Dry soil+tare, gms.	100.000			833.100
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	26.0		27.3	27.3
Moist specimen weight, gms.	1049.70			
Diameter, in.	2.800		2.886	
Area, in.²	6.158		6.543	
Height, in.	5.600		5.063	
Net decrease in height, in.		0.551	-0.014	
Net decrease in water volume, cc.			6.600	
Wet density, pcf	116.0		121.9	
Dry density, pcf	92.0		95.8	
Void ratio	0.8313		0.7594	
Saturation, %	84.4		97.0	

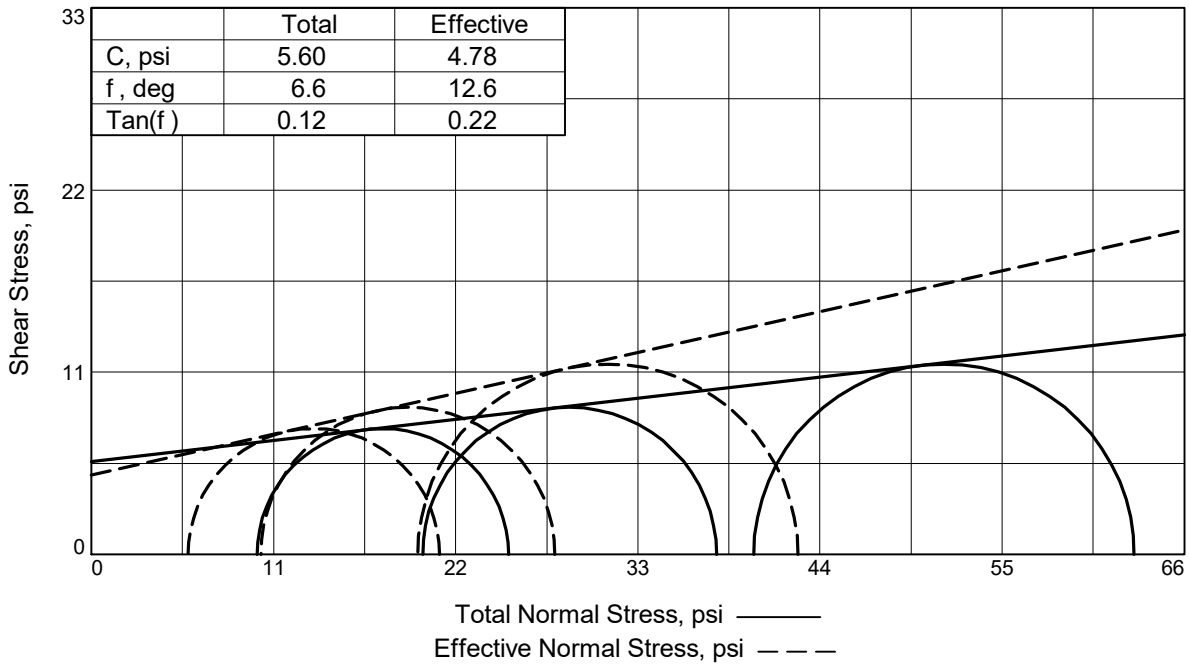
Test Readings for Specimen No. 3

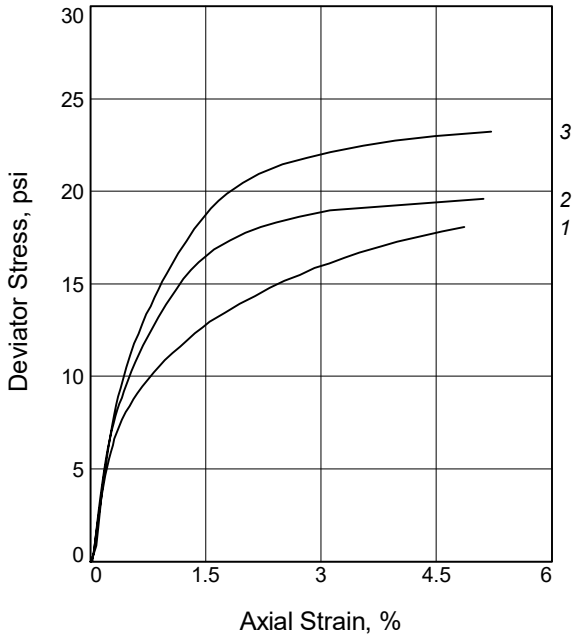
Consolidation cell pressure = 90.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 40.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 65.77 psi **at reading no.** 37

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.9201	3.579	0.0	0.0	0.00	39.71	39.71	1.00	50.29	39.71	0.00
1	-0.9187	20.184	16.6	0.0	2.54	38.81	41.34	1.07	51.19	40.07	1.27
2	-0.9173	39.686	36.1	0.1	5.52	37.73	43.24	1.15	52.27	40.49	2.76
3	-0.9159	58.289	54.7	0.1	8.35	36.63	44.99	1.23	53.37	40.81	4.18
4	-0.9145	75.777	72.2	0.1	11.02	35.59	46.62	1.31	54.41	41.10	5.51
5	-0.9131	91.889	88.3	0.1	13.48	34.62	48.10	1.39	55.38	41.36	6.74
6	-0.9117	106.797	103.2	0.2	15.75	33.73	49.48	1.47	56.27	41.61	7.87
7	-0.9103	120.469	116.9	0.2	17.83	32.93	50.76	1.54	57.07	41.85	8.92
8	-0.9089	133.740	130.2	0.2	19.85	32.18	52.03	1.62	57.82	42.10	9.92
9	-0.9075	146.226	142.6	0.2	21.75	31.52	53.26	1.69	58.48	42.39	10.87
10	-0.9061	157.096	153.5	0.3	23.40	30.92	54.31	1.76	59.08	42.62	11.70
11	-0.9047	167.823	164.2	0.3	25.03	30.38	55.41	1.82	59.62	42.90	12.51
12	-0.9033	178.161	174.6	0.3	26.59	29.90	56.50	1.89	60.10	43.20	13.30
13	-0.9019	187.499	183.9	0.4	28.01	29.47	57.48	1.95	60.53	43.48	14.00
14	-0.9005	196.558	193.0	0.4	29.38	29.07	58.45	2.01	60.93	43.76	14.69
15	-0.8991	206.181	202.6	0.4	30.84	28.66	59.50	2.08	61.34	44.08	15.42
16	-0.8977	215.191	211.6	0.4	32.20	28.27	60.47	2.14	61.73	44.37	16.10
17	-0.8963	224.429	220.8	0.5	33.59	27.90	61.50	2.20	62.10	44.70	16.80
18	-0.8949	232.653	229.1	0.5	34.84	27.60	62.43	2.26	62.40	45.01	17.42
19	-0.8935	240.668	237.1	0.5	36.04	27.33	63.38	2.32	62.67	45.35	18.02
20	-0.8907	255.499	251.9	0.6	38.28	26.88	65.16	2.42	63.12	46.02	19.14
21	-0.8893	263.480	259.9	0.6	39.48	26.65	66.13	2.48	63.35	46.39	19.74
22	-0.8865	277.922	274.3	0.7	41.65	26.26	67.91	2.59	63.74	47.09	20.83
23	-0.8837	290.353	286.8	0.7	43.51	25.96	69.47	2.68	64.04	47.71	21.76
24	-0.8809	303.502	299.9	0.8	45.48	25.66	71.14	2.77	64.34	48.40	22.74
25	-0.8781	315.747	312.2	0.8	47.31	25.36	72.67	2.87	64.64	49.01	23.66

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
26	-0.8753	326.936	323.4	0.9	48.98	25.10	74.08	2.95	64.90	49.59	24.49
27	-0.8725	337.888	334.3	0.9	50.61	24.87	75.48	3.04	65.13	50.18	25.31
28	-0.8697	347.944	344.4	1.0	52.11	24.62	76.72	3.12	65.38	50.67	26.05
29	-0.8669	358.105	354.5	1.1	53.61	24.34	77.95	3.20	65.66	51.14	26.81
30	-0.8641	367.158	363.6	1.1	54.95	24.17	79.12	3.27	65.83	51.64	27.48
31	-0.8585	381.931	378.4	1.2	57.12	23.88	81.00	3.39	66.12	52.44	28.56
32	-0.8529	393.843	390.3	1.3	58.85	23.69	82.54	3.48	66.31	53.12	29.43
33	-0.8473	404.576	401.0	1.4	60.40	23.52	83.93	3.57	66.48	53.72	30.20
34	-0.8417	413.103	409.5	1.5	61.62	23.38	85.00	3.64	66.62	54.19	30.81
35	-0.8361	420.809	417.2	1.7	62.71	23.26	85.97	3.70	66.74	54.62	31.35
36	-0.8249	431.262	427.7	1.9	64.14	23.31	87.44	3.75	66.69	55.37	32.07
37	-0.8081	443.621	440.0	2.2	65.77	23.42	89.19	3.81	66.58	56.30	32.88
38	-0.7857	454.238	450.7	2.7	67.05	23.87	90.91	3.81	66.13	57.39	33.52
39	-0.7633	462.660	459.1	3.1	67.99	24.30	92.29	3.80	65.70	58.30	33.99
40	-0.7352	472.184	468.6	3.7	69.00	24.79	93.80	3.78	65.21	59.30	34.50
41	-0.7072	480.460	476.9	4.2	69.82	25.25	95.07	3.77	64.75	60.16	34.91
42	-0.6792	488.242	484.7	4.8	70.55	25.65	96.20	3.75	64.35	60.93	35.27
43	-0.6624	492.506	488.9	5.1	70.92	25.88	96.81	3.74	64.12	61.35	35.46
44	-0.6399	499.933	496.4	5.5	71.66	26.15	97.81	3.74	63.85	61.98	35.83





Sample No.		1	2	3
Initial	Water Content, %	27.0	27.0	27.0
	Dry Density, pcf	99.5	99.5	99.5
	Saturation, %	105.2	105.2	105.2
	Void Ratio	0.6933	0.6933	0.6933
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	29.8	29.8	29.2
	Dry Density, pcf	93.0	93.0	94.0
	Saturation, %	99.2	99.2	99.2
	Void Ratio	0.8121	0.8121	0.7935
	Diameter, in.	2.855	2.902	2.941
	Height, in.	5.764	5.579	5.375
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.0	50.0	50.0
Cell Pressure, psi		60.0	70.0	90.0
Fail. Stress, psi		15.2	17.7	23.0
Excess Pore Pr., psi		4.2	9.8	20.3
Ult. Stress, psi				
Excess Pore Pr., psi				
$\bar{s}_1$ Failure, psi		21.0	28.0	42.7
$\bar{s}_3$ Failure, psi		5.8	10.2	19.7

Type of Test:
CU with Pore Pressures

Sample Type: Remold

Description: gray clay

LL= X **PI=** X

Assumed Specific Gravity= 2.7

Remarks: Specimen remolded to 99.5 pcf dry density at 27.0% moisture.

Clayey Shale (CH)

Client: Gannet Fleming, Inc

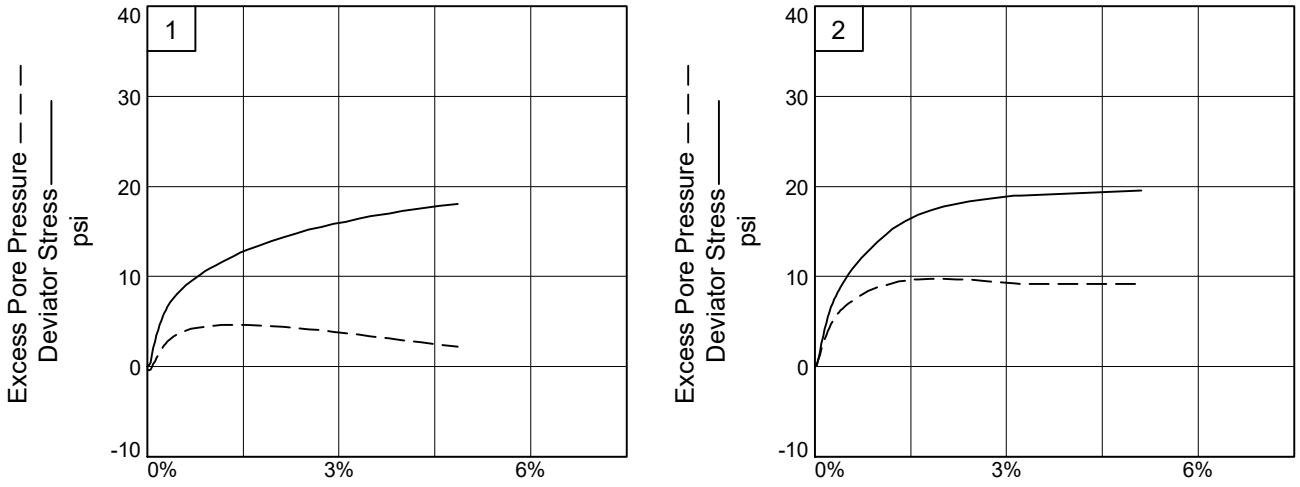
Project: Matejcek Dam

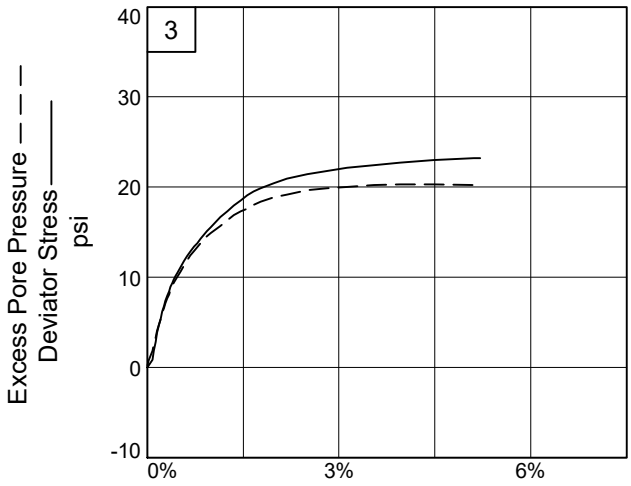
Source of Sample: GF-4 **Depth:** 105.0-124.0 ft

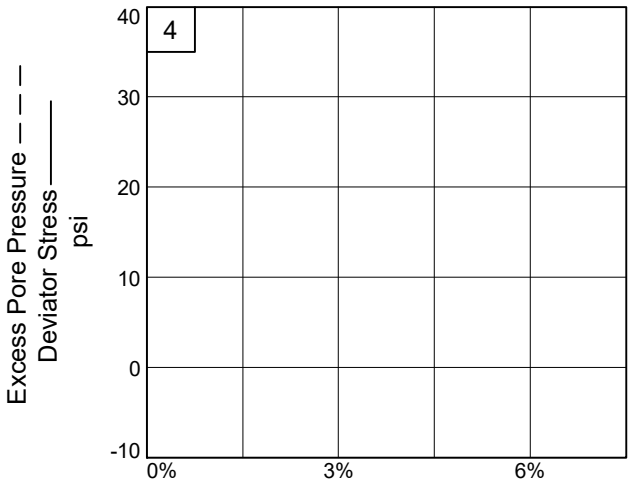
Sample Number: S42-S49

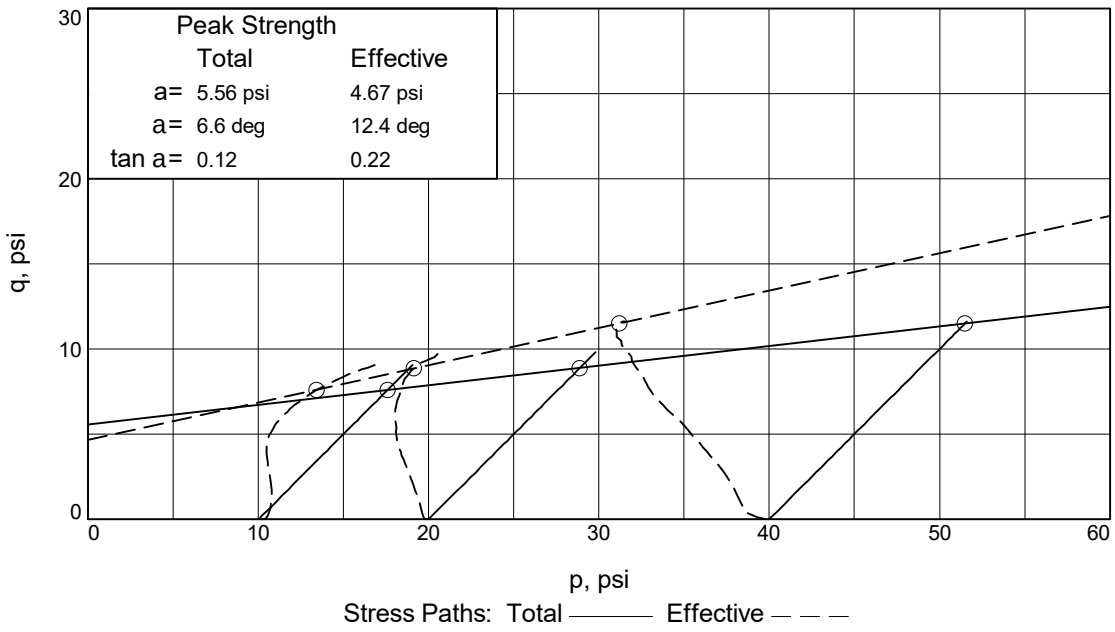
Proj. No.: M5191000 **Date Sampled:** N/A

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN









Client: Gannet Fleming, Inc
Project: Matejcek Dam
Source of Sample: GF-4 **Depth:** 105.0-124.0 ft **Sample Number:** S42-S49
Project No.: M5191000

Terracon Consultants, Inc.

TRIAXIAL COMPRESSION TEST 5/16/2019

CU with Pore Pressures 9:23 AM

Date: N/A
Client: Gannet Fleming, Inc
Project: Matejcek Dam
Project No.: M5191000
Location: GF-4
Depth: 105.0-124.0 ft **Sample Number:** S42-S49
Description: gray clay
Remarks: Specimen remolded to 99.5 pcf dry density at 27.0% moisture.
Type of Sample: Remold
Assumed Specific Gravity=2.7 **LL=**X **PL=** **PI=**X
Test Method: ASTM D 4767 Method A (staged method triaxial test)

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.000			1148.210
Moisture content: Dry soil+tare, gms.	100.000			889.010
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	27.0	29.8	29.8	29.2
Moist specimen weight, gms.	1144.28			
Diameter, in.	2.800	2.863	2.855	
Area, in.²	6.158	6.439	6.402	
Height, in.	5.600	5.731	5.764	
Net decrease in height, in.		-0.131	-0.033	
Net decrease in water volume, cc.			0.000	
Wet density, pcf	126.4	120.8	120.8	
Dry density, pcf	99.5	93.0	93.0	
Void ratio	0.6933	0.8121	0.8121	
Saturation, %	105.2	99.2	99.2	

Test Readings for Specimen No. 1

Consolidation cell pressure = 60.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 10.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 15.18 psi **at reading no.** 35

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.0664	2.783	0.0	0.0	0.00	10.25	10.25	1.00	49.75	10.25	0.00
1	-0.0650	3.482	0.7	0.0	0.11	10.38	10.49	1.01	49.62	10.44	0.05
2	-0.0635	5.763	3.0	0.0	0.47	10.34	10.81	1.04	49.66	10.57	0.23
3	-0.0621	11.134	8.4	0.1	1.30	10.05	11.36	1.13	49.95	10.70	0.65
4	-0.0607	15.999	13.2	0.1	2.06	9.73	11.79	1.21	50.27	10.76	1.03
5	-0.0593	20.735	18.0	0.1	2.80	9.39	12.19	1.30	50.61	10.79	1.40
6	-0.0579	25.137	22.4	0.1	3.49	9.04	12.52	1.39	50.96	10.78	1.74
7	-0.0565	28.953	26.2	0.2	4.08	8.70	12.78	1.47	51.30	10.74	2.04
8	-0.0551	32.609	29.8	0.2	4.65	8.39	13.04	1.55	51.61	10.71	2.32
9	-0.0537	35.631	32.8	0.2	5.12	8.11	13.22	1.63	51.89	10.67	2.56
10	-0.0523	38.353	35.6	0.2	5.54	7.85	13.39	1.71	52.15	10.62	2.77
11	-0.0509	40.879	38.1	0.3	5.93	7.62	13.56	1.78	52.38	10.59	2.97
12	-0.0495	43.177	40.4	0.3	6.29	7.42	13.71	1.85	52.58	10.56	3.15
13	-0.0481	45.304	42.5	0.3	6.62	7.24	13.86	1.92	52.76	10.55	3.31
14	-0.0453	48.755	46.0	0.4	7.15	6.95	14.10	2.03	53.05	10.52	3.58
15	-0.0425	51.964	49.2	0.4	7.65	6.67	14.32	2.15	53.33	10.49	3.83
16	-0.0397	54.671	51.9	0.5	8.07	6.45	14.52	2.25	53.55	10.48	4.03
17	-0.0369	56.866	54.1	0.5	8.40	6.27	14.68	2.34	53.73	10.47	4.20
18	-0.0341	59.151	56.4	0.6	8.76	6.12	14.87	2.43	53.88	10.50	4.38
19	-0.0313	61.206	58.4	0.6	9.07	5.98	15.05	2.52	54.02	10.52	4.54
20	-0.0271	63.857	61.1	0.7	9.47	5.83	15.30	2.63	54.17	10.56	4.74
21	-0.0229	66.267	63.5	0.8	9.84	5.72	15.56	2.72	54.28	10.64	4.92
22	-0.0187	68.673	65.9	0.8	10.21	5.63	15.83	2.81	54.37	10.73	5.10
23	-0.0145	71.120	68.3	0.9	10.58	5.57	16.15	2.90	54.43	10.86	5.29
24	-0.0103	73.044	70.3	1.0	10.87	5.50	16.36	2.98	54.50	10.93	5.43
25	-0.0047	75.685	72.9	1.1	11.27	5.42	16.68	3.08	54.58	11.05	5.63
26	0.0009	77.972	75.2	1.2	11.61	5.38	16.98	3.16	54.62	11.18	5.80
27	0.0065	80.290	77.5	1.3	11.95	5.37	17.32	3.23	54.63	11.34	5.98
28	0.0121	82.722	79.9	1.4	12.32	5.36	17.67	3.30	54.64	11.52	6.16
29	0.0177	84.882	82.1	1.5	12.64	5.39	18.02	3.35	54.61	11.71	6.32
30	0.0233	86.975	84.2	1.6	12.95	5.37	18.32	3.41	54.63	11.85	6.47
31	0.0345	90.368	87.6	1.7	13.44	5.42	18.86	3.48	54.58	12.14	6.72
32	0.0457	93.794	91.0	1.9	13.94	5.53	19.47	3.52	54.47	12.50	6.97
33	0.0569	96.677	93.9	2.1	14.35	5.59	19.94	3.57	54.41	12.77	7.18
34	0.0681	99.631	96.8	2.3	14.77	5.71	20.48	3.59	54.29	13.09	7.39
35	0.0793	102.482	99.7	2.5	15.18	5.84	21.02	3.60	54.16	13.43	7.59
36	0.0905	104.700	101.9	2.7	15.49	5.96	21.44	3.60	54.04	13.70	7.74
37	0.1017	107.278	104.5	2.9	15.85	6.12	21.97	3.59	53.88	14.05	7.92
38	0.1129	109.169	106.4	3.1	16.10	6.26	22.36	3.57	53.74	14.31	8.05
39	0.1241	111.368	108.6	3.3	16.40	6.43	22.83	3.55	53.57	14.63	8.20
40	0.1354	113.439	110.7	3.5	16.68	6.63	23.31	3.52	53.37	14.97	8.34
41	0.1522	116.052	113.3	3.8	17.02	6.83	23.85	3.49	53.17	15.34	8.51
42	0.1634	118.035	115.3	4.0	17.28	7.05	24.33	3.45	52.95	15.69	8.64
43	0.1802	120.242	117.5	4.3	17.56	7.26	24.82	3.42	52.74	16.04	8.78
44	0.1970	122.332	119.5	4.6	17.82	7.55	25.37	3.36	52.45	16.46	8.91
45	0.2137	124.463	121.7	4.9	18.08	7.78	25.86	3.33	52.22	16.82	9.04

Parameters for Specimen No. 2

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.000			1148.210
Moisture content: Dry soil+tare, gms.	100.000			889.010
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	27.0		29.8	29.2
Moist specimen weight, gms.	1144.28			
Diameter, in.	2.800		2.902	
Area, in.²	6.158		6.615	
Height, in.	5.600		5.579	
Net decrease in height, in.		0.116	-0.095	
Net decrease in water volume, cc.			0.000	
Wet density, pcf	126.4		120.8	
Dry density, pcf	99.5		93.0	
Void ratio	0.6933		0.8121	
Saturation, %	105.2		99.2	

Test Readings for Specimen No. 2

Consolidation cell pressure = 70.00 psi

Consolidation back pressure = 50.00 psi

Consolidation effective confining stress = 20.00 psi

Strain rate, in./min. = 0.001

Fail. Stress = 17.75 psi **at reading no.** 36

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.0650	2.513	0.0	0.0	0.00	19.93	19.93	1.00	50.07	19.93	0.00
1	-0.0633	2.936	0.4	0.0	0.06	19.69	19.75	1.00	50.31	19.72	0.03
2	-0.0619	7.461	4.9	0.1	0.75	19.24	19.99	1.04	50.76	19.62	0.37
3	-0.0605	13.374	10.9	0.1	1.64	18.68	20.32	1.09	51.32	19.50	0.82
4	-0.0591	19.373	16.9	0.1	2.55	18.10	20.65	1.14	51.90	19.37	1.27
5	-0.0577	24.916	22.4	0.1	3.38	17.52	20.91	1.19	52.48	19.22	1.69
6	-0.0563	30.047	27.5	0.2	4.16	16.99	21.15	1.24	53.01	19.07	2.08
7	-0.0549	34.818	32.3	0.2	4.87	16.50	21.38	1.30	53.50	18.94	2.44
8	-0.0535	39.071	36.6	0.2	5.52	16.06	21.57	1.34	53.94	18.81	2.76
9	-0.0521	42.925	40.4	0.2	6.10	15.66	21.75	1.39	54.34	18.71	3.05
10	-0.0507	46.330	43.8	0.3	6.61	15.30	21.91	1.43	54.70	18.60	3.30
11	-0.0493	49.436	46.9	0.3	7.07	14.97	22.04	1.47	55.03	18.51	3.54
12	-0.0479	52.099	49.6	0.3	7.47	14.69	22.16	1.51	55.31	18.42	3.74
13	-0.0465	54.673	52.2	0.3	7.86	14.43	22.29	1.54	55.57	18.36	3.93
14	-0.0451	56.976	54.5	0.4	8.20	14.19	22.40	1.58	55.81	18.29	4.10
15	-0.0437	59.205	56.7	0.4	8.54	13.97	22.51	1.61	56.03	18.24	4.27
16	-0.0423	61.261	58.7	0.4	8.85	13.76	22.61	1.64	56.24	18.19	4.42
17	-0.0409	63.587	61.1	0.4	9.19	13.57	22.76	1.68	56.43	18.16	4.60
18	-0.0381	67.296	64.8	0.5	9.75	13.23	22.97	1.74	56.77	18.10	4.87
19	-0.0353	70.951	68.4	0.5	10.29	12.94	23.23	1.80	57.06	18.09	5.15
20	-0.0324	74.205	71.7	0.6	10.78	12.71	23.48	1.85	57.29	18.10	5.39
21	-0.0296	77.142	74.6	0.6	11.21	12.46	23.67	1.90	57.54	18.07	5.61
22	-0.0268	80.209	77.7	0.7	11.67	12.22	23.88	1.95	57.78	18.05	5.83
23	-0.0240	82.848	80.3	0.7	12.06	12.01	24.06	2.00	57.99	18.04	6.03
24	-0.0212	85.494	83.0	0.8	12.45	11.81	24.26	2.05	58.19	18.04	6.22
25	-0.0184	88.045	85.5	0.8	12.82	11.64	24.46	2.10	58.36	18.05	6.41

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
26	-0.0156	90.502	88.0	0.9	13.18	11.48	24.66	2.15	58.52	18.07	6.59
27	-0.0128	92.858	90.3	0.9	13.53	11.34	24.87	2.19	58.66	18.10	6.77
28	-0.0100	95.251	92.7	1.0	13.88	11.20	25.08	2.24	58.80	18.14	6.94
29	-0.0030	100.547	98.0	1.1	14.66	10.97	25.63	2.34	59.03	18.30	7.33
30	0.0026	104.682	102.2	1.2	15.26	10.75	26.01	2.42	59.25	18.38	7.63
31	0.0082	108.027	105.5	1.3	15.74	10.57	26.31	2.49	59.43	18.44	7.87
32	0.0138	110.911	108.4	1.4	16.16	10.43	26.59	2.55	59.57	18.51	8.08
33	0.0194	113.460	110.9	1.5	16.52	10.35	26.87	2.60	59.65	18.61	8.26
34	0.0250	115.871	113.4	1.6	16.86	10.33	27.19	2.63	59.67	18.76	8.43
35	0.0362	119.461	116.9	1.8	17.36	10.26	27.62	2.69	59.74	18.94	8.68
36	0.0474	122.325	119.8	2.0	17.75	10.24	27.99	2.73	59.76	19.11	8.87
37	0.0586	124.654	122.1	2.2	18.06	10.35	28.41	2.74	59.65	19.38	9.03
38	0.0698	126.676	124.2	2.4	18.32	10.36	28.67	2.77	59.64	19.52	9.16
39	0.0866	129.174	126.7	2.7	18.63	10.55	29.18	2.77	59.45	19.87	9.31
40	0.1090	131.929	129.4	3.1	18.96	10.72	29.68	2.77	59.28	20.20	9.48
41	0.1146	132.384	129.9	3.2	19.00	10.84	29.84	2.75	59.16	20.34	9.50
42	0.2200	139.000	136.5	5.1	19.58	10.84	30.42	2.81	59.16	20.63	9.79

Parameters for Specimen No. 3

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.000			1148.210
Moisture content: Dry soil+tare, gms.	100.000			889.010
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	27.0		29.2	29.2
Moist specimen weight, gms.	1144.28			
Diameter, in.	2.800		2.941	
Area, in.²	6.158		6.795	
Height, in.	5.600		5.375	
Net decrease in height, in.		0.306	-0.081	
Net decrease in water volume, cc.			6.200	
Wet density, pcf	126.4		121.4	
Dry density, pcf	99.5		94.0	
Void ratio	0.6933		0.7935	
Saturation, %	105.2		99.2	

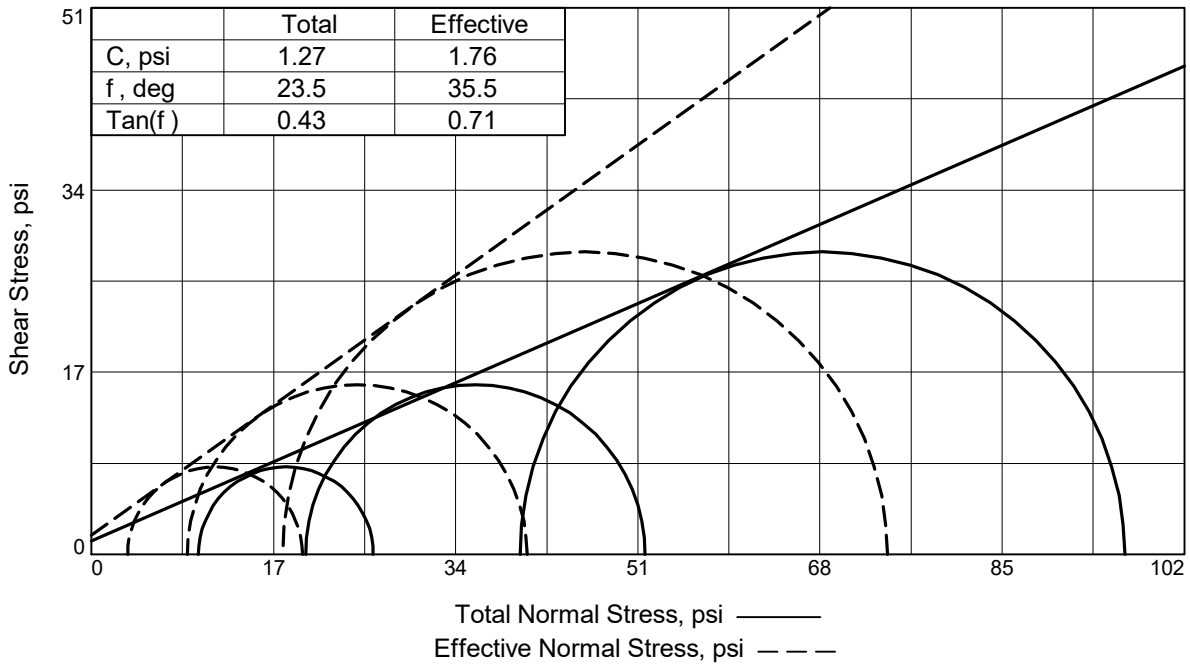
Test Readings for Specimen No. 3

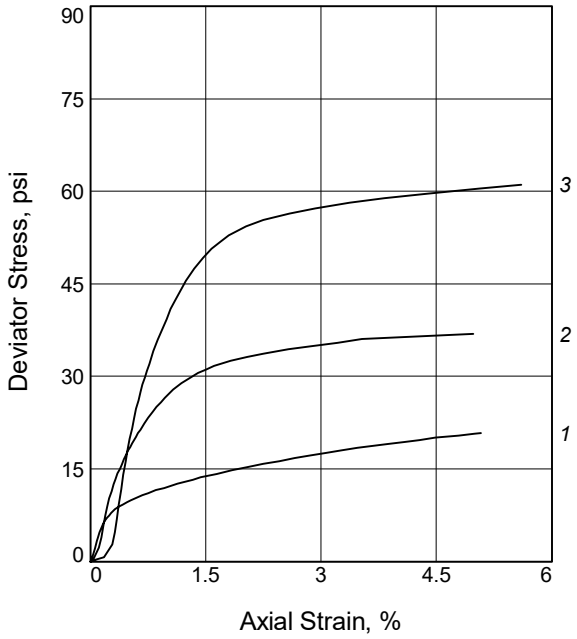
Consolidation cell pressure = 90.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 40.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 22.97 psi **at reading no.** 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.0605	2.540	0.0	0.0	0.00	39.78	39.78	1.00	50.22	39.78	0.00
1	-0.0591	3.966	1.4	0.0	0.21	39.22	39.43	1.01	50.78	39.32	0.10
2	-0.0563	8.265	5.7	0.1	0.84	38.17	39.01	1.02	51.83	38.59	0.42
3	-0.0549	14.933	12.4	0.1	1.82	37.46	39.28	1.05	52.54	38.37	0.91
4	-0.0535	21.877	19.3	0.1	2.84	36.69	39.53	1.08	53.31	38.11	1.42
5	-0.0521	28.553	26.0	0.2	3.82	35.96	39.78	1.11	54.04	37.87	1.91
6	-0.0507	34.321	31.8	0.2	4.67	35.27	39.94	1.13	54.73	37.61	2.33
7	-0.0493	39.894	37.4	0.2	5.49	34.62	40.10	1.16	55.38	37.36	2.74
8	-0.0479	44.606	42.1	0.2	6.18	34.00	40.18	1.18	56.00	37.09	3.09
9	-0.0465	48.939	46.4	0.3	6.81	33.43	40.24	1.20	56.57	36.83	3.41
10	-0.0451	52.797	50.3	0.3	7.37	32.89	40.26	1.22	57.11	36.57	3.69
11	-0.0437	56.651	54.1	0.3	7.94	32.38	40.32	1.25	57.62	36.35	3.97
12	-0.0423	60.144	57.6	0.3	8.45	31.91	40.35	1.26	58.09	36.13	4.22
13	-0.0409	63.286	60.7	0.4	8.91	31.46	40.36	1.28	58.54	35.91	4.45
14	-0.0395	66.353	63.8	0.4	9.35	31.04	40.39	1.30	58.96	35.71	4.68
15	-0.0381	69.015	66.5	0.4	9.74	30.65	40.39	1.32	59.35	35.52	4.87
16	-0.0367	71.710	69.2	0.4	10.13	30.29	40.43	1.33	59.71	35.36	5.07
17	-0.0353	74.347	71.8	0.5	10.52	29.95	40.47	1.35	60.05	35.21	5.26
18	-0.0325	78.637	76.1	0.5	11.14	29.37	40.51	1.38	60.63	34.94	5.57
19	-0.0297	82.974	80.4	0.6	11.77	28.74	40.51	1.41	61.26	34.63	5.88
20	-0.0269	86.753	84.2	0.6	12.32	28.15	40.46	1.44	61.85	34.30	6.16
21	-0.0241	90.441	87.9	0.7	12.85	27.60	40.45	1.47	62.40	34.02	6.42
22	-0.0213	94.120	91.6	0.7	13.38	27.10	40.48	1.49	62.90	33.79	6.69
23	-0.0185	97.011	94.5	0.8	13.79	26.65	40.45	1.52	63.35	33.55	6.90
24	-0.0157	100.269	97.7	0.8	14.26	26.21	40.47	1.54	63.79	33.34	7.13
25	-0.0129	103.203	100.7	0.9	14.68	25.82	40.50	1.57	64.18	33.16	7.34

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
26	-0.0101	106.400	103.9	0.9	15.14	25.45	40.59	1.60	64.55	33.02	7.57
27	-0.0073	109.183	106.6	1.0	15.54	25.12	40.66	1.62	64.88	32.89	7.77
28	0.0011	116.941	114.4	1.1	16.64	24.31	40.95	1.68	65.69	32.63	8.32
29	0.0067	121.738	119.2	1.3	17.32	23.68	41.00	1.73	66.32	32.34	8.66
30	0.0123	126.308	123.8	1.4	17.97	23.14	41.11	1.78	66.86	32.12	8.98
31	0.0179	130.286	127.7	1.5	18.53	22.70	41.22	1.82	67.30	31.96	9.26
32	0.0235	134.299	131.8	1.6	19.09	22.37	41.46	1.85	67.63	31.91	9.54
33	0.0291	137.193	134.7	1.7	19.49	22.01	41.50	1.89	67.99	31.75	9.74
34	0.0347	139.986	137.4	1.8	19.87	21.66	41.53	1.92	68.34	31.59	9.93
35	0.0460	144.384	141.8	2.0	20.46	21.10	41.56	1.97	68.90	31.33	10.23
36	0.0572	148.071	145.5	2.2	20.95	20.83	41.78	2.01	69.17	31.30	10.47
37	0.0740	152.024	149.5	2.5	21.45	20.33	41.78	2.06	69.67	31.05	10.72
38	0.0908	154.891	152.4	2.8	21.79	20.14	41.93	2.08	69.86	31.03	10.89
39	0.1076	157.629	155.1	3.1	22.11	19.97	42.08	2.11	70.03	31.02	11.05
40	0.1300	160.699	158.2	3.5	22.45	19.76	42.21	2.14	70.24	30.98	11.23
41	0.1524	163.365	160.8	4.0	22.73	19.72	42.44	2.15	70.28	31.08	11.36
42	0.1804	165.980	163.4	4.5	22.97	19.70	42.68	2.17	70.30	31.19	11.49
43	0.2140	168.669	166.1	5.1	23.20	19.80	43.00	2.17	70.20	31.40	11.60
44	0.2196	169.052	166.5	5.2	23.23	19.91	43.13	2.17	70.09	31.52	11.61
45	0.2197	169.022	166.5	5.2	23.22	19.91	43.13	2.17	70.09	31.52	11.61





Sample No.		1	2	3
Initial	Water Content, %	29.0	29.0	29.0
	Dry Density, pcf	93.0	93.0	93.0
	Saturation, %	96.5	96.5	96.5
	Void Ratio	0.8116	0.8116	0.8116
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	27.4	26.4	25.4
	Dry Density, pcf	96.7	98.2	99.8
	Saturation, %	99.5	99.5	99.5
	Void Ratio	0.7428	0.7172	0.6889
	Diameter, in.	2.766	2.816	2.861
	Height, in.	5.519	5.247	5.001
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.0	50.0	50.0
Cell Pressure, psi		60.0	70.0	90.0
Fail. Stress, psi		16.3	31.7	56.4
Excess Pore Pr., psi		6.6	11.0	22.2
Ult. Stress, psi				
Excess Pore Pr., psi				
$\bar{s}_1$ Failure, psi		19.7	40.7	74.3
$\bar{s}_3$ Failure, psi		3.4	9.0	17.8

Type of Test:
CU with Pore Pressures

Sample Type: Remolded from SPT

Description: gray sandy clay

LL= X **PI=** X

Assumed Specific Gravity= 2.7

Remarks: Specimen remolded to 93.0 pcf dry density at 29.0% moisture.

Foundation Till (ML)

Client: Gannet Fleming, Inc

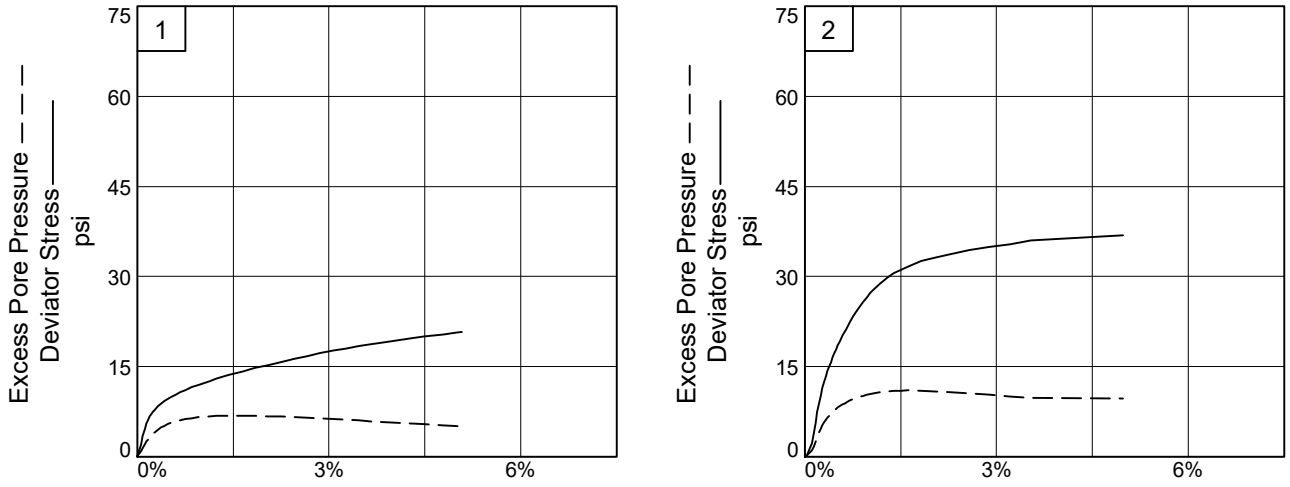
Project: Matejcek Dam

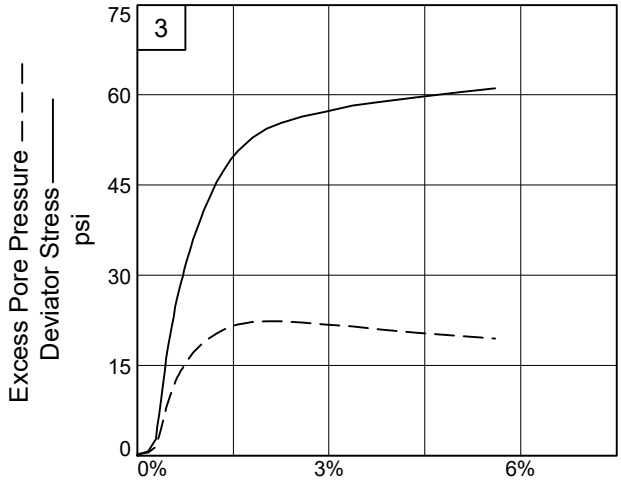
Source of Sample: GF-5 **Depth:** 37.5-50.0 ft

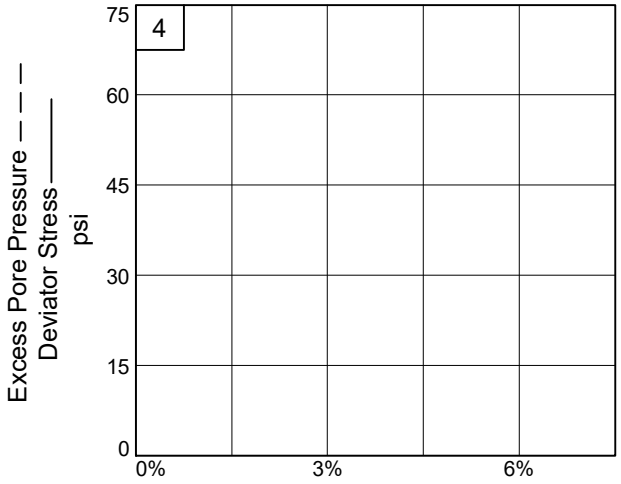
Sample Number: S15-S19

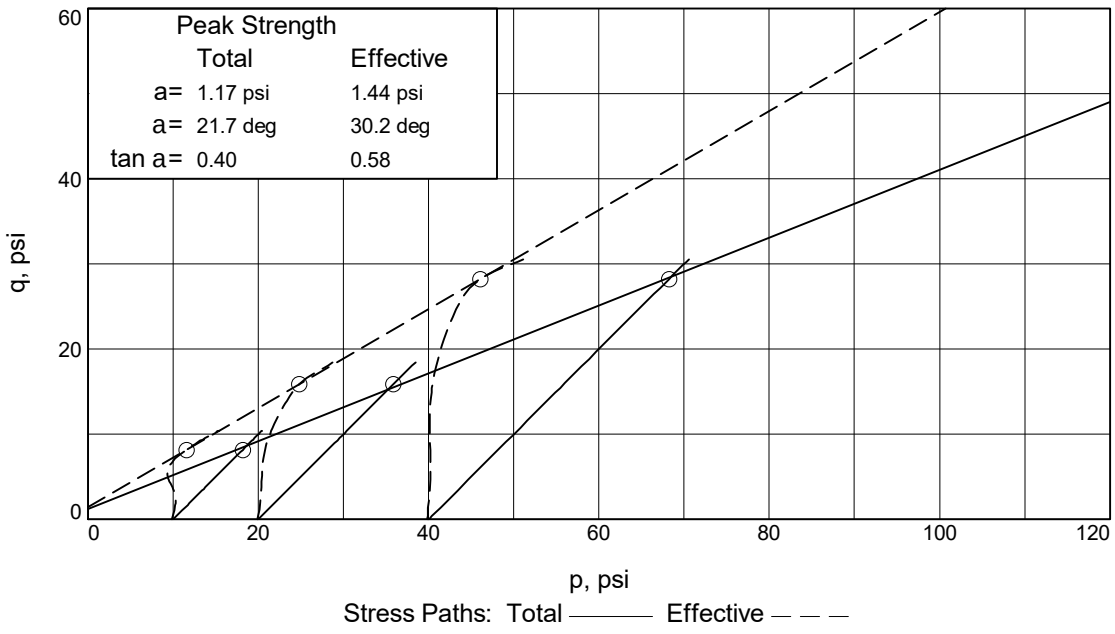
Proj. No.: M5191000 **Date Sampled:** N/A

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN









Client: Gannet Fleming, Inc
Project: Matejcek Dam
Source of Sample: GF-5 **Depth:** 37.5-50.0 ft **Sample Number:** S15-S19
Project No.: M5191000

Terracon Consultants, Inc.

TRIAXIAL COMPRESSION TEST 5/16/2019

CU with Pore Pressures 9:24 AM

Date: N/A
Client: Gannet Fleming, Inc
Project: Matejcek Dam
Project No.: M5191000
Location: GF-5
Depth: 37.5-50.0 ft **Sample Number:** S15-S19
Description: gray sandy clay
Remarks: Specimen remolded to 93.0 pcf dry density at 29.0% moisture.
Type of Sample: Remolded from SPT
Assumed Specific Gravity=2.7 **LL=**X **PL=** **PI=**X
Test Method: ASTM D 4767 Method A (staged method triaxial test)

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	129.000			1022.080
Moisture content: Dry soil+tare, gms.	100.000			815.160
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	29.0	27.7	27.4	25.4
Moist specimen weight, gms.	1086.38			
Diameter, in.	2.800	2.769	2.766	
Area, in.²	6.158	6.022	6.011	
Height, in.	5.600	5.539	5.519	
Net decrease in height, in.		0.061	0.020	
Net decrease in water volume, cc.			3.000	
Wet density, pcf	120.0	122.9	123.2	
Dry density, pcf	93.0	96.2	96.7	
Void ratio	0.8116	0.7524	0.7428	
Saturation, %	96.5	99.5	99.5	

Test Readings for Specimen No. 1

Consolidation cell pressure = 60.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 10.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 16.30 psi **at reading no.** 31

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	0.0647	4.893	0.0	0.0	0.00	9.81	9.81	1.00	50.19	9.81	0.00
1	0.0666	11.531	6.6	0.0	1.10	9.45	10.55	1.12	50.55	10.00	0.55
2	0.0680	17.599	12.7	0.1	2.11	9.08	11.20	1.23	50.92	10.14	1.06
3	0.0694	25.140	20.2	0.1	3.37	8.57	11.93	1.39	51.43	10.25	1.68
4	0.0698	27.370	22.5	0.1	3.74	8.41	12.14	1.44	51.59	10.27	1.87
5	0.0698	27.272	22.4	0.1	3.72	8.41	12.13	1.44	51.59	10.27	1.86
6	0.0712	33.256	28.4	0.1	4.71	7.92	12.63	1.60	52.08	10.27	2.36
7	0.0726	38.118	33.2	0.1	5.52	7.46	12.98	1.74	52.54	10.22	2.76
8	0.0740	42.146	37.3	0.2	6.19	7.07	13.26	1.88	52.93	10.16	3.09
9	0.0754	45.221	40.3	0.2	6.70	6.74	13.43	1.99	53.26	10.08	3.35
10	0.0768	47.826	42.9	0.2	7.13	6.43	13.56	2.11	53.57	10.00	3.56
11	0.0782	49.958	45.1	0.2	7.48	6.18	13.65	2.21	53.82	9.92	3.74
12	0.0796	52.015	47.1	0.3	7.82	5.93	13.75	2.32	54.07	9.84	3.91
13	0.0825	55.844	51.0	0.3	8.45	5.49	13.94	2.54	54.51	9.71	4.22
14	0.0853	58.423	53.5	0.4	8.87	5.13	14.01	2.73	54.87	9.57	4.44
15	0.0881	60.688	55.8	0.4	9.24	4.85	14.09	2.91	55.15	9.47	4.62
16	0.0909	62.922	58.0	0.5	9.61	4.59	14.20	3.09	55.41	9.40	4.80
17	0.0937	65.016	60.1	0.5	9.95	4.38	14.33	3.27	55.62	9.36	4.98
18	0.0979	67.368	62.5	0.6	10.33	4.13	14.46	3.50	55.87	9.30	5.17
19	0.1021	70.073	65.2	0.7	10.77	3.91	14.68	3.75	56.09	9.30	5.39
20	0.1063	72.217	67.3	0.8	11.12	3.74	14.86	3.97	56.26	9.30	5.56
21	0.1119	75.123	70.2	0.9	11.58	3.55	15.14	4.26	56.45	9.35	5.79
22	0.1175	77.213	72.3	1.0	11.92	3.43	15.34	4.48	56.57	9.38	5.96
23	0.1273	81.457	76.6	1.1	12.59	3.27	15.86	4.86	56.73	9.56	6.30
24	0.1329	83.716	78.8	1.2	12.95	3.21	16.16	5.04	56.79	9.68	6.48
25	0.1385	85.784	80.9	1.3	13.28	3.18	16.46	5.18	56.82	9.82	6.64
26	0.1441	87.974	83.1	1.4	13.62	3.14	16.77	5.33	56.86	9.95	6.81
27	0.1553	91.679	86.8	1.6	14.20	3.14	17.34	5.53	56.86	10.24	7.10
28	0.1665	95.570	90.7	1.8	14.81	3.17	17.97	5.68	56.83	10.57	7.40
29	0.1777	98.615	93.7	2.0	15.27	3.23	18.50	5.73	56.77	10.87	7.64
30	0.1889	102.011	97.1	2.3	15.79	3.30	19.10	5.78	56.70	11.20	7.90
31	0.2001	105.353	100.5	2.5	16.30	3.39	19.69	5.81	56.61	11.54	8.15
32	0.2113	108.466	103.6	2.7	16.77	3.49	20.26	5.81	56.51	11.88	8.39
33	0.2226	111.576	106.7	2.9	17.24	3.59	20.84	5.80	56.41	12.21	8.62
34	0.2338	114.269	109.4	3.1	17.64	3.71	21.35	5.76	56.29	12.53	8.82
35	0.2450	116.582	111.7	3.3	17.98	3.83	21.81	5.69	56.17	12.82	8.99
36	0.2562	119.551	114.7	3.5	18.41	3.96	22.37	5.65	56.04	13.16	9.21
37	0.2674	121.604	116.7	3.7	18.70	4.09	22.80	5.57	55.91	13.44	9.35
38	0.2786	124.022	119.1	3.9	19.05	4.22	23.27	5.52	55.78	13.74	9.53
39	0.2898	126.321	121.4	4.1	19.38	4.34	23.72	5.46	55.66	14.03	9.69
40	0.3010	128.582	123.7	4.3	19.70	4.46	24.16	5.41	55.54	14.31	9.85
41	0.3122	131.081	126.2	4.5	20.05	4.59	24.64	5.37	55.41	14.62	10.03
42	0.3290	133.490	128.6	4.8	20.37	4.79	25.16	5.26	55.21	14.97	10.19
43	0.3402	135.776	130.9	5.0	20.69	4.90	25.59	5.22	55.10	15.25	10.34
44	0.3450	136.625	131.7	5.1	20.80	4.96	25.77	5.19	55.04	15.37	10.40

Parameters for Specimen No. 2

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	129.000			1022.080
Moisture content: Dry soil+tare, gms.	100.000			815.160
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	29.0		26.4	25.4
Moist specimen weight, gms.	1086.38			
Diameter, in.	2.800		2.816	
Area, in.²	6.158		6.229	
Height, in.	5.600		5.247	
Net decrease in height, in.		0.361	-0.008	
Net decrease in water volume, cc.			8.000	
Wet density, pcf	120.0		124.1	
Dry density, pcf	93.0		98.2	
Void ratio	0.8116		0.7172	
Saturation, %	96.5		99.5	

Test Readings for Specimen No. 2

Consolidation cell pressure = 70.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 20.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 31.69 psi **at reading no.** 34

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.0012	3.132	0.0	0.0	0.00	19.90	19.90	1.00	50.10	19.90	0.00
1	0.0006	4.615	1.5	0.0	0.24	19.79	20.03	1.01	50.21	19.91	0.12
2	0.0048	17.422	14.3	0.1	2.29	18.96	21.25	1.12	51.04	20.11	1.15
3	0.0062	27.700	24.6	0.1	3.94	18.25	22.19	1.22	51.75	20.22	1.97
4	0.0076	39.383	36.3	0.2	5.81	17.40	23.21	1.33	52.60	20.31	2.90
5	0.0090	49.595	46.5	0.2	7.44	16.64	24.08	1.45	53.36	20.36	3.72
6	0.0104	58.552	55.4	0.2	8.88	15.95	24.83	1.56	54.05	20.39	4.44
7	0.0119	67.101	64.0	0.2	10.24	15.30	25.55	1.67	54.70	20.42	5.12
8	0.0133	74.426	71.3	0.3	11.41	14.75	26.16	1.77	55.25	20.46	5.71
9	0.0147	81.170	78.0	0.3	12.49	14.26	26.75	1.88	55.74	20.50	6.24
10	0.0161	86.905	83.8	0.3	13.40	13.84	27.25	1.97	56.16	20.54	6.70
11	0.0175	92.267	89.1	0.4	14.26	13.47	27.73	2.06	56.53	20.60	7.13
12	0.0189	96.963	93.8	0.4	15.01	13.15	28.16	2.14	56.85	20.66	7.50
13	0.0203	101.741	98.6	0.4	15.76	12.85	28.62	2.23	57.15	20.74	7.88
14	0.0217	106.527	103.4	0.4	16.53	12.55	29.08	2.32	57.45	20.82	8.26
15	0.0231	110.986	107.9	0.5	17.23	12.28	29.52	2.40	57.72	20.90	8.62
16	0.0245	115.237	112.1	0.5	17.91	12.04	29.94	2.49	57.96	20.99	8.95
17	0.0259	119.267	116.1	0.5	18.55	11.83	30.37	2.57	58.17	21.10	9.27
18	0.0273	122.858	119.7	0.5	19.12	11.63	30.74	2.64	58.37	21.18	9.56
19	0.0301	129.760	126.6	0.6	20.21	11.28	31.49	2.79	58.72	21.39	10.10
20	0.0315	133.379	130.2	0.6	20.78	11.11	31.89	2.87	58.89	21.50	10.39
21	0.0329	136.921	133.8	0.6	21.34	10.95	32.28	2.95	59.05	21.61	10.67
22	0.0357	143.610	140.5	0.7	22.39	10.66	33.05	3.10	59.34	21.86	11.20
23	0.0385	149.373	146.2	0.8	23.30	10.42	33.72	3.24	59.58	22.07	11.65
24	0.0413	155.376	152.2	0.8	24.24	10.18	34.43	3.38	59.82	22.31	12.12
25	0.0441	160.671	157.5	0.9	25.07	9.98	35.06	3.51	60.02	22.52	12.54

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
26	0.0469	165.542	162.4	0.9	25.83	9.82	35.66	3.63	60.18	22.74	12.92
27	0.0497	169.769	166.6	1.0	26.49	9.69	36.18	3.73	60.31	22.93	13.25
28	0.0525	174.497	171.4	1.0	27.23	9.53	36.76	3.86	60.47	23.14	13.61
29	0.0553	178.424	175.3	1.1	27.84	9.42	37.26	3.95	60.58	23.34	13.92
30	0.0609	185.073	181.9	1.2	28.86	9.23	38.09	4.13	60.77	23.66	14.43
31	0.0665	191.082	188.0	1.3	29.78	9.10	38.89	4.27	60.90	23.99	14.89
32	0.0721	196.090	193.0	1.4	30.54	9.02	39.56	4.39	60.98	24.29	15.27
33	0.0777	199.848	196.7	1.5	31.10	9.00	40.10	4.46	61.00	24.55	15.55
34	0.0833	203.769	200.6	1.6	31.69	8.96	40.65	4.54	61.04	24.81	15.84
35	0.0945	209.777	206.6	1.8	32.57	9.01	41.58	4.61	60.99	25.30	16.28
36	0.1057	214.065	210.9	2.0	33.17	9.13	42.30	4.64	60.87	25.71	16.59
37	0.1169	217.857	214.7	2.3	33.69	9.25	42.95	4.64	60.75	26.10	16.85
38	0.1337	223.435	220.3	2.6	34.46	9.48	43.93	4.64	60.52	26.70	17.23
39	0.1506	227.399	224.3	2.9	34.96	9.71	44.67	4.60	60.29	27.19	17.48
40	0.1674	231.083	228.0	3.2	35.42	9.98	45.39	4.55	60.02	27.68	17.71
41	0.1842	235.775	232.6	3.5	36.03	10.19	46.22	4.54	59.81	28.20	18.01
42	0.2600	245.000	241.9	5.0	36.89	10.29	47.18	4.59	59.71	28.73	18.45

Parameters for Specimen No. 3

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	129.000			1022.080
Moisture content: Dry soil+tare, gms.	100.000			815.160
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	29.0		25.4	25.4
Moist specimen weight, gms.	1086.38			
Diameter, in.	2.800		2.861	
Area, in.²	6.158		6.429	
Height, in.	5.600		5.001	
Net decrease in height, in.		0.614	-0.015	
Net decrease in water volume, cc.			8.800	
Wet density, pcf	120.0		125.1	
Dry density, pcf	93.0		99.8	
Void ratio	0.8116		0.6889	
Saturation, %	96.5		99.5	

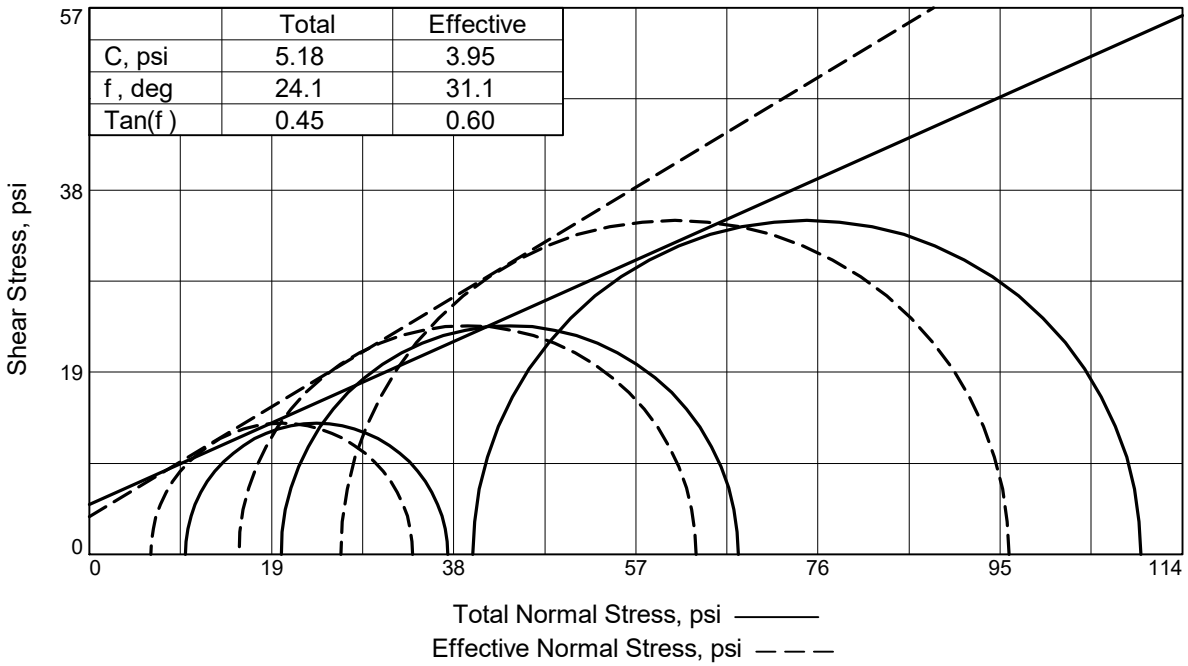
Test Readings for Specimen No. 3

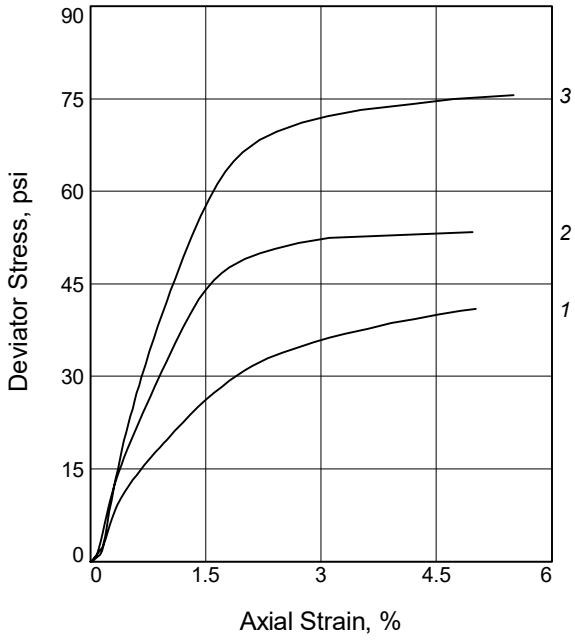
Consolidation cell pressure = 90.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 40.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 56.44 psi **at reading no.** 36

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	0.0228	3.292	0.0	0.0	0.00	39.87	39.87	1.00	50.13	39.87	0.00
1	0.0246	4.622	1.3	0.0	0.21	39.75	39.96	1.01	50.25	39.86	0.10
2	0.0316	8.102	4.8	0.2	0.75	39.52	40.27	1.02	50.48	39.90	0.37
3	0.0372	21.149	17.9	0.3	2.77	38.54	41.31	1.07	51.46	39.93	1.38
4	0.0386	33.647	30.4	0.3	4.71	37.69	42.40	1.12	52.31	40.05	2.35
5	0.0400	47.335	44.0	0.3	6.83	36.73	43.56	1.19	53.27	40.14	3.41
6	0.0414	62.914	59.6	0.4	9.24	35.57	44.81	1.26	54.43	40.19	4.62
7	0.0428	79.060	75.8	0.4	11.74	34.34	46.08	1.34	55.66	40.21	5.87
8	0.0442	94.522	91.2	0.4	14.13	33.13	47.26	1.43	56.87	40.20	7.06
9	0.0456	108.340	105.0	0.5	16.27	32.04	48.31	1.51	57.96	40.17	8.13
10	0.0470	120.865	117.6	0.5	18.20	31.05	49.25	1.59	58.95	40.15	9.10
11	0.0484	131.929	128.6	0.5	19.91	30.16	50.06	1.66	59.84	40.11	9.95
12	0.0498	142.588	139.3	0.5	21.55	29.32	50.88	1.73	60.68	40.10	10.78
13	0.0512	153.172	149.9	0.6	23.18	28.51	51.70	1.81	61.49	40.11	11.59
14	0.0526	163.201	159.9	0.6	24.73	27.76	52.48	1.89	62.24	40.12	12.36
15	0.0540	172.528	169.2	0.6	26.16	27.08	53.24	1.97	62.92	40.16	13.08
16	0.0554	181.003	177.7	0.7	27.46	26.47	53.93	2.04	63.53	40.20	13.73
17	0.0568	188.988	185.7	0.7	28.69	25.91	54.60	2.11	64.09	40.26	14.34
18	0.0583	196.208	192.9	0.7	29.80	25.42	55.22	2.17	64.58	40.32	14.90
19	0.0597	203.192	199.9	0.7	30.87	24.96	55.82	2.24	65.04	40.39	15.43
20	0.0611	210.539	207.2	0.8	31.99	24.48	56.47	2.31	65.52	40.48	16.00
21	0.0625	217.598	214.3	0.8	33.07	24.04	57.11	2.38	65.96	40.57	16.54
22	0.0639	224.292	221.0	0.8	34.09	23.62	57.71	2.44	66.38	40.67	17.05
23	0.0667	236.474	233.2	0.9	35.95	22.89	58.85	2.57	67.11	40.87	17.98
24	0.0695	247.413	244.1	0.9	37.62	22.26	59.88	2.69	67.74	41.07	18.81
25	0.0723	258.635	255.3	1.0	39.33	21.66	60.98	2.82	68.34	41.32	19.66

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
26	0.0751	269.023	265.7	1.0	40.90	21.11	62.01	2.94	68.89	41.56	20.45
27	0.0779	277.909	274.6	1.1	42.25	20.66	62.91	3.04	69.34	41.78	21.12
28	0.0849	299.666	296.4	1.2	45.53	19.65	65.18	3.32	70.35	42.41	22.76
29	0.0905	312.750	309.5	1.4	47.48	19.06	66.55	3.49	70.94	42.81	23.74
30	0.0961	324.771	321.5	1.5	49.27	18.58	67.85	3.65	71.42	43.21	24.64
31	0.1017	334.301	331.0	1.6	50.68	18.24	68.91	3.78	71.76	43.58	25.34
32	0.1073	342.153	338.9	1.7	51.82	17.98	69.80	3.88	72.02	43.89	25.91
33	0.1129	349.394	346.1	1.8	52.87	17.81	70.67	3.97	72.19	44.24	26.43
34	0.1241	359.838	356.5	2.0	54.34	17.66	71.99	4.08	72.34	44.82	27.17
35	0.1353	367.409	364.1	2.3	55.36	17.68	73.04	4.13	72.32	45.36	27.68
36	0.1521	375.780	372.5	2.6	56.44	17.84	74.29	4.16	72.16	46.07	28.22
37	0.1689	382.100	378.8	2.9	57.20	18.17	75.37	4.15	71.83	46.77	28.60
38	0.1914	390.397	387.1	3.4	58.18	18.58	76.76	4.13	71.42	47.67	29.09
39	0.2138	396.943	393.7	3.8	58.89	19.04	77.93	4.09	70.96	48.48	29.45
40	0.2418	404.185	400.9	4.4	59.63	19.57	79.19	4.05	70.43	49.38	29.81
41	0.2754	412.750	409.5	5.1	60.47	20.16	80.63	4.00	69.84	50.39	30.24
42	0.3029	419.288	416.0	5.6	61.08	20.57	81.66	3.97	69.43	51.11	30.54





Sample No.		1	2	3
Initial	Water Content, %	26.5	26.5	26.5
	Dry Density, pcf	95.0	95.0	95.0
	Saturation, %	92.5	92.5	92.5
	Void Ratio	0.7735	0.7735	0.7735
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	28.1	27.7	27.0
	Dry Density, pcf	95.2	95.9	96.8
	Saturation, %	98.6	98.5	98.5
	Void Ratio	0.7706	0.7581	0.7411
	Diameter, in.	2.801	2.858	2.910
	Height, in.	5.586	5.329	5.091
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.0	50.0	50.0
Cell Pressure, psi		60.0	70.0	90.0
Fail. Stress, psi		27.4	47.7	69.7
Excess Pore Pr., psi		3.6	4.4	13.8
Ult. Stress, psi				
Excess Pore Pr., psi				
$\bar{s}_1$ Failure, psi		33.7	63.3	95.9
$\bar{s}_3$ Failure, psi		6.4	15.6	26.2

Type of Test:
CU with Pore Pressures

Sample Type: Remold

Description: gray sandy clay

LL= X **PI=** X

Assumed Specific Gravity= 2.7

Remarks: Specimen remolded to 95.0 pcf dry density at 26.5% moisture.

Colluvial/Residual (ML)

Client: Gannet Fleming, Inc

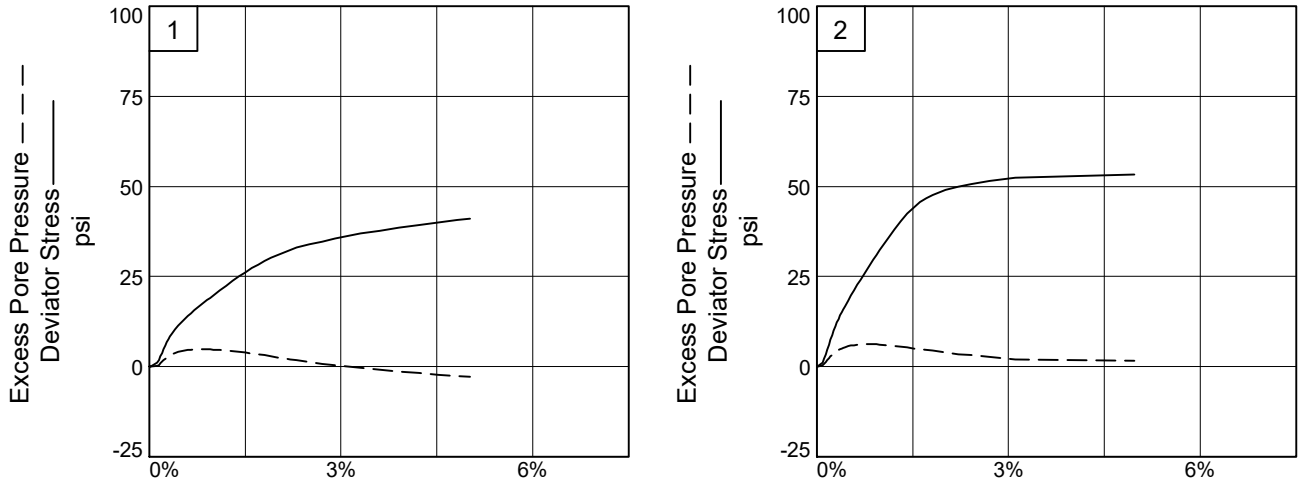
Project: Matejcek Dam

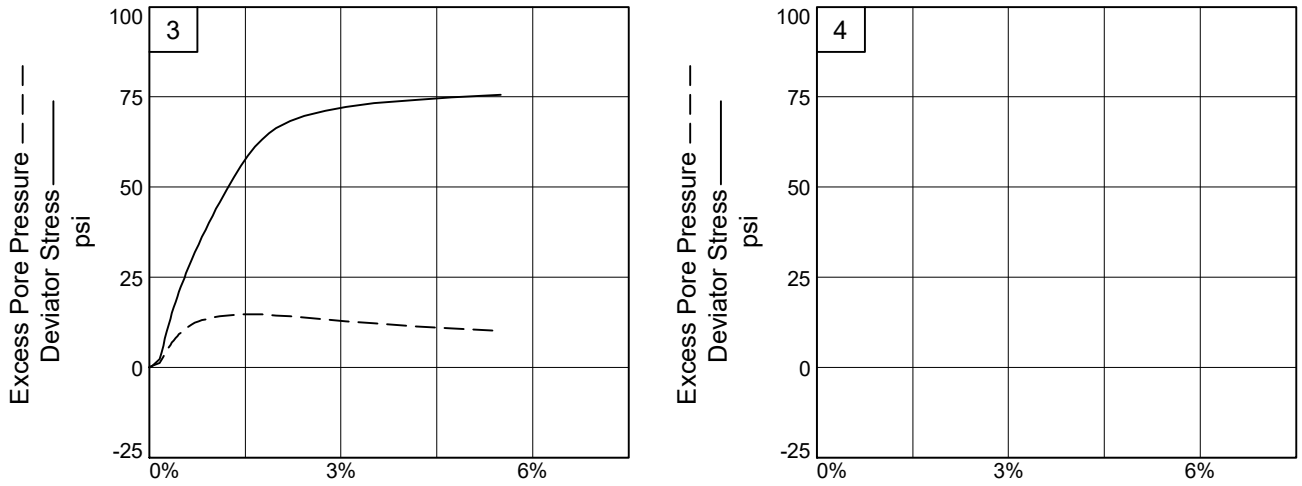
Source of Sample: GF-6 **Depth:** 7.5-30.0 ft

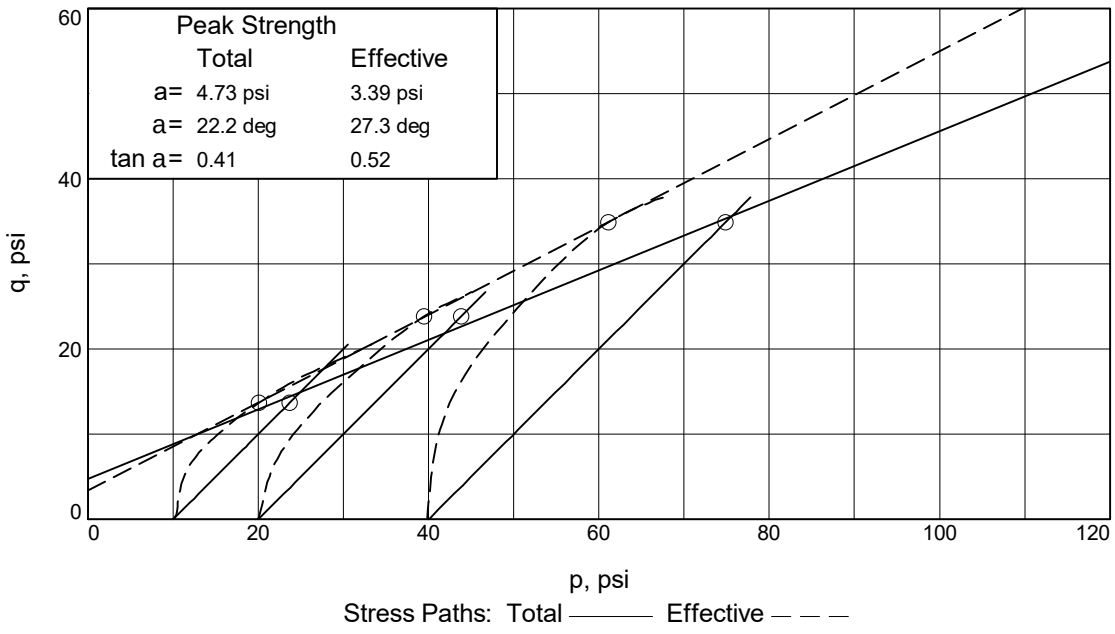
Sample Number: S3-S10

Proj. No.: M5191000 **Date Sampled:** N/A

TRIAXIAL SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN







Client: Gannet Fleming, Inc
Project: Matejcek Dam
Source of Sample: GF-6 **Depth:** 7.5-30.0 ft **Sample Number:** S3-S10
Project No.: M5191000

Terracon Consultants, Inc.

TRIAXIAL COMPRESSION TEST 5/16/2019

CU with Pore Pressures 9:24 AM

Date: N/A
Client: Gannet Fleming, Inc
Project: Matejcek Dam
Project No.: M5191000
Location: GF-6
Depth: 7.5-30.0 ft **Sample Number:** S3-S10
Description: gray sandy clay
Remarks: Specimen remolded to 95.0 pcf dry density at 26.5% moisture.
Type of Sample: Remold
Assumed Specific Gravity=2.7 **LL=**X **PL=** **PI=**X
Test Method: ASTM D 4767 Method A (staged method triaxial test)

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	126.500			1068.750
Moisture content: Dry soil+tare, gms.	100.000			841.270
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	26.5	28.2	28.1	27.0
Moist specimen weight, gms.	1088.24			
Diameter, in.	2.800	2.799	2.801	
Area, in.²	6.158	6.153	6.163	
Height, in.	5.600	5.598	5.586	
Net decrease in height, in.		0.002	0.012	
Net decrease in water volume, cc.			0.300	
Wet density, pcf	120.2	121.9	122.0	
Dry density, pcf	95.0	95.1	95.2	
Void ratio	0.7735	0.7716	0.7706	
Saturation, %	92.5	98.6	98.6	

Test Readings for Specimen No. 1

Consolidation cell pressure = 60.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 10.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 27.35 psi **at reading no.** 30

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.1799	3.359	0.0	0.0	0.00	9.96	9.96	1.00	50.04	9.96	0.00
1	-0.1785	4.129	0.8	0.0	0.12	9.98	10.11	1.01	50.02	10.04	0.06
2	-0.1729	9.993	6.6	0.1	1.08	9.82	10.90	1.11	50.18	10.36	0.54
3	-0.1715	14.168	10.8	0.2	1.75	9.55	11.30	1.18	50.45	10.43	0.88
4	-0.1701	20.922	17.6	0.2	2.84	9.08	11.93	1.31	50.92	10.50	1.42
5	-0.1687	27.143	23.8	0.2	3.85	8.61	12.47	1.45	51.39	10.54	1.93
6	-0.1673	33.436	30.1	0.2	4.87	8.16	13.03	1.60	51.84	10.60	2.43
7	-0.1659	39.756	36.4	0.3	5.89	7.76	13.65	1.76	52.24	10.70	2.95
8	-0.1645	45.293	41.9	0.3	6.79	7.40	14.18	1.92	52.60	10.79	3.39
9	-0.1631	50.694	47.3	0.3	7.66	7.07	14.73	2.08	52.93	10.90	3.83
10	-0.1617	55.575	52.2	0.3	8.44	6.77	15.22	2.25	53.23	11.00	4.22
11	-0.1603	60.032	56.7	0.4	9.16	6.52	15.69	2.41	53.48	11.10	4.58
12	-0.1575	67.560	64.2	0.4	10.38	6.14	16.52	2.69	53.86	11.33	5.19
13	-0.1547	73.836	70.5	0.5	11.38	5.88	17.26	2.94	54.12	11.57	5.69
14	-0.1519	79.749	76.4	0.5	12.33	5.66	17.99	3.18	54.34	11.82	6.17
15	-0.1491	85.248	81.9	0.6	13.21	5.50	18.71	3.40	54.50	12.11	6.61
16	-0.1463	90.127	86.8	0.6	13.99	5.40	19.39	3.59	54.60	12.40	7.00
17	-0.1435	95.005	91.6	0.7	14.77	5.32	20.09	3.78	54.68	12.71	7.39
18	-0.1407	100.296	96.9	0.7	15.62	5.21	20.83	4.00	54.79	13.02	7.81
19	-0.1379	105.177	101.8	0.8	16.40	5.15	21.54	4.18	54.85	13.35	8.20
20	-0.1350	109.297	105.9	0.8	17.05	5.15	22.20	4.31	54.85	13.67	8.53
21	-0.1322	113.864	110.5	0.9	17.78	5.15	22.92	4.45	54.85	14.04	8.89
22	-0.1294	118.224	114.9	0.9	18.47	5.18	23.65	4.57	54.82	14.41	9.23
23	-0.1266	122.331	119.0	1.0	19.12	5.23	24.35	4.66	54.77	14.79	9.56
24	-0.1238	126.716	123.4	1.0	19.81	5.28	25.09	4.76	54.72	15.18	9.91
25	-0.1182	135.486	132.1	1.1	21.20	5.39	26.60	4.93	54.61	15.99	10.60
26	-0.1126	143.658	140.3	1.2	22.49	5.54	28.03	5.06	54.46	16.79	11.25
27	-0.1070	152.374	149.0	1.3	23.86	5.66	29.53	5.21	54.34	17.60	11.93
28	-0.1014	160.244	156.9	1.4	25.10	5.87	30.97	5.28	54.13	18.42	12.55
29	-0.0958	167.427	164.1	1.5	26.22	6.13	32.36	5.27	53.87	19.24	13.11
30	-0.0902	174.696	171.3	1.6	27.35	6.38	33.74	5.28	53.62	20.06	13.68
31	-0.0846	180.846	177.5	1.7	28.31	6.65	34.96	5.25	53.35	20.81	14.15
32	-0.0790	187.579	184.2	1.8	29.35	6.85	36.20	5.29	53.15	21.52	14.68
33	-0.0734	192.787	189.4	1.9	30.15	7.13	37.28	5.23	52.87	22.21	15.08
34	-0.0678	198.035	194.7	2.0	30.95	7.42	38.38	5.17	52.58	22.90	15.48
35	-0.0622	202.773	199.4	2.1	31.67	7.69	39.37	5.12	52.31	23.53	15.84
36	-0.0566	206.903	203.5	2.2	32.30	7.98	40.28	5.05	52.02	24.13	16.15
37	-0.0510	211.553	208.2	2.3	33.00	8.15	41.16	5.05	51.85	24.66	16.50
38	-0.0398	217.704	214.3	2.5	33.91	8.70	42.61	4.90	51.30	25.66	16.95
39	-0.0286	223.460	220.1	2.7	34.75	9.19	43.93	4.78	50.81	26.56	17.37
40	-0.0174	229.068	225.7	2.9	35.56	9.57	45.13	4.72	50.43	27.35	17.78
41	-0.0062	233.769	230.4	3.1	36.22	10.00	46.23	4.62	50.00	28.12	18.11
42	0.0050	238.651	235.3	3.3	36.91	10.38	47.29	4.56	49.62	28.83	18.46
43	0.0218	244.814	241.5	3.6	37.76	10.89	48.65	4.47	49.11	29.77	18.88
44	0.0387	251.263	247.9	3.9	38.65	11.31	49.96	4.42	48.69	30.63	19.33
45	0.0555	256.251	252.9	4.2	39.30	11.80	51.11	4.33	48.20	31.46	19.65
46	0.0723	261.314	258.0	4.5	39.97	12.19	52.15	4.28	47.81	32.17	19.98

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
47	0.0891	266.653	263.3	4.8	40.66	12.60	53.26	4.23	47.40	32.93	20.33
48	0.1003	269.196	265.8	5.0	40.97	12.81	53.79	4.20	47.19	33.30	20.49

Parameters for Specimen No. 2

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	126.500			1068.750
Moisture content: Dry soil+tare, gms.	100.000			841.270
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	26.5		27.7	27.0
Moist specimen weight, gms.	1088.24			
Diameter, in.	2.800		2.858	
Area, in.²	6.158		6.415	
Height, in.	5.600		5.329	
Net decrease in height, in.		0.294	-0.023	
Net decrease in water volume, cc.			4.000	
Wet density, pcf	120.2		122.4	
Dry density, pcf	95.0		95.9	
Void ratio	0.7735		0.7581	
Saturation, %	92.5		98.5	

Test Readings for Specimen No. 2

Consolidation cell pressure = 70.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 20.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 47.70 psi **at reading no.** 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.1747	2.952	0.0	0.0	0.00	19.89	19.89	1.00	50.11	19.89	0.00
1	-0.1734	4.115	1.2	0.0	0.18	19.89	20.07	1.01	50.11	19.98	0.09
2	-0.1701	9.963	7.0	0.1	1.09	19.62	20.71	1.06	50.38	20.17	0.55
3	-0.1687	17.025	14.1	0.1	2.19	19.20	21.40	1.11	50.80	20.30	1.10
4	-0.1674	24.427	21.5	0.1	3.34	18.76	22.10	1.18	51.24	20.43	1.67
5	-0.1660	33.061	30.1	0.2	4.69	18.24	22.92	1.26	51.76	20.58	2.34
6	-0.1647	42.154	39.2	0.2	6.10	17.68	23.78	1.34	52.32	20.73	3.05
7	-0.1634	50.736	47.8	0.2	7.43	17.17	24.61	1.43	52.83	20.89	3.72
8	-0.1621	59.275	56.3	0.2	8.76	16.68	25.44	1.53	53.32	21.06	4.38
9	-0.1607	67.711	64.8	0.3	10.07	16.27	26.34	1.62	53.73	21.30	5.03
10	-0.1594	75.149	72.2	0.3	11.22	15.90	27.13	1.71	54.10	21.52	5.61
11	-0.1581	82.012	79.1	0.3	12.29	15.60	27.89	1.79	54.40	21.74	6.14
12	-0.1567	88.200	85.2	0.3	13.24	15.34	28.59	1.86	54.66	21.97	6.62
13	-0.1554	94.165	91.2	0.4	14.17	15.13	29.29	1.94	54.87	22.21	7.08
14	-0.1541	99.880	96.9	0.4	15.05	14.93	29.98	2.01	55.07	22.45	7.53
15	-0.1527	105.277	102.3	0.4	15.89	14.76	30.65	2.08	55.24	22.70	7.94
16	-0.1514	110.705	107.8	0.4	16.72	14.60	31.32	2.15	55.40	22.96	8.36
17	-0.1487	121.204	118.3	0.5	18.34	14.34	32.69	2.28	55.66	23.51	9.17
18	-0.1461	130.723	127.8	0.5	19.81	14.16	33.97	2.40	55.84	24.06	9.91
19	-0.1434	139.998	137.0	0.6	21.24	14.02	35.26	2.51	55.98	24.64	10.62

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
20	-0.1408	149.568	146.6	0.6	22.71	13.90	36.62	2.63	56.10	25.26	11.36
21	-0.1381	158.591	155.6	0.7	24.10	13.85	37.94	2.74	56.15	25.90	12.05
22	-0.1354	167.431	164.5	0.7	25.45	13.77	39.22	2.85	56.23	26.49	12.73
23	-0.1328	176.660	173.7	0.8	26.87	13.71	40.58	2.96	56.29	27.14	13.43
24	-0.1301	186.008	183.1	0.8	28.30	13.72	42.01	3.06	56.28	27.87	14.15
25	-0.1274	194.868	191.9	0.9	29.65	13.76	43.42	3.15	56.24	28.59	14.83
26	-0.1248	203.447	200.5	0.9	30.96	13.83	44.79	3.24	56.17	29.31	15.48
27	-0.1221	212.068	209.1	1.0	32.28	13.89	46.17	3.32	56.11	30.03	16.14
28	-0.1154	233.250	230.3	1.1	35.50	14.11	49.61	3.52	55.89	31.86	17.75
29	-0.1101	249.898	246.9	1.2	38.03	14.28	52.31	3.66	55.72	33.30	19.02
30	-0.1048	265.133	262.2	1.3	40.34	14.42	54.75	3.80	55.58	34.58	20.17
31	-0.0995	279.276	276.3	1.4	42.47	14.65	57.12	3.90	55.35	35.88	21.23
32	-0.0942	290.255	287.3	1.5	44.11	14.91	59.02	3.96	55.09	36.97	22.06
33	-0.0888	300.162	297.2	1.6	45.59	15.16	60.74	4.01	54.84	37.95	22.79
34	-0.0835	307.894	304.9	1.7	46.72	15.41	62.13	4.03	54.59	38.77	23.36
35	-0.0782	314.579	311.6	1.8	47.70	15.59	63.29	4.06	54.41	39.44	23.85
36	-0.0675	323.787	320.8	2.0	49.01	16.08	65.09	4.05	53.92	40.59	24.50
37	-0.0569	330.843	327.9	2.2	49.99	16.52	66.51	4.03	53.48	41.51	24.99
38	-0.0463	336.249	333.3	2.4	50.71	16.85	67.55	4.01	53.15	42.20	25.35
39	-0.0303	343.062	340.1	2.7	51.58	17.37	68.96	3.97	52.63	43.16	25.79
40	-0.0090	350.336	347.4	3.1	52.47	17.95	70.42	3.92	52.05	44.19	26.24
41	0.0900	363.000	360.0	5.0	53.34	18.31	71.65	3.91	51.69	44.98	26.67

Parameters for Specimen No. 3

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	126.500			1068.750
Moisture content: Dry soil+tare, gms.	100.000			841.270
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	26.5		27.0	27.0
Moist specimen weight, gms.	1088.24			
Diameter, in.	2.800		2.910	
Area, in.²	6.158		6.650	
Height, in.	5.600		5.091	
Net decrease in height, in.		0.536	-0.027	
Net decrease in water volume, cc.			5.400	
Wet density, pcf	120.2		123.0	
Dry density, pcf	95.0		96.8	
Void ratio	0.7735		0.7411	
Saturation, %	92.5		98.5	

Test Readings for Specimen No. 3

Consolidation cell pressure = 90.00 psi
Consolidation back pressure = 50.00 psi
Consolidation effective confining stress = 40.00 psi
Strain rate, in./min. = 0.001
Fail. Stress = 69.68 psi **at reading no.** 38

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-0.1812	2.831	0.0	0.0	0.00	39.95	39.95	1.00	50.05	39.95	0.00
1	-0.1798	4.157	1.3	0.0	0.20	39.76	39.96	1.01	50.24	39.86	0.10
2	-0.1728	18.341	15.5	0.2	2.33	38.73	41.06	1.06	51.27	39.90	1.16
3	-0.1714	30.093	27.3	0.2	4.09	37.97	42.06	1.11	52.03	40.01	2.05
4	-0.1700	43.084	40.3	0.2	6.04	37.08	43.12	1.16	52.92	40.10	3.02
5	-0.1686	56.245	53.4	0.2	8.01	36.19	44.20	1.22	53.81	40.20	4.01
6	-0.1672	68.955	66.1	0.3	9.92	35.35	45.27	1.28	54.65	40.31	4.96
7	-0.1658	80.924	78.1	0.3	11.71	34.56	46.27	1.34	55.44	40.42	5.85
8	-0.1644	92.078	89.2	0.3	13.38	33.84	47.22	1.40	56.16	40.53	6.69
9	-0.1630	102.903	100.1	0.4	15.00	33.16	48.15	1.45	56.84	40.66	7.50
10	-0.1616	113.675	110.8	0.4	16.61	32.50	49.10	1.51	57.50	40.80	8.30
11	-0.1602	124.032	121.2	0.4	18.15	31.88	50.03	1.57	58.12	40.95	9.08
12	-0.1588	133.779	130.9	0.4	19.61	31.33	50.94	1.63	58.67	41.14	9.80
13	-0.1574	143.029	140.2	0.5	20.99	30.84	51.83	1.68	59.16	41.34	10.49
14	-0.1560	151.724	148.9	0.5	22.28	30.40	52.68	1.73	59.60	41.54	11.14
15	-0.1546	160.309	157.5	0.5	23.56	29.98	53.54	1.79	60.02	41.76	11.78
16	-0.1532	168.576	165.7	0.6	24.79	29.60	54.38	1.84	60.40	41.99	12.39
17	-0.1518	177.235	174.4	0.6	26.08	29.21	55.29	1.89	60.79	42.25	13.04
18	-0.1504	185.543	182.7	0.6	27.31	28.83	56.14	1.95	61.17	42.49	13.66
19	-0.1490	193.669	190.8	0.6	28.52	28.49	57.00	2.00	61.51	42.74	14.26
20	-0.1476	201.714	198.9	0.7	29.71	28.17	57.88	2.05	61.83	43.03	14.86
21	-0.1448	216.520	213.7	0.7	31.91	27.68	59.59	2.15	62.32	43.64	15.95
22	-0.1420	231.369	228.5	0.8	34.10	27.25	61.36	2.25	62.75	44.30	17.05
23	-0.1392	245.507	242.7	0.8	36.19	26.90	63.10	2.35	63.10	45.00	18.10
24	-0.1364	258.590	255.8	0.9	38.12	26.65	64.77	2.43	63.35	45.71	19.06
25	-0.1335	272.001	269.2	0.9	40.10	26.41	66.51	2.52	63.59	46.46	20.05

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
26	-0.1307	285.578	282.7	1.0	42.10	26.17	68.27	2.61	63.83	47.22	21.05
27	-0.1279	298.276	295.4	1.0	43.97	26.00	69.97	2.69	64.00	47.99	21.98
28	-0.1251	310.500	307.7	1.1	45.76	25.87	71.63	2.77	64.13	48.75	22.88
29	-0.1195	335.287	332.5	1.2	49.39	25.62	75.02	2.93	64.38	50.32	24.70
30	-0.1139	357.972	355.1	1.3	52.70	25.49	78.19	3.07	64.51	51.84	26.35
31	-0.1083	380.118	377.3	1.4	55.93	25.34	81.26	3.21	64.66	53.30	27.96
32	-0.1027	399.336	396.5	1.5	58.71	25.30	84.01	3.32	64.70	54.65	29.36
33	-0.0971	416.269	413.4	1.7	61.15	25.34	86.49	3.41	64.66	55.91	30.57
34	-0.0915	430.780	427.9	1.8	63.22	25.39	88.61	3.49	64.61	57.00	31.61
35	-0.0859	442.601	439.8	1.9	64.90	25.50	90.40	3.54	64.50	57.95	32.45
36	-0.0803	452.894	450.1	2.0	66.34	25.62	91.96	3.59	64.38	58.79	33.17
37	-0.0691	467.432	464.6	2.2	68.33	25.90	94.23	3.64	64.10	60.06	34.17
38	-0.0579	477.677	474.8	2.4	69.68	26.23	95.91	3.66	63.77	61.07	34.84
39	-0.0411	489.016	486.2	2.8	71.10	26.75	97.86	3.66	63.25	62.30	35.55
40	-0.0243	498.196	495.4	3.1	72.20	27.20	99.40	3.65	62.80	63.30	36.10
41	-0.0019	507.335	504.5	3.5	73.20	27.83	101.03	3.63	62.17	64.43	36.60
42	0.0317	517.311	514.5	4.2	74.14	28.62	102.75	3.59	61.38	65.69	37.07
43	0.0597	525.901	523.1	4.7	74.94	29.15	104.09	3.57	60.85	66.62	37.47
44	0.0990	534.569	531.7	5.5	75.57	29.86	105.42	3.53	60.14	67.64	37.78
45	0.0990	534.520	531.7	5.5	75.56	29.86	105.42	3.53	60.14	67.64	37.78

Objective:

This narrative documents the assumptions and methodology used in the Matejcek Dam embankment stability analysis to meet requirements of TR-60 (Ref. 1). Analyses performed include steady-state static stability and rapid drawdown. Seepage analyses were also performed to determine the corresponding pore pressures for the appropriate stability models.

References:

1. NRCS Technical Release 60. Earth Dams and Reservoirs.
2. U.S. Department of Agriculture, Soil Conservation Service. 1964. Flood Retarding Fish and Wildlife Dam No. 1. Middle-South Branch Forest River Watershed Grand Forks, Nelson & Walsh Counties, North Dakota. *As-Built Drawings. (Selected Sheets Attached)*
3. Houston Engineering. 2019. Matejcek Dam Surface Topography.
4. Gannett Fleming. 2019. Matejcek Dam Boring Logs. *(Selected Logs Attached*)
5. Gannett Fleming. 2019 Summary of Laboratory Test Results for Matejcek Dam.
6. USBR. 1987. Design Standards No. 13 Embankment Dams. Chapter 8 Seepage Analysis and Control.
7. Gannett Fleming. 2019. Piezometer Data for Matejcek Dam.
8. Gannett Fleming. 2019. Shear Strength Calculations for Matejcek Dam.
9. Bowles, J.C. 1996. Foundation Analysis and Design. 5th Edition.

GENERAL ASSUMPTIONS AND MODEL INPUTS

Purpose

The analyses completed in this scope of work include normal pool steady-state seepage, static stability, maximum surcharge pool static stability, and stability of the upstream slope during rapid drawdown conditions, in accordance with Ref. 1.

Geometry

The geometry of the models is developed based on As-Built drawings (Ref. 2), which indicate embankment zone limits, supplemented with existing site topography (Ref. 3) and subsurface boring logs (Ref. 4). Borings GF-4 and GF-5 were drilled at approximately Station 17+80, which per the Ref. 2 indicates the maximum height of fill, however the overall embankment height is greatest at approximately Station 18+80. Therefore, the model is a composite of conditions utilizing subsurface stratigraphy encountered in the borings and topography at the maximum height section.

Five different regions were modeled in: Zone I, Zone II, Zone III, Drain Fill, Foundation Soil (Glacial Till), and Foundation Rock (Shale). The original ground surface beneath Zone I is based off of data from TH-11, a pre-construction boring located upstream of the dam centerline (note that a roadway structure had crossed the Middle Branch Forest River at the dam centerline prior to dam construction).

The model utilizes NAVD 88 as the reference datum, which is approximately 1.2 feet greater than NAVD 29, the reference datum presumably used in the as-built drawings. Therefore, referenced elevations from the as-built drawings utilized in the GeoStudio model are increased by 1.2 feet.

Seepage Modeling

General

SEEP/W models were developed for normal pool, and raised pool (equal to the auxiliary spillway crest) conditions to develop the appropriate pore water conditions to meet Ref. 1 criteria, as applicable. The use of these SEEP/W models in conjunction with specific SLOPE/W stability models is presented herein.

Boundary Conditions

The boundary conditions (BC) used for seepage modeling, i.e., generation of pore pressures, are:

1. A total head BC equal to the respective pool elevation was used to model different reservoir pool conditions.
    a. Normal Pool is modeled at El. 1336.0, which is equal to the invert of the 1st Stage of the principal spillway.
    b. Flood Surcharge Pool is modeled at El. 1366.2 which is equal to maximum flood hydrograph.
2. A potential seepage face review BC was used on the downstream embankment slope for each of the three modeled pool conditions. This is a conservative approach in which the program starts by solving the problem based on the upstream boundary conditions and then computes the pressure on the nodes that make up the potential seepage face, with the assumed requirement that water can't pond on the surface – it simply runs off. The program iterates through all nodes, preventing ponded water, until a solution is reached where the phreatic surface may be at the ground surface for some portion of the potential seepage face.
3. A zero pressure head BC, $H_P=0$, was used to model the existing pipe within the internal embankment drain. This BC is considered appropriate because the drain outlets are understood to be actively flowing.

Hydraulic Conductivity Input

Material Models – SEEP/W requires the selection of a model type for each material that is being used in the seepage analysis. In general, the "Saturated/Unsaturated" model was selected for all materials that exist near the ground surface or near the anticipated phreatic surface through the dam during normal and raised pool seepage conditions – for the purposes of this evaluation, all strata, except for the foundation rock, was modeled as "Saturated/Unsaturated". The "Saturated Only" model was chosen for the foundation rock which is always completely submerged below the phreatic surface during the analyses. The selected material model for each layer is shown on the output reports. A summary of the saturated hydraulic conductivity (k_{sat}) values is displayed in Table 1.

Strata	Material Model	Permeability (ft/sec)	Permeability (cm/sec)	Data Source
Zone I	Saturated/Unsaturated	$1.3x10^{-9}$	$3.9x10^{-8}$	Ref. 5
Zone II	Saturated/Unsaturated	$1.3x10^{-8}$	$3.9x10^{-7}$	See Note 2
Zone III	Saturated/Unsaturated	$1.3x10^{-7}$	$3.9x10^{-6}$	See Note 3
Existing Drain Fill	Saturated/Unsaturated	$1.3x10^{-5}$	$3.9x10^{-4}$	See Note 4
Glacial Till	Saturated/Unsaturated	$8.4x10^{-8}$	$2.6x10^{-6}$	Ref. 5
Foundation Rock	Saturated Only	$1.9x10^{-7}$	$5.9x10^{-6}$	Ref. 5

Notes:

1) Per Ref. 2 Sheet 6, Zone II is comprised of "Impervious or Pervious Material". Since Zone I is "Impervious" per Ref. 2, assume Zone II is one order of magnitude greater than Zone I.
2) Per Ref. 2 Sheet 6, Zone III is comprised of "Shaley, gravelly excavation". Assume this is two orders of magnitude greater than Zone I.
3) Per Ref. 2, drain fill is reportedly "pit run sand and gravel", which is typically a well-graded, straight out of the ground with minimal processing or quality control aggregate. Assume this material is two orders of magnitude greater than Zone III.

Saturated Only Model – For this model type, a saturated hydraulic conductivity value is required. No function is required because the geomaterial is assumed to be continuously saturated. Inputs for saturated water content, equal to the material porosity, are also required.

Saturated/Unsaturated Model – A hydraulic conductivity function, i.e., k-function, must be input for each Saturated/Unsaturated material. The k-function defines the hydraulic conductivity as a function of negative pore water pressure. Each material k-function was generated by the software using the volumetric water content function and k_{sat}. K-functions for Drain Fill was estimated using the Fredlund & Xing method due to the apparent coarseness of this material. The finer grained Zone I, Zone II, and Zone III, and Glacial Till utilized the Van Genuchten estimation

method which also requires a residual volumetric water content (Θ_r), typically set to 10% of the porosity. All materials utilized a k-ratio of 1.

The volumetric water content function (water content versus negative pore water pressure) is generated by a subroutine within the software using the saturated water content, i.e., material porosity, and the general soil type (e.g., clay, silty sand, gravel, etc.) or lab test data, if available. Porosity is estimated using the USCS material classifications provided in Ref. 5 and Ref. 6, Table A-8. Material porosities and selected volumetric water content function representative soil types are summarized in Table 2.

Table 2. Summary of Design Porosity Values

Strata	Representative Sample Material	Porosity
Zone I	ML (see Ref. 5)	0.45 (Ref. 5)
Zone II	Silt (see Note 1)	0.35 (Ref. 6)
Zone III	MH (see Ref. 5)	0.35 (Ref. 6)
Existing Drain Fill	Sand (see Ref. 2)	0.2 (Ref. 6)
Glacial Till	ML (see Ref. 5)	0.45 (Ref. 5)
Foundation Rock	Not Used (see Note 2)	0.41 (Ref. 5)

Notes:

1) Zone II was not sampled during the recent subsurface exploration. Material parameters are assumed to be similar to other embankment zones based on description relative to other embankment zoning (Ref. 2) and laboratory data of those other embankment zones.
2) The Foundation Rock utilizes the "Saturated Only" model which does not require a volumetric water content function and therefore a representative soil type was not assigned.

Sample Material Estimations

Materials that were subjected to laboratory classification (Zone I, Zone III, and Glacial Till) utilize the Modified Kovacs estimation method, where the soil saturated volumetric water content (i.e., porosity), D_{10}, D_{60} and LL are input into the SEEP/W model. These materials and the input values are presented in Table 3. Other strata utilized the sample material estimations provided by Geo-Studio. For example, the Drain Fill utilized the sand sample function.

Table 3. Modified Kovacs Material Estimation Inputs Parameters

Zone	D60 (mm)	D10 (mm)	LL (%)
Zone I	0.055	0.002	45
Zone III	0.168	0.001	57
Glacial Till	0.066	0.001	45

Piezometer Data Used to Calibrate the Model

Pore pressure data obtained from piezometer GF-5U/5D, installed during the subsurface exploration in February 2019, was utilized to calibrate the seepage model (i.e., confirm user inputs). The SEEP/W model under normal pool conditions yields pore pressures within two feet of the pore pressures measured in GF-5U/5D (Ref. 7)

Data from GF-4U, located in the glacial till, and GF-4D, located in the foundation rock, show pore pressures nearly equal to the pool elevation despite being located downstream of the Zone I impervious core. Pore pressures of this magnitude are unusual for a zoned earth embankment dam and would indicate an open flow path between the reservoir to the piezometer. However, such a flow path is not likely due to the lower heads recorded in GF-5U/5D located in the same strata immediately downstream of GF-4U/4D. It is hypothesized that GF-4U/4D is being influenced by an unknown, non-reservoir source, and is therefore not considered appropriate for use to calibrate the seepage model.

SLOPE STABILITY MODELING

Pore Water Pressures

Static Stability at Normal Pool

Pore water pressures were developed using the SEEP/W model during steady-state normal pool conditions. The existing embankment drain is modeled as being fully functioning due to the understanding that the outlet pipes are actively flowing. The analysis is carried out for the downstream slope of the dam.

Static Stability at Flood Surcharge Pool

Pore water pressures were developed using the SEEP/W model during steady-state flood surcharge pool conditions. The analysis is carried out for the downstream slope of the dam.

Rapid Drawdown

Pore water pressures for this analysis were modeled using a manually-input single piezometric line equal to El. 1309.76, which is the invert elevation of the lowest gated outlet from the upstream-most boundary of the model to the Zone I impervious core. The piezometric line is then drawn from El. 1309.76 at the Zone I/Zone II interface to the modeled location of the toe drain pipe, 134 feet downstream of dam centerline at El. 1289.9, and then drawn at a constant elevation until intersection with the modeled ground surface. This piezometric surface represents an instantaneous drawdown within the SLOPE/W model. The analysis is carried out for the upstream slope of the dam.

Shear Strength Parameters

General

Design shear strength parameters were calculated using lab testing results (Ref. 8) for the Zone I and Glacial Till materials. The shear strength parameters for the existing drain fill are based on typical values for relatively clean course grained materials. Shear strength values for the Zone II and Zone III materials are assumed to be the same as the Zone I material. This assumption is considered conservative and therefore applicable due to the following:

1. Material descriptions from Ref. 2 suggest that Zone I is the finest grained and Zone III is the coarsest grained. This relationship is supported by laboratory classifications in Ref. 4. Typically, coarser grained soils coincide with a higher angle of internal friction.
2. Split-spoon sampler N values for Zone I and Zone III materials from Ref. 4 are similar enough to suggest a similar friction angle based on empirical correlations in available literature (Ref. 9, Table 3-4).
3. Pocket penetrometer values for both Zone I and Zone III materials from Ref. 4 are similar, which suggests similar material properties as unconfined compressive strength can be correlated to undrained shear strength (i.e., cohesion).

Consideration was given to applying an impenetrable material model to the Foundation Rock. This feature is applied when rock is known to be intact or unlikely to develop a failure surface through the material matrix. However, the Pierre Shale (i.e., the Foundation Rock per Ref. 4) is known to contain bentonite interbedding, which would enable such a failure surface. The orientation of the bentonite interbedding is not discernable based on the 2019 subsurface exploration documentation and therefore shear strength parameters obtained from reconstituted test specimens are utilized to represent the shear strength along the bentonite interbedding.

Design shear strength parameters are summarized in Table 4.

Static Stability at Normal Pool

The SLOPE/W model utilizes effective strength parameters as presented in Table 4. Two evaluations were performed, one where the impenetrable material model is applied to the Foundation Rock and one where the Foundation Rock utilizes effective stress parameters obtained from Ref. 8.

Static Stability at Flood Surcharge Pool

The SLOPE/W model utilizes bilinear strength parameters, i.e., the lowest of the effective or the consolidated total stress failure envelope as required in Ref. 1. SLOPE/W requires the input of both effective and total stress parameters as well as the normal stress of the intersection of the two

failure envelopes to perform a bilinear strength analysis. These parameters are presented in Table 4.

Rapid Drawdown

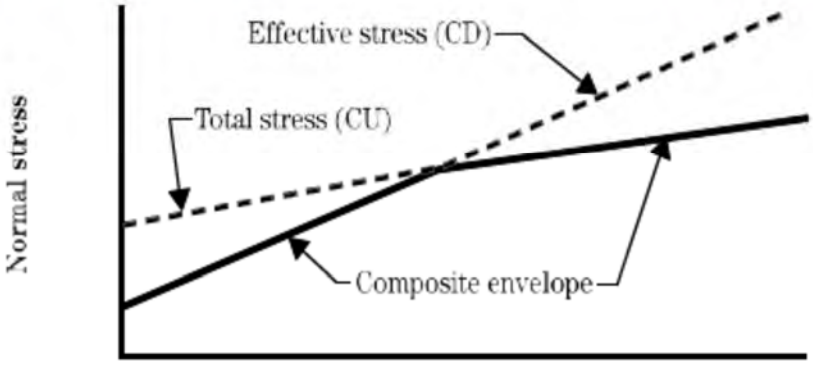
The SLOPE/W model utilizes bilinear strength parameters (previously defined) as required per Ref. 1 for the Foundation and Zoned Embankment materials as these materials are relatively low permeability and are expected to have limited drainage during a drawdown of the pool.

Table 4. SLOPE/W Soil and Rock Design Parameter Summary

Material	Unit Weight (pcf)	Shear Strength Parameters				
		Effective Stress		Total Stress		Bilinear Stress
		Cohesion, c' (psf)	Friction Angle, ϕ' (degrees)	Cohesion, c (psf)	Friction Angle, ϕ (degrees)	Normal Stress[1], σ_N (psf)
Zone I	115	0	34	430	25	2065
Zone II	115	0	34	430	25	2065
Zone III	115	0	34	430	25	2065
Drain Fill	115	0	34	0	34	-
Glacial Till	120	0	36	185	24	658
Foundation Rock	125	0	13	865	7	8003

Note: 1) The normal stress, σ_N, is the normal stress coordinate of the intersection of the effective stress and total stress failure envelope (Ref. 1, Figure 5-2 is duplicated below) and is calculated with the equation: $\sigma_N = \frac{c - c'}{\tan\phi - \tan\phi}$

Figure 5–2: Mohr-Coulomb Envelope for Upstream Drawdown



ANALYSIS AND CONCLUSION

A summary of the embankment stability analyses performed during this scope of work is presented in Table 5.

- The evaluation indicates that the existing embankment does not meet TR-60 criteria (Ref. 1) for normal pool, steady-state seepage, when the failures through the underlying Foundation Rock are considered (FS=1.2, required FS=1.5).

- The evaluation indicates that the existing embankment does not meet TR-60 criteria (Ref. 1) for flood surcharge pool, steady-state seepage, when the failures through the underlying Foundation Rock are considered (FS=1.0, required FS=1.4).

- The evaluation indicates that the existing embankment meets TR-60 criteria for both normal pool and flood surcharge pool conditions if the underlying Foundation Rock is considered impenetrable.

- The evaluation indicates that the existing embankment does meet TR-60 criteria (Ref. 1) for stability of the upstream slope during rapid drawdown of the reservoir from normal pool (FS=2.3, required FS=1.2).

Table 5. Summary of Matejcek Dam Embankment Stability Evaluation

Pool Condition	Pool Elevation	Seepage Conditions	PWP Conditions	Design Criteria	Slope	Stability Analysis	Shear Strength Parameters	Required Factor of Safety	Calculated Factor of Safety
Normal	1336.0	Steady State	From Normal Pool SEEP/W Analysis, Existing Embankment Drain Functioning	TR-60	Downstream	Static	Effective Stress Strengths for All Materials	1.5	1.2
Normal	1336.0	Steady State	From Normal Pool SEEP/W Analysis, Existing Embankment Drain Functioning	TR-60	Downstream	Static	Effective Stress Strengths for All Soil Materials, Impenetrable for Rock	1.5	1.7
Flood Surcharge	1366.2	Steady-State	From Flood Surcharge Pool SEEP/W Analysis, Existing Embankment Drain Functioning	TR-60	Downstream	Static	Bilinear Strengths for Embankment and Foundation materials.	1.4	1.0
Flood Surcharge	1366.2	Steady-State	From Flood Surcharge Pool SEEP/W Analysis, Existing Embankment Drain Functioning	TR-60	Downstream	Static	Bilinear Strengths for All Soil Materials, Impenetrable for Rock	1.4	1.7
Rapid Drawdown	1309.76	Steady-State	Piezometric Surface Equal to Invert of Lowest Gated Outlet	TR-60	Upstream	Static	Bilinear Strengths for Embankment and Foundation materials, Effective Stress Strength for Rock.	1.2	1.6

Ref. 1

Overall height of embankment, H, (ft)	Minimum top width (ft)		
	All dams	Single-purpose floodwater retarding	Multipurpose or other purposes
35<94.9	N/A	14	(H+35)/5
95.0+	N/A	16	26

Embankment Slope Stability

Analyze the stability of embankment slopes using generally accepted methods based on sound engineering principles. Document all aspects of the analyses performed. Documentation should include analysis program and methods used, input data, and tabular and graphical output. Document shear strength parameters used for each zone of the embankment and each soil type or horizon in the foundation and the basis for these parameters. Document piezometric assumptions included in the analyses and any other variables that will influence stability, along with the basis for the values. The stability analysis should incorporate zones of saturation and seepage pressures consistent with the results of the seepage analysis. Identify and incorporate features necessary to achieve required safety factors in the design.

The extent and intent of the site investigation, soil testing program, and analyses should be consistent. The level of investigation, testing, and analysis should be commensurate with the complexity of the site and structure, along with the consequences of failure. Minimum required static stability safety factors are summarized in figure 5–3 for each condition analyzed.

This TR does not address all potential situations that may arise in the embankment dam stability analysis. When using approaches outside the scope of this TR, document references for all analysis methods used. Include justification for the methodology used, the basis for material characterization and pore pressure assumptions, and comparison of the analysis results with analysis methods included in this technical release.

Consider the following guidance in analyzing slope stability for all conditions:

- Evaluate the overall stability of the embankment and foundation. Determine the stability of critical slip zones (zones that encompass a significant portion of the embankment, pass through major portions of the embankment and foundation, and zones that include the crest), and identify slip surfaces with the overall minimum factors of safety. Document the location of slip surfaces evaluated relative to the location of comparatively weaker materials and areas of high pore pressure, to assure the evaluation of zones that have a propensity to control stability.
- Use effective stress parameters for soils that will drain as rapidly as load is applied. These parameters apply for all conditions of stability analyzed for these soils.
- Limit the use of infinite slope equations and associated safety factors listed in figure 5–3 to the stability of near surface failure surfaces in the exterior slope of embankments with cohesionless soils, when the critical failure is wholly within soils of this character, and analysis of deeper failures would result in higher factors of safety. Infinite slope equations should model the predicted seepage pattern in the slope under analysis. Different equations apply for no seepage, horizontal seepage paths, and seepage paths parallel to the slope face. If shallow slope failure

could progress and affect deeper embankment zones, use the higher safety factors listed in figure 5–3. If cohesionless zones occur with other soil types in analysis of a cross section, use other methods to analyze circular arc or wedge-shaped surfaces that intersect the soil zones with cohesion to locate the minimum safety factor.

- Use residual effective stress parameters for modeling slope stability analyses involving fissured clays or shales if preexisting movements have occurred. Drained shear strength tests provide the basis for these parameters. Use residual parameters for designing against shallow slope failures in desiccated clay embankments with previous movement. Designers can use fully softened shear strength with conservative pore pressure assumptions to evaluate the potential for first time shallow slope failures in compacted high plasticity clay embankments.

Static Stability

Analyze embankment stability for each of the following conditions in the structure life that are appropriate to the site. Clearly document the reasons for not analyzing a condition. Document the source of all shear strength parameters used. When using a shear strength parameter determined from an empirical correlation, include correlations to field performance and document the justification for use of the empirically based value rather than site-specific sampling and testing. Include discussion on the sensitivity of the outcome of the analysis to the variability of the parameter. Stability analyses must identify and incorporate any lower strength materials that may control stability.

Stability During Construction

The construction sequence may control the configuration of the embankment and rate of construction when analysis predicts that embankment soil, foundation soils, or both will develop significant pore pressures during embankment construction. Evaluate site conditions, such as soft clay layers in the foundation that may require special designs. Consider flattened slopes and sequentially staged construction to achieve stable conditions. Factors determining the likelihood of this occurring include the overall height of the planned embankment, the speed of construction, the saturated consistency of foundation soils, and others. Perform appropriate shear tests to model placement conditions of embankment soils, as summarized in figure 5–3. Consider the highest likely placement water content of embankment soils in the shear-testing program. Alternatively, designers can use effective stress shear parameters to establish limits for pore pressure buildup during construction. The design should include procedures for monitoring pore pressures during construction to assure that actual pore pressures do not exceed limits established during design.

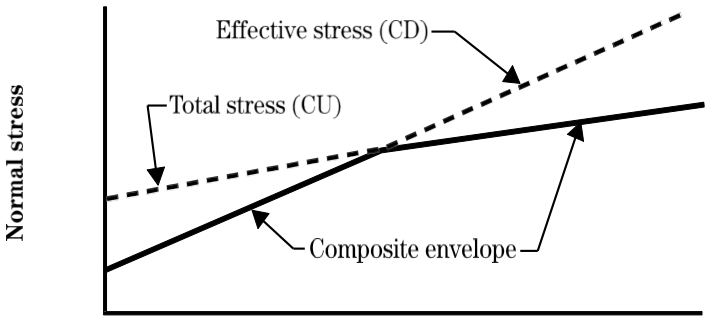
Construction stability analysis must include stability of excavation slopes that could have significant safety or construction consequences, such as excavation of existing embankment slopes during rehabilitation construction.

Rapid Drawdown

Analyze the stability of the upstream embankment slope for the condition created by a rapid drawdown of the water level in the reservoir from the normal full reservoir level from which a phreatic line is likely to develop to the elevation of the lowest gated outlet. If the potential exists for saturation of zones in the upstream slope during temporary flood retention storage above the permanent normal pool, consider the effect of drawdown back to the normal pool on that saturated portion of the embankment. Designers may use transient seepage analysis to estimate the short-term saturation of the portion of the embankment above permanent normal pool. Select shear strength parameters for the

analyses according to figure 5–3, as illustrated in figure 5–2.

Figure 5–2: Mohr-Coulomb Envelope for Upstream Drawdown



In cases where rapid drawdown slope stability is critical to embankment geometry or zoning, or for modifications to a previously constructed embankment, designers can also analyze rapid drawdown using procedures included in U.S. Army Corps of Engineers (USACE) Engineer Manual (EM) 1110-2-1902, Appendix G. Documentation should include the difference in analysis results between the methods and justification to use the selected results.

Steady Seepage

Analyze downstream slope stability of new or previously constructed dams under steady-state seepage conditions. Perform the analysis with the reservoir elevation at the highest normal pool level. Use shear parameters as listed in figure 5–3. Base the location of the steady-state phreatic surface on the highest normal reservoir pool elevation. Designers can develop the phreatic surface for the analyses using computer programs for seepage analysis, flow nets, or Casagrande procedures.

Existing embankments may not have achieved steady-state conditions. Thus, use the calculated long-term high-level steady-state seepage condition for both new and existing embankments. For existing embankments, compare the computed phreatic surface with field performance and field measurements, when available, to assure that the computed phreatic surface meets or exceeds that which has occurred over the life of the structure.

Include a separate foundation phreatic surface as appropriate at sites with limited foundation seepage cutoff, particularly in sites with confined seepage that results in uplift at the downstream toe.

If steady-state seepage stability is highly dependent on the success of internal drainage features to control the phreatic surface, check stability assuming partially functioning or plugged drainage systems.

For appropriate slopes, designers can use infinite slope equations and applicable safety factors listed in figure 5-3.

Flood Surcharge

Analyze downstream slope stability of new or previously constructed dams under flood detention conditions. Perform the analysis with the reservoir elevation at the freeboard hydrograph pool level. Use shear parameters as listed in figure 5–3.

Develop a phreatic surface resulting from the maximum reservoir elevation. Consider material properties and the potential for defects in the upper portion of the embankment when selecting the appropriate seepage analysis and evaluating seepage conditions that could develop. Also consider the potential for increase in pore pressures in the normally saturated portion of the foundation or embankment that may result from the higher reservoir loading. Evaluate a range of potential seepage conditions to determine the sensitivity of flood storage stability to potential seepage conditions.

If short term flood storage stability is highly dependent on the success of internal drainage features to control the phreatic surface, check stability assuming partially functioning or plugged drainage systems.

For appropriate slopes, designers can use infinite slope equations and applicable safety factors listed in figure 5-3.

Figure 5–3: Table of Static Slope Stability Criteria

Design condition	Primary assumption	Remarks	Applicable shear strength parameters	Minimum safety factor
1. Construction Stability (upstream or downstream slope)	Zones of the embankment or layers of the foundation expected to develop significant pore pressures during construction	Low-permeability embankment soils should be tested at water contents that are as wet as likely during construction (usually wet of optimum). Saturated low permeable foundation soils not expected to consolidate fully during construction. Existing dams with additional fill placed above saturated low-permeability zones.	Unconsolidated; Total stress consistent with preconstruction stress state	1.4 for failure surfaces extending into foundation layers 1.3 for embankments on stronger foundations where the failure surface is located entirely in the embankment
	Embankment zones and/or strata not expected to develop significant pore pressures during construction	Embankment zones, foundation strata, or both comprised of material with a permeability high enough to drain as rapidly as they are loaded	Effective stress	
2. Rapid drawdown (upstream slope)	Drawdown from the highest normal pool to the lowest gated outlet	Consider failure surfaces both within the embankment and extending into the foundation Low-permeability embankment and foundation soils that will have limited drainage during reservoir drawdown Embankment zones, foundation strata, or both comprised of material with a permeability high enough to drain as the reservoir is drawn down	Lowest of effective stress or consolidated; total stress; consistent with predrawdown consolidation stresses (See fig. 5-1) Effective stress	1.2 1.1 for near surface (infinite slope) failure surfaces in cohesionless soils
3. Steady seepage	Reservoir water surface at highest normal pool. Phreatic surface developed from the highest normal pool; typically the principal spillway crest	Consider failure surfaces within both the embankment and extending into the foundation. Foundation analysis may require separate phreatic surface evaluation, particularly in sites with confined seepage that results in uplift at the downstream toe.	Effective stress	1.5 1.3 for near surface (infinite slope) failure surfaces in cohesionless soils
4. Flood surcharge	Reservoir at freeboard hydrograph level. Steady seepage phreatic surface incorporating increased pore water pressure that may occur from flood detention and pore water pressure from short term seepage resulting from reservoir surface above the normal pool elevation	Consider failure surfaces within both the embankment and extending into the foundation. Embankment zones, foundation strata, or both comprised of material with a permeability high enough to drain rapidly with changes in reservoir elevation Low-permeability embankment and foundation soils that will have limited drainage as the increased reservoir load is applied	Effective stress Lowest of effective stress or consolidated; total stress (See fig. 5-1)	1.4 1.2 for near surface (infinite slope) failure surfaces in cohesionless soils

Figure 5–4: Shear Strength Parameters, Associated Tests, and Nomenclature

Shear strength parameter	Types of shear tests	NRCS notation	Other common abbreviation	Notes	American Standard for Testing Materials (ASTM) test standard
Total stress; unconsolidated[1]	Unconsolidated undrained triaxial	UU	Q		D2850
	Unconfined-compression	qu		Suitable for limited types of soils[2]	D2166
	Field vane shear			Limited to saturated low strength (Su<2 tsf) clays and silts. Field vane shear test results must be corrected for plasticity index to determine undrained strength	D2573
Total stress; consolidated [1]	Consolidated undrained triaxial	CU	R	ASTM standard for cohesive soils	D4767
Effective stress	Consolidated undrained triaxial with pore pressure measurements	$\overline{CU}$	R	Determine effective stress parameters by subtracting measured pore pressures from total stresses.	D4767
	Consolidated drained triaxial[3]	CD	S		D7181
	Direct shear			Strain rate must be limited to the extent required to allow drainage	D3080
Residual effective stress	Ring shear			Residual shear strength of cohesive materials containing preexisting shear surfaces	D6467
				Fully softened shear strength of cohesive materials without preexisting shear surfaces.	D7608
	Repeated direct shear			No ASTM standard for soils	

1. Using total stress parameters in the analyses model generates pore pressures (positive or negative) in laboratory specimens that simulate the pore pressures that will develop in the field soils during loading. Total stress parameters used in developing composite shear strength envelopes should not consider large negative pore pressures that may result from shear testing. Take the stress condition at failure to correspond to either maximum deviator stress or maximum principal effective stress ratio to define total stress parameters. Only use the stress conditions at a target axial strain to define failure when more limiting than other criteria.
2. The test for unconfined compressive strength (qu) applies only to cohesive materials that will retain strength without confining pressure and will not expel water during testing. This test does not apply to dry, crumbly, fissured, or non-cohesive soils or other soils that will not hold their shape without confinement. Some soils will exhibit higher strengths when tested using the unconsolidated undrained (UU) test. See ASTM D2166.
3. NRCS generally performs consolidated undrained with pore pressure measurements ($\overline{CU}$) tests rather than consolidated drained (CD) tests, as a more rapid strain rate with the CU test reduces the time required to complete the test. With appropriately performed tests, effective shear strength parameters obtained from CU *bar* tests should be equivalent to those from CD tests.

Dynamic Stability

Evaluate the effects of earthquake loading for all dams.

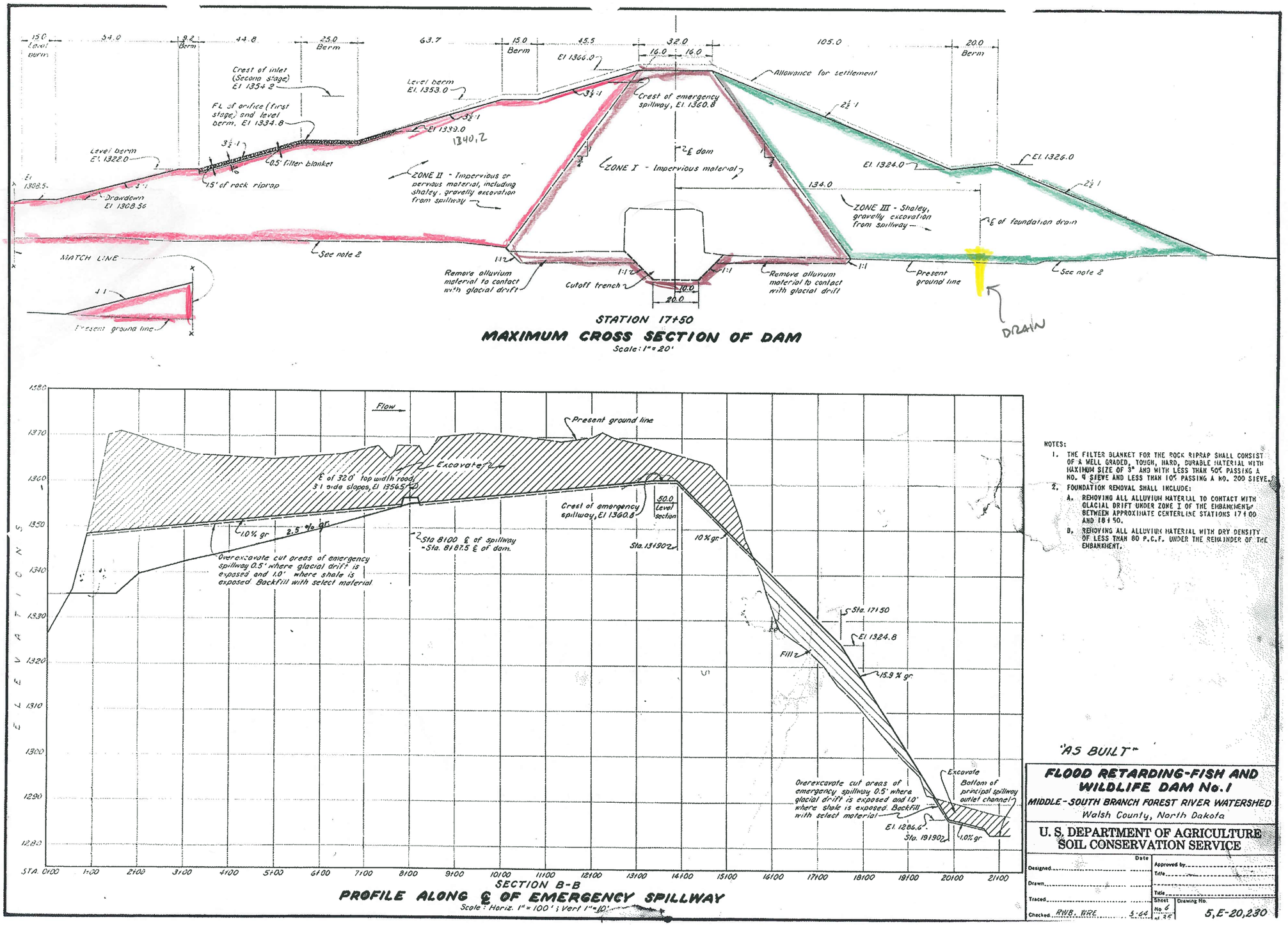
Analysis of dams for earthquake loading must address all potential failure modes. Distress of embankment dams from earthquake loading primarily manifests itself in deformation causing crest settlement, lateral spreading, cracking and differential displacements between the embankment or foundation and appurtenant structures.

Ref. 2

DH

1,196

NAVD88 ⇒ 1,198 ft greater



NOTES:

1. THE FILTER BLANKET FOR THE ROCK RIPRAP SHALL CONSIST OF A WELL GRADED, TOUGH, HARD, DURABLE MATERIAL WITH MAXIMUM SIZE OF 3" AND WITH LESS THAN 50% PASSING A NO. 4 SIEVE AND LESS THAN 10% PASSING A NO. 200 SIEVE.
2. FOUNDATION REMOVAL SHALL INCLUDE:
   A. REMOVING ALL ALLUVIUM MATERIAL TO CONTACT WITH GLACIAL DRIFT UNDER ZONE I OF THE EMBANKMENT BETWEEN APPROXIMATE CENTERLINE STATIONS 17+00 AND 18+50.
   B. REMOVING ALL ALLUVIUM MATERIAL WITH DRY DENSITY OF LESS THAN 80 P.C.F. UNDER THE REMAINDER OF THE EMBANKMENT.

"AS BUILT"

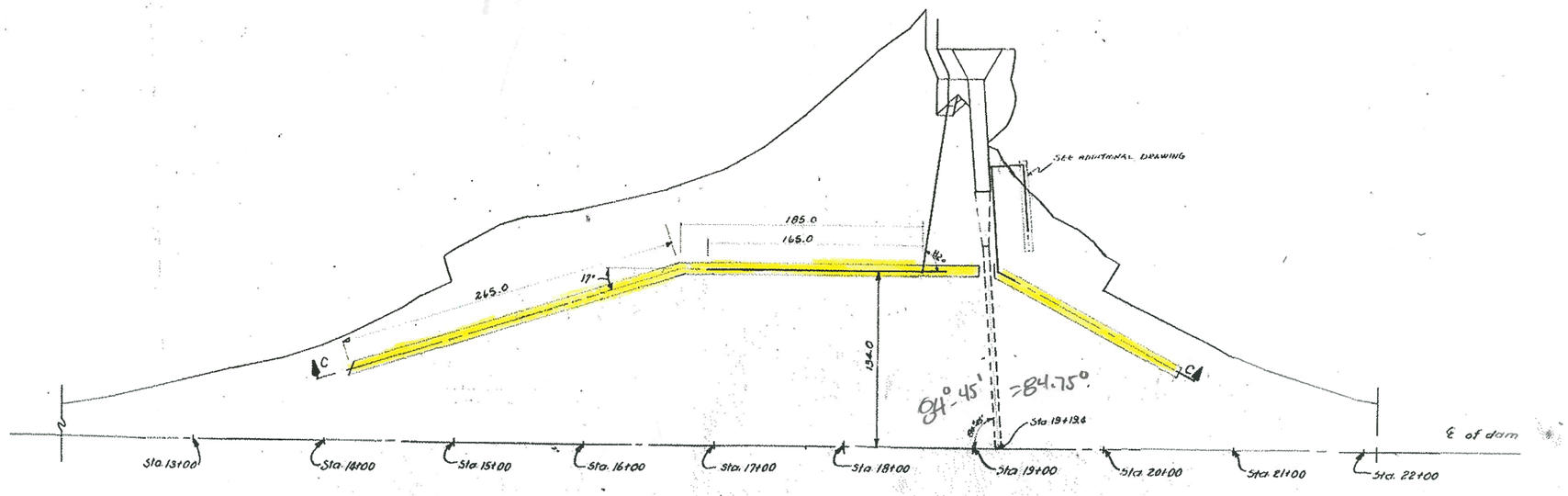
FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

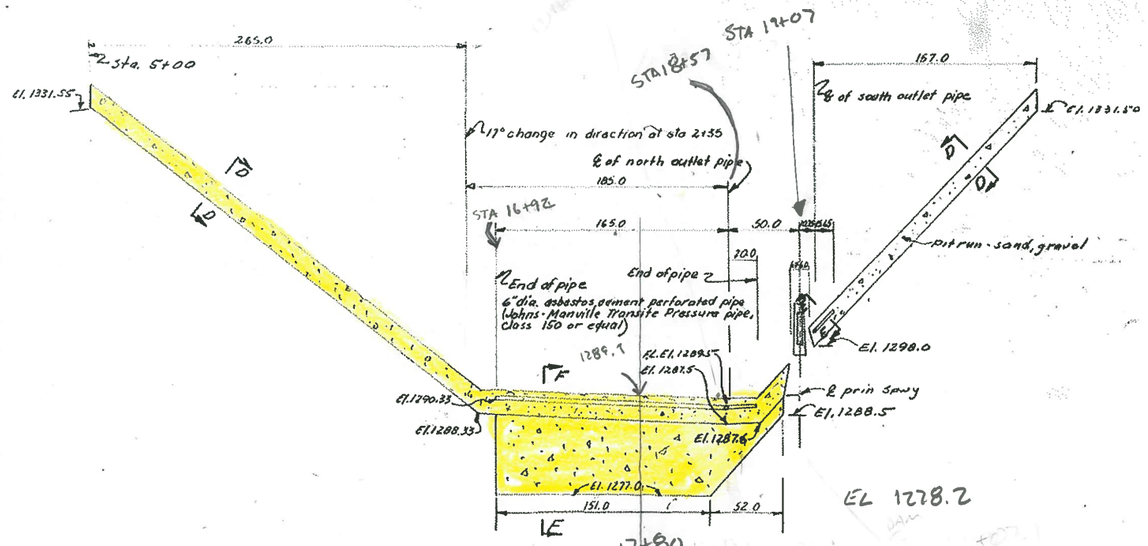
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PLAN FOUNDATION DRAIN

Scale 1" = 50'

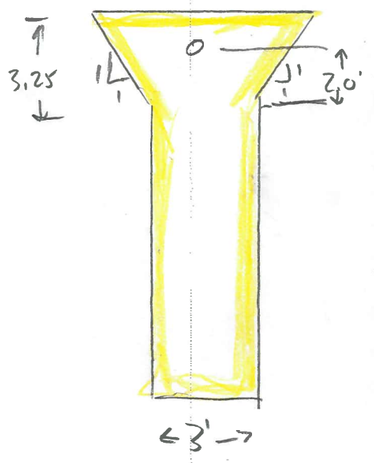
94°45' = 84.75°

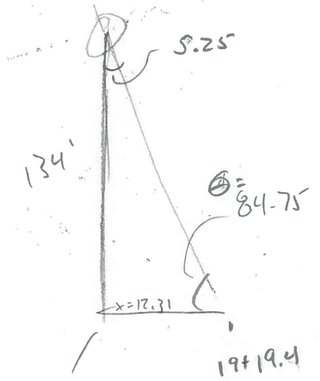


SECTION C - C

SECTION ALONG ℄ OF TRANSVERSE DRAINS

Scale: Horiz 1" = 50'; Vert 1" = 10'





tan 5.25 = x/13.1

1907.1

"AS BUILT"

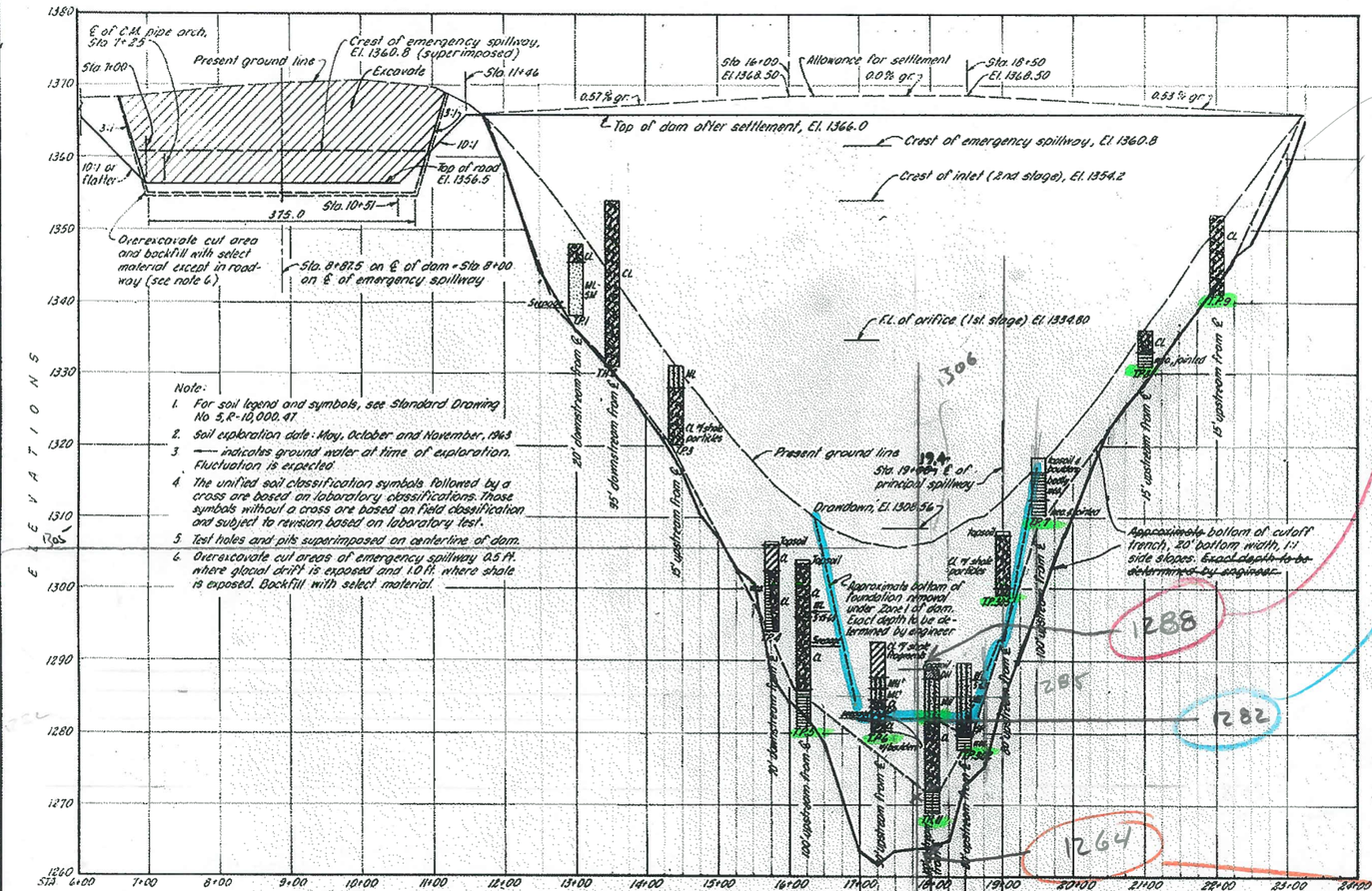
FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1

"As Built"

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
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Traced		Title
Checked		Sheet No 19 of 75 — Drawing No SE-20,230

Form SCS-512 (November 1968)



SECTION A-A

PROFILE ALONG ℄ OF DAM

Scale: Horiz. 1"=100', Vert. 1"=10'

DESIGN SECTION ~17+80

LOG OF SOIL BORINGS

LOCATION	BORROW NORTH ABUTMENT																																
T.H. NO.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
ELEVATION				1371.1	1371.3	1365.6	1366.0	1368.2	1355.0	1356.8	1368.2	1370.0	1370.1	1366.6	1367.9	1367.2	1367.6	1363.5	1363.6	1366.0	1364.6	1367.5	1370.5	1368.6	1367.6	1366.9	1368.6	1364.5	1363.9	1368.8	1368.0	1369.0	1367.7	1366.8	1364.7	1361.9	1362.7	1365.1	1364.9	1363.7

DEPTH IN FEET 0 10 20 30

LOG OF SOIL BORINGS

LOCATION	NORTH ABUTMENT									
T.H. NO.	9A	9B	11A	11B	11C	13A	13B	16A	16B	17A
ELEVATION	1365.0	1371.0	1370.0	1370.0	1364.0	1371.0	1364.0	1330.0	1318.0	1309.0

DEPTH IN FEET 0 10 20 30

LOG OF SOIL BORINGS

LOCATION	FOUNDATION				
T.H. NO.	10	301	303	601	605
ELEVATION		1287.0	1286.8	1287.0	1294.0

DEPTH IN FEET 0 10 20

"AS BUILT"

FLOOD RETARDING - FISH AND WILDLIFE DAM NO. 1

MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED

Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed E.J.P. J.M.M. Date
Drawn E.J.P.
Traced
Checked D.E.M. W.P.E.
Approved by
Title
Title
Sheet No. 5 of 35
Drawing No. 5-E-20,230

① STA 17+80 ORIGINAL GSE ~ 1288
ADJUST TO NAVD88 = 1288+1.2 = 1289.2

BOTTOM of ZONE I
ADJUST TO NAVD88 = 1282+1.2 say 1283.2

1286.8 ORIGINAL Ground

BOTTOM of FF RE CL
126 + 2 - 126 2

Ref. 4

Date Started: 2/12/19	**DRILLING LOG**		Hole Number: 4
Date Finished: 2/13/19	Gannett Fleming		Sheet: 1 of 4
Soil Drilling: 104.3 ft			Line & Station:
Rock Sampling: 19.7 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043		Offset:
Total Depth of Hole: 124.0 ft	Drilling Agency: Interstate Drilling Services, Inc.		N Coordinate: 17526026.5 ft
No. of Undist. Samples: 0	Driller: Jared Zak		E Coordinate: 1902365.0 ft
Total Number of Core Boxes: 0	Bit Size and Type: N/A	Bulk Sampler: N/A	Elev. Top of Hole: +1368.3 ft
GROUNDWATER OBSERVATIONS Not recorded	Casing Size: N/A	Spoon Size: 2.0 " OD	Direction of Hole
	Hollow Stem Auger: 3.25 " ID x 6.5 " OD	Hammer Wt.: 140 lb	Vertical ☒ Inclined ☐
	Drilling Fluid: N/A	Hammer Drop: 30.0 "	Degrees from Vertical ---
	Drill Rig: Dietrich 50 Track Rig	Hammer Type: Automatic	Logged By: W. Roman

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.5						0.0'-2.5': Unsampled	Began 12-Feb-2019 at 1148
						El. 1365.8	
2.5 - 5.0	S-1	25-30-32-40-28	2.0	80		2.5'-5.0': Silty Clayey SAND with gravel (sc) (EMBANKMENT), 25% gravel, 40% sand, 35% fines. Gravel is subangular to subrounded, fine and coarse, max. particle size: >1.5"; Sand is fine to coarse, subangular to rounded; Fines: low to medium plasticity, Grayish brown (2.5Y 5/2), Moist, weak HCl reaction, homogeneous, mixed gravel of varying hardness, including white (2.5Y 8/1) dolomite, soft dark gray shale, and pink granite	P.P. = 3 tsf
						El. 1363.3	
5.0 - 7.5	S-2	7-9-14-15-18	1.4	56		2.5'-5': High dry strength 5.0'-94.5': Sandy SILT (ML) (EMBANKMENT), 10% gravel, 45% sand, 45% fines. Gravel is subangular to rounded, fine, max. particle size: 1"; Sand is fine to coarse, subangular to rounded; Fines: low to medium plasticity, Grayish brown (2.5Y 5/2), Moist, weak HCl reaction, color varies from grayish-brown (2.5Y 5/2 and gray (GLEY 1 N5) to very dark grayish-brown (2.5Y 3/2) and dark gray (GLEY 1 N4); mixed gravel of varying hardness, including white to light gray dolomite, soft dark gray shale, and pink granite	P.P. = 4 tsf
7.5 - 10.0	S-3	8-10-10-12-14	1.7	68			P.P. = 3.2 tsf
10.0 - 12.5	S-4	4-5-7-9-12	1.4	56		5.0'-94.5': Field classified as silty clayey sand (sc).	P.P. = 2.3 tsf
12.5 - 15.0	S-5	6-9-12-14-17	1.5	60			P.P. = 4.2 tsf
15.0 - 17.5	S-6	5-7-14-16-22	1.7	68			P.P. = 3.3 tsf
17.5 - 20.0	S-7	6-12-14-16-19	2.0	80			P.P. = 4.5 tsf
20.0 - 22.5	S-8	6-22-18-16-14	1.9	76		20'-22.5': little black fines	P.P. = 4.1 tsf
22.5 - 25.0	S-9	54-22-26-23-18	1.8	72		22.5'-25': strong HCl reaction	P.P. = 3.7 tsf

Purpose:	Sample embankment materials and foundation soils
Drilling Method:	Continous split spoon sampling using hollow stem auger; drilled dry.
Termination:	20' of rock or low permeability material
Abandonment:	Two vibrating wire pressure transducers installed in cement-bentonite grout
Additional Remarks:	Drilled between cartway of County Road 14 and guiderail, 7' west and 1.1' higher than staked location. Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900930 at 121.5', SN1900931 at 96'; connected to Geokon 8002-4-2 SN 1847930 data logger.

Log Checked By: EJB, 10/11/19

Agency: Interstate Drilling Services, Inc.	DRILLING LOG	Hole Number: 4
Driller: Jared Zak		Sheet: 2 of 4
Inspector: W. Roman	Gannett Fleming	Elev. Top of Hole: +1368.3 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
25.0 - 27.5	S-10	17-15-14-20-18	1.4	56			P.P. = 4.1 to >4.5 tsf
27.5 - 30.0	S-11	34-21-23-24-24	1.8	72		27.5'-30': includes clasts of red granite (till source)	P.P. = 4 tsf
30.0 - 32.5	S-12	84-53-19-18-22	1.1	44			P.P. = >4.5 tsf
32.5 - 35.0	S-13	19-10-13-17-20	1.6	64		32.5'-35': includes clasts of red granite (till source)	P.P. = >4.5 tsf
35.0 - 37.5	S-14	31-18-12-18-17	1.2	48			P.P. = >4.5 tsf
37.5 - 40.0	S-15	20-15-16-19-20	1.7	68			P.P. = >4.5 tsf
40.0 - 42.5	S-16	20-15-13-15-17	1.7	68		40'-42.5': Field dispersion test grade = 1 (non-dispersive)	P.P. = 4.3 tsf
42.5 - 45.0	S-17	12-9-10-15-20	1.7	68		42.5'-45': strong HCl reaction	P.P. = 4.3 tsf
45.0 - 47.5	S-18	9-15-16-17-26	1.5	60			P.P. = 3.3 tsf
47.5 - 50.0	S-19	10-10-14-20-22	0.0	0		47.5'-50': no recovery	
50.0 - 52.5	S-20	8-14-18-25-26	2.2	88			P.P. = >4.5 tsf
52.5 - 55.0	S-21	9-12-16-24-27	0.0	0		52.5'-55': no recovery	
55.0 - 57.5	S-22	5-9-15-18-24	1.0	40		55'-57.5': includes subangular clast of white to light gray dolomite 1"x1"x1"	P.P. = 4.2 tsf
57.5 - 60.0	S-23	9-14-16-19-29	2.5	100			P.P. = 3.8 tsf

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 4
Driller: Jared Zak		Sheet: 3 of 4
Inspector: W. Roman	Gannett Fleming	Elev. Top of Hole: +1368.3 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
60.0 - 62.5	S-24	17-20-24-23-19	2.3	92			P.P. = >4.5 tsf
62.5 - 65.0	S-25	8-9-13-18-21	2.0	80		62.5'-65': includes subangular clast of pinkish white (7.5YR 8/2) dolomite 1"x1"x2"	P.P. = >4.5 tsf
65.0 - 67.5	S-26	9-14-15-23-30	1.7	68			P.P. = too disturbed to measure tsf
67.5 - 70.0	S-27	5-12-17-20-25	2.2	88			P.P. = >4.5 tsf
70.0 - 72.5	S-28	5-8-13-17-24	2.5	100			P.P. = >4.5 tsf
72.5 - 75.0	S-29	15-15-20-22-24	2.4	96			P.P. = >4.5 tsf
75.0 - 77.5	S-30	7-10-16-19-19	2.5	100			P.P. = 4.5 tsf
77.5 - 80.0	S-31	14-15-20-22-25	0.2	8			End 12-Feb-2019 at 77.5' at 1720. P.P. = too disturbed to measure tsf Resume 13-Feb-2019 at 77.5' at 0840.
80.0 - 82.5	S-32	4-21-19-19-12	0.7	28		80'-87.5': mostly pale brown (10YR 6/3); trace subangular to subrounded quartzite pebbles	P.P. = 2 tsf
82.5 - 85.0	S-33	5-10-8-14-18	2.5	100		82.5'-85': Field dispersion test grade = 1 (non-dispersive)	P.P. = 2.2 tsf
85.0 - 87.5	S-34	4-7-12-18-17	2.3	92			P.P. = 3.3 tsf
87.5 - 90.0	S-35	7-14-20-27-39	0.7	28		87.5'-92.5': strong HCl reaction	P.P. = >4.5 tsf
90.0 - 92.5	S-36	5-12-20-27-29	0.6	24			P.P. = 3.2 tsf
92.5 - 95.0	S-37	7-11-17-21-25	2.5	100			P.P. = >4.5 tsf

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 4
Driller: Jared Zak	Gannett Fleming	Sheet: 4 of 4
Inspector: W. Roman		Elev. Top of Hole: +1368.3 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
						El. 1273.8	
95.0 - 97.5	S-38	4-8-8-10-7	2.3	92		94.5'-104.3': Silty Clayey SAND (sc) (GLACIAL TILL), 10% gravel, 45% sand, 45% fines. Gravel is subangular to rounded, fine, max. particle size: <0.5"; Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Grayish brown (10YR 5/2), Wet to Moist, weak HCl reaction, Gravel consists of white chalky dolomite, light gray dolomite, dark gray shale, and light gray quartzite	P.P. = 1.2 tsf
97.5 - 100.0	S-39	8-9-15-17-23	2.4	96		95'-96': wet 95'-97.5': high dry strength 97.5'-100': Field dispersion test grade = 2 (intermediate)	P.P. = 4 tsf
100.0 - 102.5	S-40	6-6-10-12-11	0.0	0		100'-102.5': no recovery	
102.5 - 105.0	S-41	4-5-8-10-13	2.5	100		Top of Rock @ 104.3 ft El. 1264.0	P.P. = 4.1 tsf
105.0 - 107.5	S-42	4-7-12-15-20	2.0	80		104.3'-124.0': Clayey SHALE, *[Pierre Shale]* comprised of clay to silt sized particles, Very dark gray, (GLEY1 N3), very slight to fresh, very soft, high plasticity, like a hard fat clay; specimens broken by hand and gouged by fingernail; also gray to greenish-gray; some hairline fractures develop parallel bedding, which is nearly flat; some burrows; none to weak HCl reaction. Laboratory classified as Fat CLAY (CH).	P.P. = >4.5 tsf
107.5 - 110.0	S-43	9-13-16-22-31	2.5	100		105'-107.5': no HCl reaction 107.5'-112.5': weak HCl reaction	P.P. = >4.5 tsf
110.0 - 112.5	S-44	7-11-18-24-32	2.5	100			P.P. = >4.5 tsf
112.5 - 115.0	S-45	9-16-21-25-40	2.5	100		112.5'-124': no HCl reaction 112.5'-115': Field dispersion test grade = 4 (highly dispersive)	P.P. = >4.5 tsf
115.0 - 117.5	S-46	7-9-17-24-30	2.5	100			P.P. = >4.5 tsf
117.5 - 120.0	S-47	11-15-24-35-41	2.5	100			P.P. = >4.5 tsf
120.0 - 122.5	S-48	12-18-27-36-40	2.5	100			P.P. = >4.5 tsf SPT completed at 124' at 1430 13-Feb-2019.
122.5 - 124.0	S-49	12-18-25	1.5	100		122.5'-124': trace angular white specks, possibly authigenic dolomite El. 1244.3	P.P. = >4.5 tsf
						Bottom of Borehole at 124.0 feet.	

Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900930 at 121.5', SN1900931 at 96'; connected to Geokon 8002-4-2 SN 1847930 data logger.

Date Started: 2/14/19	**DRILLING LOG**		Hole Number: 5
Date Finished: 2/15/19	Gannett Fleming		Sheet: 1 of 3
Soil Drilling: 51.5 ft			Line & Station:
Rock Sampling: 13.5 ft	Project:Forest River Dam No. 1 (Matejcek Dam) - ND00043		Offset:
Total Depth of Hole: 65.0 ft	Drilling Agency: Interstate Drilling Services, Inc.		N Coordinate: 17526027.6 ft
No. of Undist. Samples: 0	Driller: Jared Zak		E Coordinate: 1902500.0 ft
Total Number of Core Boxes: 0	Bit Size and Type: N/A	Bulk Sampler: N/A	Elev. Top of Hole: +1327.1 ft
GROUNDWATER OBSERVATIONS Not recorded	Casing Size: N/A	Spoon Size: 2.0 " OD	Direction of Hole
	Hollow Stem Auger: 3.25 " ID x 6.5 " OD	Hammer Wt.: 140 lb	Vertical ☒ Inclined ☐
	Drilling Fluid: N/A	Hammer Drop: 30.0 "	Degrees from Vertical ---
	Drill Rig: Dietrich 50 Track Rig	Hammer Type: Automatic	Logged By: W. Roman

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
0.0 - 2.5						0.0'-2.5': Unsampled El. 1324.6	Began 14-Feb-2019 at 0250
2.5 - 5.0	S-1	8-13-18-24-27	1.8	72		2.5'-37.5': Sandy Elastic SILT (MH) (EMBANKMENT), 5% gravel, 55% sand, 40% fines. Gravel is subrounded to rounded, fine to coarse, Sand is medium to coarse, subrounded to rounded; Fines: low to medium plasticity, Grayish brown (10YR 5/2), Moist, weak HCl reaction, homogeneous, Color varies to very dark gray (10YR 3/1); gravel and coarse sand includes clasts of soft dark gray shale, pinkish-white dolomite, chalky white dolomite, and hard quartzite 2.5'-37.5': Field classified as silty clayey sand (sc). 5'-7.5': Field dispersion test grade = 1 (non-dispersive)	P.P. = too disturbed to measure tsf
5.0 - 7.5	S-2	8-13-18-21-27	2.0	80			P.P. = >4.5 tsf
7.5 - 10.0	S-3	13-15-17-18-18	0.1	4			P.P. = too disturbed to measure tsf
10.0 - 12.5	S-4	6-9-10-16-17	0.9	36			P.P. = 4.4 tsf
12.5 - 15.0	S-5	6-7-8-10-11	1.2	48			P.P. = >4.5 tsf
15.0 - 17.5	S-6	7-11-12-14-15	1.2	48		15'-17.5': includes subangular clast of white, to light gray and dolomite 1"x1.25"x1.5", broken by drillng	P.P. = 2.2 tsf
17.5 - 20.0	S-7	6-6-12-11-15	0.9	36			P.P. = too disturbed to measure tsf
20.0 - 22.5	S-8	6-10-12-11-13	0.0	0		20'-22.5': no recovery	
22.5 - 25.0	S-9	9-9-13-16-21	1.2	48		22.5'-25': includes subangular clast of pinkish-white dolomite 0.75"x1.25"x1.25", broken by drilling	P.P. = 4 tsf

Purpose: Sample embankment materials and foundation soils
Drilling Method: Continous split spoon sampling using hollow stem auger; drilled dry.
Termination: 20' of rock or low permeability material
Abandonment: Two vibrating wire pressure transducers installed in cement-bentonite grout
Additional Remarks: Drilled 5' east of stake on bench. Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900933 at 45', SN1900932 at 64'; connected to Geokon 8002-4-2 SN 1847932 data logger.

Log Checked By: EJB, 10/11/19

Agency: Interstate Drilling Services, Inc.	**DRILLING LOG**	Hole Number: 5
Driller: Jared Zak	Gannett Fleming	Sheet: 2 of 3
Inspector: W. Roman		Elev. Top of Hole: +1327.1 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
25.0 - 27.5	S-10	5-8-11-13-15	1.7	68			P.P. = 4.4 tsf
27.5 - 30.0	S-11	9-9-11-16-20	1.1	44			P.P. = 3.9 tsf
30.0 - 32.5	S-12	6-7-12-14-18	1.7	68		30'-32.5': Field dispersion test grade = 1 (non-dispersive)	P.P. = >4.5 tsf
32.5 - 35.0	S-13	10-11-11-12-13	1.2	48			P.P. = >4.5 tsf
35.0 - 37.5	S-14	6-6-8-16-17	0.0	0		35'-37.5': no recovery El. 1289.6	
37.5 - 40.0	S-15	6-5-7-12-11	1.6	64		37.5'-51.5': Sandy SILT (ML) (GLACIAL TILL), 10% gravel, 45% sand, 45% fines. Gravel is subangular to rounded, fine, max. particle size: <1"; Sand is fine to coarse, subrounded to rounded; Fines: low to medium plasticity, Grayish brown (10YR 5/2), Moist, weak HCl reaction, Gravel consists of white chalky dolomite, light gray dolomite, dark gray shale, and light gray quartzite 37.5'-51.5': Field classified as silty, clayey sand (sc).	P.P. = 3 tsf
40.0 - 42.5	S-16	5-6-9-12-15	1.6	64			P.P. = 3.4 tsf
42.5 - 45.0	S-17	5-7-10-9-7	1.8	72		42.5'-45': Field dispersion test grade = 1 (non-dispersive)	P.P. = 2.4 tsf
45.0 - 47.5	S-18	2-3-8-8-11	1.7	68			P.P. = 2.7 tsf
47.5 - 50.0	S-19	5-6-6-8-8	2.0	80			P.P. = 2.5 tsf
50.0 - 52.5	S-20	3-5-7-11-7	2.5	100		Top of Rock @ 51.5 ft El. 1275.6	P.P. = 2.6 above rock; >4.5 in rock tsf End 14-Feb-2019 at 52.5' at 1715.
52.5 - 55.0	S-21	5-5-5-7-11	2.5	100		51.5'-65.0': Clayey SHALE, *[Pierre Shale]* comprised of clay to silt sized particles, Very dark gray, (GLEY 1 N3), very slight to fresh, very soft, high plasticity, like a very stiff to hard fat clay; none to strong HCl reaction; specimens broken by hand and gouged by fingernail; also gray to greenish-gray; some hairline fractures develop parallel bedding; trace white angular specks, possible authigenic dolomite 51.5'-52.5': strong HCl reaction in light gray material 52.5'-65': no HCl reaction 52.5'-55': high dry strength	P.P. = 2.7 tsf Resume 15-Feb-2019 at 52.5' at 0830. Measured water level at 41.5' after sampling to 55'.
55.0 - 57.5	S-22	4-4-7-9-10	2.5	100			P.P. = 2.5 tsf
57.5 - 60.0	S-23	5-7-9-11-12	2.5	100		57.5'-60': Field dispersion test grade = 4 (highly dispersive)	P.P. = 3.3 tsf

Agency: Interstate Drilling Services, Inc.	DRILLING LOG	Hole Number: 5
Driller: Jared Zak		Sheet: 3 of 3
Inspector: W. Roman	Gannett Fleming	Elev. Top of Hole: +1327.1 ft

Forest River Dam No. 1 (Matejcek Dam) - ND00043

Depth (Ft.)	Sample No.	Blows or RQD (%)	Rec. (ft.)	Rec. (%)	USCS	Description Of Materials	Remarks
60.0 - 62.5	S-24	4-7-8-14-22	2.5	100			P.P. = 4 tsf SPT completed at 65 at 0930 15-Feb-2019.
62.5 - 65.0	S-25	6-8-12-14-17	2.5	100		El. 1262.1	P.P. = 3.9 tsf
						Bottom of Borehole at 65.0 feet.	Gekon 4500 S350 kpa vibrating wire pressure transducers installed; SN1900933 at 45', SN1900932 at 64'; connected to Geokon 8002-4-2 SN 1847932 data logger.

Ref. 5

Gannett Fleming

Matejcek Dam
Summary of Laboratory Soil & Rock Test Results

crb 3/2019
EJB 5/2019

Test Boring Number	Sample Number	Sample Depth (ft)	Elevation Top of Sample (ft)	Stratum	USCS Class	Material Description	% Gravel	% Sand	% Silt	% Clay	LL (%)	PL (%)	Plasticity Index	Natural Moisture (%)	Specific Gravity (dim.)	Dry Unit Weight (pcf)	Moist Unit Weight (pcf)	Slake Durability		Crumb Dispersion Grade
																		Index (%)	Fragment Type	
Dam																				
GF-4	S-6 to 18	15 - 47.5	1353.6	Emb (Zone 1)	ML	Sandy SILT	0.0	30.3	51.3	18.4	45	32	13	29.2	2.55					
GF-4	S-9	22.5 - 25	1346.1	Emb (Zone 1)										29.2						
GF-4	S-10	25 - 27.5	1343.6	Emb (Zone 1)										23.6		93.4	115.4			
GF-4	S-16	40 - 42.5	1328.6	Emb (Zone 1)																1
GF-5	S-10 to 13	25 - 35	1302	Emb (Zone 3)	MH	Sandy Elastic SILT	5.2	40.2	29.4	25.1	57	33	24	25.7	2.57					1
GF-5	S-12	30 - 32.5	1297	Emb (Zone 3)										25.7						
GF-5	S-15 to 19	37.5 - 50	1289.5	Fndn Till	ML	Sandy SILT	0.5	36.7	40.7	22.1	45	32	13	26.3	2.61					
GF-5	S-15	37.5 - 40	1289.5	Fndn Till										26.3						
GF-5	S-16	40.0 - 42.5	1287	Fndn Till																1
GF-5	S-17	42.5 - 45	1284.5	Fndn Till										21.7						
GF-5	S-18	45.0 - 47.5	1282	Fndn Till																1
GF-5	S-19	47.5 - 50	1279.5	Fndn Till										30.5		90.8	118.5			
GF-4	S-39	97.5 - 100	1271.1	Fndn Till										22.3		100.6	123.0			
GF-6	S-3 to 10	7.5 - 30	1319.5	Colluvial/Residual	ML	SILT with Sand	0.0	29.5	53.4	17.1	42	33	9	25.9	2.58					
GF-6	S-4	10 - 12.5	1317	Colluvial/Residual										25.5						
GF-6	S-5	12.5 - 15	1314.5	Colluvial/Residual										28.0						
GF-6	S-6	15.0 - 17.5	1312	Colluvial/Residual										26.3						1
GF-6	S-10	27.5 - 30	1299.5	Colluvial/Residual										36.3						
GF-4	S-42 to 49	105 - 124	1263.6	Clayey SHALE	CH	Fat CLAY	0.0	1.5	20.4	78.1	83	31	52	27.1	2.74					
GF-4	S-44	110 - 112.5	1258.6	Clayey SHALE										25.9		101.4	127.7			3
GF-4	S-46	115 - 117.5	1253.6	Clayey SHALE										27.1						
GF-4	S-48	120 - 122.5	1248.6	Clayey SHALE										28.8		97.2	125.2			
GF-4	S-49	122.5 - 124	1246.1	Clayey SHALE																2
Spillway																				
GF-3	S-1 to 3	2.5 - 10.0	1359.5	Outwash	SM	Silty SAND	3.5	49.8	32.3	14.4	49	32	17	12.6	2.58					
GF-3	S-1	2.5 - 5.0	1359.5	Outwash										12.6						
GF-2	S-4 to 6	10 - 16.5	1351.6	Till	ML	Sandy SILT	0.0	37.4	40.5	22.1	46	32	14	28.8	2.55					
GF-2	S-4	10 - 12.4	1351.6	Till																1
GF-2	S-6	15 - 16.5	1346.6	Till																1
GF-2	S-11 to 14	27.5 - 37.5	1334.1	Till	ML	Sandy SILT	0.2	35.5	45.0	19.2	39	26	13	27.6	2.59					
GF-2	S-11	27.5 - 29.5	1334.1	Till																1
GF-2	S-12	30 - 32	1331.6	Till																1
GF-2	S-17,18	42.5 - 45.9	1319.1	Clayey SHALE	MH	Elastic SILT	0.0	5.1	48.1	46.8	79	40	39	31.0	2.53					2
GF-3	S-18,19	44.5 - 48.8	1317.5																	2
GF-2	R1	47.5	1314.1	Clayey SHALE																2
GF-2	R1	48 - 49.5	1313.6	Clayey SHALE														19.5	3	
GF-2	R3	52 - 53	1309.6	Clayey SHALE										21.4		90.8	110.2			
GF-2	R4	54.5	1307.1	Clayey SHALE																2
GF-2	R4	55 - 56.5	1306.6	Clayey SHALE														40.7	2	

PERMEABILITY

Test Boring Number	Sample Number	Sample Depth (ft)	Elevation Top of Sample (ft)	Stratum	USCS Class	Material Description	Permeability (cm/s)	Void Ratio	Porosity	Bulk Density (g/cm^3)	Water Content (cm^3/cm^3)[1]	Intrinsic Permeability (cm^2)[1]
GF-4	S-6 to 18	15 - 47.5	1353.6	Emb (Zone 1)	ML	Sandy SILT	3.89E-08	0.83	0.45	1.86	0.38	3.99E-13
GF-5	S-15 to 19	37.5 - 50	1289.5	Fndn Till	ML	Sandy SILT	2.57E-06	0.81	0.45	1.92	0.43	2.63E-11
GF-6	S-3 to 10	7.5 - 30	1319.5	Colluvial/Residual	ML	SILT with Sand	6.75E-06	0.77	0.44	1.93	0.40	6.91E-11
GF-4	S-42 to 49	105 - 124	1263.6	Clayey SHALE	CH	Fat CLAY	5.88E-06	0.69	0.41	2.03	0.43	6.03E-11

1. at 20°C

1. at 20°C

Ref. 6

DESIGN STANDARDS

EMBANKMENT DAMS

NO. 13

CHAPTER 8

SEEPAGE ANALYSIS AND CONTROL

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
TECHNICAL SERVICE CENTER
DENVER, COLORADO

Table A-8 - Porosity (n) of Embankment Soils
(n increases with uniformity)

UNIFIED SOIL CLASSIFICATION	POROSITY, n RANGE
GP	0.25 to 0.35
GW	0.20 to 0.30
GM	0.20 to 0.35
GM - SM	0.20 to 0.25
GC	0.25 to 0.35
GC - SC	0.20 to 0.30
SP	0.25 to 0.35
SW	0.20 to 0.30
SM	0.25 to 0.35
SM - ML	0.25 to 0.35
SM - SC	0.25 to 0.35
SC	0.20 to 0.30
ML	0.30 to 0.40
ML-CL	0.25 to 0.40
CL	0.25 to 0.40
CH	0.35 to 0.50
References: [3],[5],[33]	

Table A-9 - Porosity (n) of Unconsolidated Natural Soils
(n inversely related to density)

SOIL	POROSITY, n RANGE
Gravel, coarse	0.25 to 0.40
Gravel, medium	0.25 to 0.45
Gravel, fine	0.25 to 0.45
Sand, coarse	0.25 to 0.45
Sand, medium	0.25 to 0.50
Sand, fine	0.25 to 0.50
Sand, fine	0.25 to 0.50
Sand, till	0.20 to 0.35
Sand, dune	0.40 to 0.50
Silt	0.30 to 0.60
Silt, till	0.30 to 0.40
Loess	0.45 to 0.60
Clay	0.35 to 0.80
References: [34],[39],[40],[42],[43]	

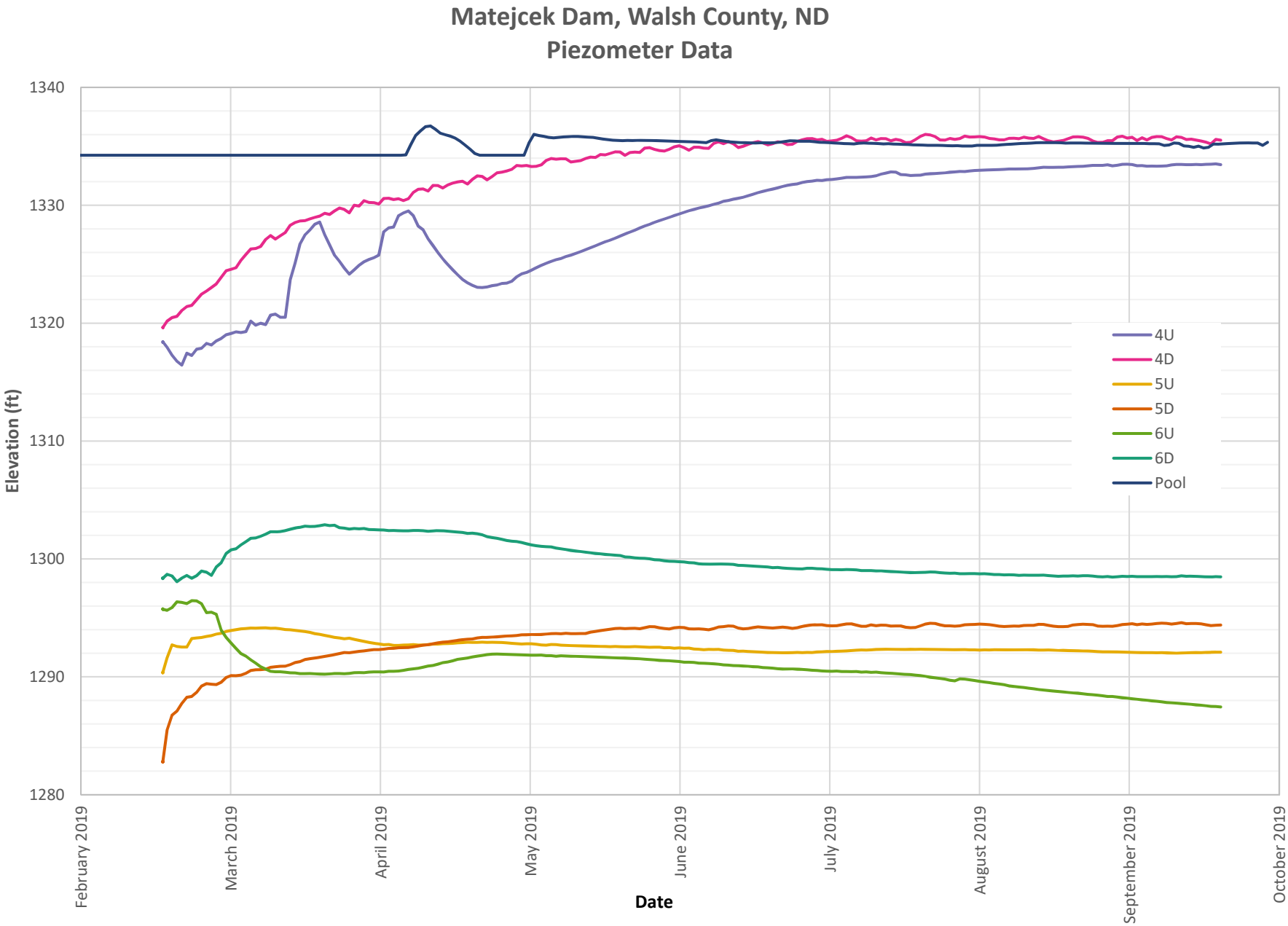
Zone II (ML) & Zone III (MH): use n = 0.35

Drain Fill (Pit-Run Sand & Gravel): use n = 0.2

Table A-10 - Porosity (n) of Rocks.
(Range due to grain size, cementation, weathering)

ROCK	POROSITY, n	ROCK	POROSITY, n
Shale	0.01 to 0.10	Basalt	0.03 to 0.35
Claystone	0.40 to 0.45	Sandstone, fine	0.01 to 0.50
Siltstone	0.20 to 0.40	Sandstone, medium	0.30 to 0.45
Tuff	0.07 to 0.55	Gabbro (weathered)	0.35 to 0.45
Schist	0.04 to 0.50	Granite, weathered	0.35 to 0.55
Dolomite	0.20 to 0.35	Most other	< 0.01
Limestone	.07 to .55		
References: [39],[40],[42]			

Ref. 7


Matejcek Dam, Walsh County, ND
Piezometer Data
Elevation (ft)
1340
1330
1320
1310
1300
1290
1280
February 2019
March 2019
April 2019
May 2019
June 2019
July 2019
August 2019
September 2019
October 2019
Date
4U
4D
5U
5D
6U
6D
Pool

Ref. 9

TABLE 3-4
Empirical values for ϕ, D_r, and unit weight of granular soils based on the SPT at about 6 m depth and normally consolidated [approximately, $\phi = 28° + 15°D_r$ ($\pm 2°$)]

Description	Very loose	Loose	Medium	Dense	Very dense
Relative density D_r	0	0.15	0.35	0.65	0.85
SPT N'_{70}: fine	1–2	3–6	7–15	16–30	?
medium	2–3	4–7	8–20	21–40	> 40
coarse	3–6	5–9	10–25	26–45	> 45
ϕ: fine	26–28	28–30	30–34	33–38	
medium	27–28	30–32	32–36	36–42	< 50
coarse	28–30	30–34	33–40	40–50	
γ_{wet}, pcf	70 - 102	90 - 114	108 - 127	108 - 140	127 - 146
γ_{wet}, kN/m^3	11–16*	14–18	17–20	17–22	20–23

* Excavated soil or material dumped from a truck has a unit weight of 11 to 14 kN/m^3 and must be quite dense to weigh much over 21 kN/m^3. No existing soil has a $D_r = 0.00$ nor a value of 1.00. Common ranges are from 0.3 to 0.7.

$$\gamma_{dry} = \frac{\gamma_{wet}}{1 + w}$$

G-102

Gannett Fleming

Excellence Delivered As Promised

Matejcek Dam

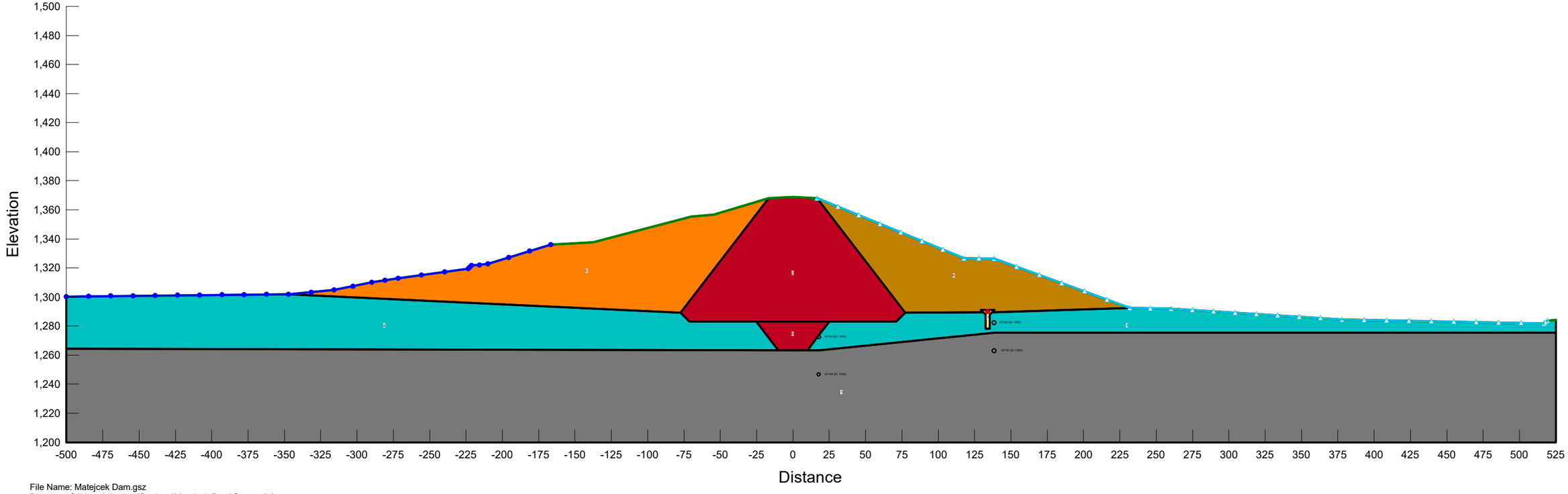
Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Steady-State Seepage, Normal Pool

Color	Name	Model	K-Function	Vol. WC. Function	Sat Kx (ft/sec)	Volumetric Water Content (ft^3/ft^3)
	Drainfill	Saturated / Unsaturated	Drainfill	Drainfill		
	Foundation Rock (Impenetrable)	Saturated Only			1.9e-007	0.41
	Glacial Till	Saturated / Unsaturated	Glacial Till	Glacial Till		
	Zone I	Saturated / Unsaturated	Zone I	Zone I		
	Zone II	Saturated / Unsaturated	Zone II	Zone II		
	Zone III	Saturated / Unsaturated	Zone III	Zone III		

Comparison of Pore Pressures

Piezometer	Actual Head (ft)	Modeled Head (ft)
GF-4U	1334	1304
GF-4D	1336	1305
GF-5U	1292	1290
GF-5D	1294	1293



File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Gannett Fleming

Excellence Delivered As Promised

Matejcek Dam

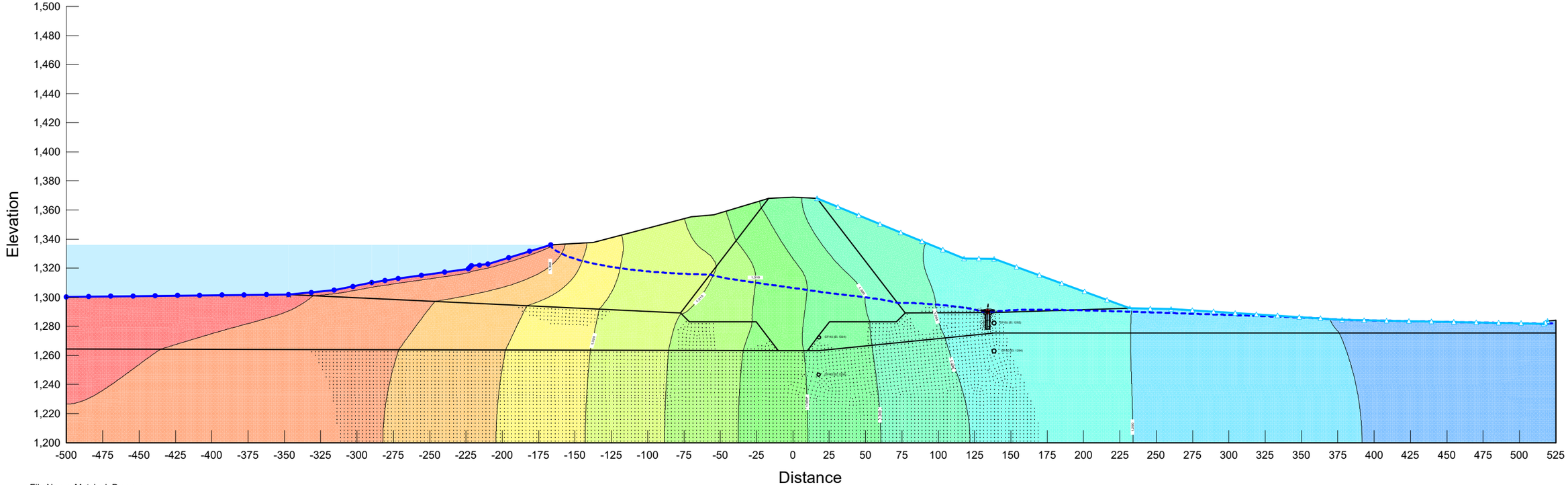
Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Steady-State Seepage, Normal Pool

Color	Name	Model	K-Function	Vol. WC. Function	Sat Kx (ft/sec)	Volumetric Water Content (ft^3/ft^3)
	Drainfill	Saturated / Unsaturated	Drainfill	Drainfill		
	Foundation Rock (Impenetrable)	Saturated Only			1.9e-007	0.41
	Glacial Till	Saturated / Unsaturated	Glacial Till	Glacial Till		
	Zone I	Saturated / Unsaturated	Zone I	Zone I		
	Zone II	Saturated / Unsaturated	Zone II	Zone II		
	Zone III	Saturated / Unsaturated	Zone III	Zone III		

Comparison of Pore Pressures

Piezometer	Actual Head (ft)	Modeled Head (ft)
GF-4U	1334	1304
GF-4D	1336	1305
GF-5U	1292	1290
GF-5D	1294	1293



File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Steady-State Seepage, Normal Pool

Report generated using GeoStudio 2016. Copyright © 1991-2017 GEO-SLOPE International Ltd.

File Information

File Version: 8.16
Created By: Christensen, Karl
Last Edited By: Barben, Edward J.
Revision Number: 87
Date: 10/15/2019
Time: 3:37:50 PM
Tool Version: 8.16.2.14053
File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Mass(M) Units: Pounds
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Normal Pool

Kind: SEEP/W
Method: Steady-State
Settings
    Include Air Flow: No
Control
    Apply Runoff: Yes
Convergence
    Maximum Number of Iterations: 500
    Minimum Pressure Head Difference: 0.005
    Significant Digits: 2
    Max # of Reviews: 10
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1
        Under-Relaxation Min. Rate: 0.1

Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 0 sec
Duration: 0 sec
Ending Time: 0 sec

Materials

Foundation Rock (Impenetrable)

Model: Saturated Only
Hydraulic
Sat Kx: 1.9e-007 ft/sec
Ky'/Kx' Ratio: 1
Rotation: 0 °
Volumetric Water Content: 0.41 ft^3/ft^3
Mv: 2.4e-005 /psf

Zone I

Model: Saturated / Unsaturated
Hydraulic
K-Function: Zone I
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Zone I

Zone II

Model: Saturated / Unsaturated
Hydraulic
K-Function: Zone II
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Zone II

Zone III

Model: Saturated / Unsaturated
Hydraulic
K-Function: Zone III
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Zone III

Drainfill

Model: Saturated / Unsaturated
Hydraulic

K-Function: Drainfill
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Drainfill

Glacial Till

Model: Saturated / Unsaturated
Hydraulic
K-Function: Glacial Till
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Glacial Till

Boundary Conditions

Zero Pressure

Type: Pressure Head 0
Review: No

Normal Pool

Type: Head (H) 1336
Review: No

Potential Seepage Face

Type: Total Flux (Q) 0
Review: Yes

K Functions

Zone I

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 1.3e-009
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 1.3e-009)
Data Point: (0.018329807, 1.2707744e-009)
Data Point: (0.033598183, 1.2379453e-009)
Data Point: (0.061584821, 1.2012348e-009)
Data Point: (0.11288379, 1.1602307e-009)
Data Point: (0.20691381, 1.1145476e-009)
Data Point: (0.37926902, 1.0638037e-009)
Data Point: (0.6951928, 1.0076356e-009)
Data Point: (1.274275, 9.4572429e-010)

Data Point: (2.3357215, 8.7782943e-010)
Data Point: (4.2813324, 8.0383301e-010)
Data Point: (7.8475997, 7.2381031e-010)
Data Point: (14.384499, 6.381188e-010)
Data Point: (26.366509, 5.4753312e-010)
Data Point: (48.329302, 4.5344496e-010)
Data Point: (88.586679, 3.5812231e-010)
Data Point: (162.37767, 2.6507067e-010)
Data Point: (297.63514, 1.7930848e-010)
Data Point: (545.55948, 1.0710333e-010)
Data Point: (1,000, 5.4231314e-011)

Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Zone I
Saturated Kx: 1.3e-009 ft/sec
Residual Water Content: 0.045 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Zone II

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 1.3e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 1.3e-008)
Data Point: (0.018329807, 1.2997411e-008)
Data Point: (0.033598183, 1.2993045e-008)
Data Point: (0.061584821, 1.2985731e-008)
Data Point: (0.11288379, 1.2973459e-008)
Data Point: (0.20691381, 1.2952867e-008)
Data Point: (0.37926902, 1.2918339e-008)
Data Point: (0.6951928, 1.2860467e-008)
Data Point: (1.274275, 1.2763576e-008)
Data Point: (2.3357215, 1.2601689e-008)
Data Point: (4.2813324, 1.233196e-008)
Data Point: (7.8475997, 1.1885202e-008)
Data Point: (14.384499, 1.1152775e-008)
Data Point: (26.366509, 9.9762931e-009)
Data Point: (48.329302, 8.1688758e-009)
Data Point: (88.586679, 5.6544344e-009)
Data Point: (162.37767, 2.8613334e-009)
Data Point: (297.63514, 8.7391842e-010)
Data Point: (545.55948, 1.4957748e-010)
Data Point: (1,000, 1.6816337e-011)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Zone II
Saturated Kx: 1.3e-008 ft/sec
Residual Water Content: 0.035 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Zone III

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 1.3e-007
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 1.3e-007)
Data Point: (0.018329807, 1.2720962e-007)
Data Point: (0.033598183, 1.2406236e-007)
Data Point: (0.061584821, 1.205286e-007)
Data Point: (0.11288379, 1.1656517e-007)
Data Point: (0.20691381, 1.1213095e-007)
Data Point: (0.37926902, 1.0718461e-007)
Data Point: (0.6951928, 1.0168605e-007)
Data Point: (1.274275, 9.5598954e-008)
Data Point: (2.3357215, 8.8894224e-008)
Data Point: (4.2813324, 8.1554451e-008)
Data Point: (7.8475997, 7.3581181e-008)
Data Point: (14.384499, 6.5004151e-008)
Data Point: (26.366509, 5.5895399e-008)
Data Point: (48.329302, 4.6390332e-008)
Data Point: (88.586679, 3.671539e-008)
Data Point: (162.37767, 2.722709e-008)
Data Point: (297.63514, 1.8443474e-008)
Data Point: (545.55948, 1.1020438e-008)
Data Point: (1,000, 5.5721357e-009)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Zone III
Saturated Kx: 1.3e-007 ft/sec
Residual Water Content: 0.045 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Drainfill

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %

Segment Curvature: 100 %
Saturated Kx: 1.3e-005
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 1.3e-005)
Data Point: (0.018329807, 1.2998725e-005)
Data Point: (0.033598183, 1.2997264e-005)
Data Point: (0.061584821, 1.2995465e-005)
Data Point: (0.11288379, 1.2993044e-005)
Data Point: (0.20691381, 1.2989491e-005)
Data Point: (0.37926902, 1.2982613e-005)
Data Point: (0.6951928, 1.2963134e-005)
Data Point: (1.274275, 1.2909372e-005)
Data Point: (2.3357215, 1.2764023e-005)
Data Point: (4.2813324, 1.2381818e-005)
Data Point: (7.8475997, 1.145568e-005)
Data Point: (14.384499, 9.4053329e-006)
Data Point: (26.366509, 5.8850044e-006)
Data Point: (48.329302, 2.0691894e-006)
Data Point: (88.586679, 3.3180832e-007)
Data Point: (162.37767, 3.0703117e-008)
Data Point: (297.63514, 2.4862045e-009)
Data Point: (545.55948, 1.8802165e-010)
Data Point: (1,000, 5.8991767e-012)
Estimation Properties
Hyd. K-Function Estimation Method: Fredlund-Xing Function
Volume Water Content Function: Drainfill
Saturated Kx: 1.3e-005 ft/sec
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Glacial Till

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 8.4e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 8.4e-008)
Data Point: (0.018329807, 8.2111574e-008)
Data Point: (0.033598183, 7.9990311e-008)
Data Point: (0.061584821, 7.761825e-008)
Data Point: (0.11288379, 7.4968751e-008)
Data Point: (0.20691381, 7.2016924e-008)
Data Point: (0.37926902, 6.8738088e-008)
Data Point: (0.6951928, 6.510876e-008)
Data Point: (1.274275, 6.1108339e-008)
Data Point: (2.3357215, 5.6721286e-008)

Data Point: (4.2813324, 5.1939979e-008)
Data Point: (7.8475997, 4.6769281e-008)
Data Point: (14.384499, 4.1232292e-008)
Data Point: (26.366509, 3.5379063e-008)
Data Point: (48.329302, 2.9299521e-008)
Data Point: (88.586679, 2.3140211e-008)
Data Point: (162.37767, 1.7127643e-008)
Data Point: (297.63514, 1.1586086e-008)
Data Point: (545.55948, 6.9205232e-009)
Data Point: (1,000, 3.5041772e-009)

Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Glacial Till
Saturated Kx: 8.4e-008 ft/sec
Residual Water Content: 0.045 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Vol. Water Content Functions

Glacial Till

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.46146539 ft^3/ft^3
Residual Water Content: 0.046146539 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.46146539
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.45006379)
Data Point: (0.018329807, 0.45006379)
Data Point: (0.033598183, 0.45006379)
Data Point: (0.061584821, 0.45006379)
Data Point: (0.11288379, 0.45006379)
Data Point: (0.20691381, 0.45006379)
Data Point: (0.37926902, 0.45006379)
Data Point: (0.6951928, 0.45006379)
Data Point: (1.274275, 0.45006379)
Data Point: (2.3357215, 0.45006379)
Data Point: (4.2813324, 0.45006379)
Data Point: (7.8475997, 0.45006379)
Data Point: (14.384499, 0.45006379)
Data Point: (26.366509, 0.45006379)
Data Point: (48.329302, 0.45006379)

Data Point: (88.586679, 0.45006379)
Data Point: (162.37767, 0.45006379)
Data Point: (297.63514, 0.45006379)
Data Point: (545.55948, 0.44984191)
Data Point: (1,000, 0.42714254)
Estimation Properties
Vol. WC Estimation Method: Grain Size Function
Saturated Water Content: 0.45 ft³/ft³
Sample Material: Silty Sand
Liquid Limit: 45 %
Diameter at 10% passing: 0.001
Diameter at 60% passing: 0.066
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Zone I

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.46146539 ft³/ft³
Residual Water Content: 0.046146539 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.46146539
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.45006379)
Data Point: (0.018329807, 0.45006379)
Data Point: (0.033598183, 0.45006379)
Data Point: (0.061584821, 0.45006379)
Data Point: (0.11288379, 0.45006379)
Data Point: (0.20691381, 0.45006379)
Data Point: (0.37926902, 0.45006379)
Data Point: (0.6951928, 0.45006379)
Data Point: (1.274275, 0.45006379)
Data Point: (2.3357215, 0.45006379)
Data Point: (4.2813324, 0.45006379)
Data Point: (7.8475997, 0.45006379)
Data Point: (14.384499, 0.45006379)
Data Point: (26.366509, 0.45006379)
Data Point: (48.329302, 0.45006379)
Data Point: (88.586679, 0.45006379)
Data Point: (162.37767, 0.45006379)
Data Point: (297.63514, 0.45006379)
Data Point: (545.55948, 0.44984191)
Data Point: (1,000, 0.42714254)
Estimation Properties
Vol. WC Estimation Method: Grain Size Function

Saturated Water Content: 0.45 ft³/ft³
Sample Material: Clay
Liquid Limit: 45 %
Diameter at 10% passing: 0.002
Diameter at 60% passing: 0.055
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Zone II

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.35001097 ft³/ft³
Residual Water Content: 0.035001097 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.35001097
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.34999998)
Data Point: (0.018329807, 0.34999996)
Data Point: (0.033598183, 0.34999992)
Data Point: (0.061584821, 0.34999981)
Data Point: (0.11288379, 0.34999954)
Data Point: (0.20691381, 0.34999886)
Data Point: (0.37926902, 0.34999711)
Data Point: (0.6951928, 0.3499926)
Data Point: (1.274275, 0.3499808)
Data Point: (2.3357215, 0.34994978)
Data Point: (4.2813324, 0.34986789)
Data Point: (7.8475997, 0.34965114)
Data Point: (14.384499, 0.34907722)
Data Point: (26.366509, 0.34756257)
Data Point: (48.329302, 0.34361181)
Data Point: (88.586679, 0.33363431)
Data Point: (162.37767, 0.31039132)
Data Point: (297.63514, 0.26507967)
Data Point: (545.55948, 0.20055842)
Data Point: (1,000, 0.1384939)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.35 ft³/ft³
Sample Material: Silt
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01

Num. Points: 20

Zone III

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.37807833 ft³/ft³
Residual Water Content: 0.037807833 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.37807833
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.35022222)
Data Point: (0.018329807, 0.35022222)
Data Point: (0.033598183, 0.35022222)
Data Point: (0.061584821, 0.35022222)
Data Point: (0.11288379, 0.35022222)
Data Point: (0.20691381, 0.35022222)
Data Point: (0.37926902, 0.35022222)
Data Point: (0.6951928, 0.35022222)
Data Point: (1.274275, 0.35022222)
Data Point: (2.3357215, 0.35022222)
Data Point: (4.2813324, 0.35022222)
Data Point: (7.8475997, 0.35022222)
Data Point: (14.384499, 0.35022222)
Data Point: (26.366509, 0.35022222)
Data Point: (48.329302, 0.35022222)
Data Point: (88.586679, 0.35022222)
Data Point: (162.37767, 0.35022222)
Data Point: (297.63514, 0.35022222)
Data Point: (545.55948, 0.35022222)
Data Point: (1,000, 0.35022222)
Estimation Properties
Vol. WC Estimation Method: Grain Size Function
Saturated Water Content: 0.35 ft³/ft³
Sample Material: Clay
Liquid Limit: 57 %
Diameter at 10% passing: 0.001
Diameter at 60% passing: 0.168
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Drainfill

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.20000216 ft³/ft³

Residual Water Content: 0.020000216 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.20000216
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.19999999)
Data Point: (0.018329807, 0.19999997)
Data Point: (0.033598183, 0.1999999)
Data Point: (0.061584821, 0.19999971)
Data Point: (0.11288379, 0.19999911)
Data Point: (0.20691381, 0.19999718)
Data Point: (0.37926902, 0.19999093)
Data Point: (0.6951928, 0.19997055)
Data Point: (1.274275, 0.19990402)
Data Point: (2.3357215, 0.19968668)
Data Point: (4.2813324, 0.19897883)
Data Point: (7.8475997, 0.19670167)
Data Point: (14.384499, 0.18966661)
Data Point: (26.366509, 0.17040155)
Data Point: (48.329302, 0.13128038)
Data Point: (88.586679, 0.083993776)
Data Point: (162.37767, 0.050440759)
Data Point: (297.63514, 0.032219908)
Data Point: (545.55948, 0.022430781)
Data Point: (1,000, 0.01672195)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.2 ft³/ft³
Sample Material: Sand
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)	Hydraulic Boundary
Point 1	-500	1,300.08	
Point 2	-347.1	1,301.82	
Point 3	-315.8	1,304.89	
Point 4	-289.74	1,310.23	
Point 5	-271.79	1,312.93	
Point 6	-223.46	1,319.5	

Point 7	-221.09	1,321.6	
Point 8	-209.94	1,322.92	
Point 9	-166.79	1,336.11	
Point 10	-137.54	1,337.58	
Point 11	-69.9	1,355.3	
Point 12	-54.59	1,356.75	
Point 13	-16.76	1,368.06	
Point 14	0	1,368.83	
Point 15	16.53	1,368.01	
Point 16	117.84	1,326.72	
Point 17	138.53	1,326.35	
Point 18	231.93	1,292.58	
Point 19	260.31	1,291.91	
Point 20	378	1,284.46	
Point 21	516.82	1,281.75	
Point 22	519.33	1,283.66	
Point 23	525	1,284.132	
Point 24	17.9	1,274.1	
Point 25	17.9	1,263.4	
Point 26	138.5	1,289.5	
Point 27	138.5	1,275.5	
Point 28	-500	1,264.3	
Point 29	525	1,200	
Point 30	-500	1,200	
Point 31	71.2	1,283.2	
Point 32	-10	1,263.4	
Point 33	10	1,263.4	
Point 34	-25.2	1,283.2	
Point 35	25.2	1,283.2	
Point 36	-71.4	1,283.2	
Point 37	77.2	1,289.2	
Point 38	-77.4	1,289.2	
Point 39	138.5	1,282.1	
Point 40	138.5	1,263.1	
Point 41	17.9	1,272.3	
Point 42	17.9	1,246.8	

Point 43	-550	1,150	
Point 44	-550	1,850	
Point 45	570	1,850	
Point 46	570	1,150	
Point 47	10	1,850	
Point 48	134	1,289.9	Zero Pressure
Point 49	132.5	1,278.2	
Point 50	135.5	1,278.2	
Point 51	132.5	1,287.9	
Point 52	135.5	1,287.9	
Point 53	129.25	1,291.15	
Point 54	138.75	1,291.15	
Point 55	130.937	1,289.463	
Point 56	137.093	1,289.493	
Point 57	-127.55	1,340.2	
Point 58	-22.9814	1,366.2	
Point 59	525	1,275.5	

Lines

	Start Point	End Point	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	28	30	64.3	90	
Line 2	30	29	1,025	0	
Line 3	27	25	121.21	5.73	
Line 4	34	32	24.962	-52.5	
Line 5	32	28	490	-0.105	
Line 6	25	33	7.9	0	
Line 7	33	32	20	0	
Line 8	36	34	46.2	0	
Line 9	33	24	13.3	53.6	
Line 10	24	35	11.666	51.3	
Line 11	35	31	46	0	
Line 12	38	36	8.4853	-45	
Line 13	31	37	8.4853	45	
Line 14	21	22	3.1541	37.3	Potential Seepage Face
Line 15	26	18	93.481	1.89	

Line 16	18	19	28.388	-1.35	Potential Seepage Face
Line 17	19	20	117.93	-3.62	Potential Seepage Face
Line 18	20	21	138.85	-1.12	Potential Seepage Face
Line 19	2	3	31.45	5.6	Normal Pool
Line 20	3	4	26.601	11.6	Normal Pool
Line 21	4	5	18.152	8.55	Normal Pool
Line 22	5	6	48.775	7.74	Normal Pool
Line 23	6	7	3.1665	41.5	Normal Pool
Line 24	7	8	11.228	6.75	Normal Pool
Line 25	8	9	45.121	17	Normal Pool
Line 26	9	10	29.287	2.88	
Line 27	10	11	69.923	14.7	
Line 28	11	12	15.379	5.41	
Line 29	38	2	270	-2.68	
Line 30	1	28	35.78	90	
Line 31	2	1	152.91	0.652	Normal Pool
Line 32	13	38	99.479	52.4	
Line 33	37	15	99.458	-52.4	
Line 34	15	14	16.55	-2.84	
Line 35	14	13	16.778	2.63	
Line 36	15	16	109.4	-22.2	Potential Seepage Face
Line 37	16	17	20.693	-1.02	Potential Seepage Face
Line 38	17	18	99.318	-19.9	Potential Seepage Face
Line 39	37	55	53.738	0.28	
Line 40	55	51	2.2104	-45	
Line 41	51	49	9.7	90	
Line 42	49	50	3	0	
Line 43	50	52	9.7	90	
Line 44	52	56	2.2528	45	
Line 45	56	26	1.407	0.285	
Line 46	56	54	2.3434	45	
Line 47	53	55	2.3858	-45	
Line 48	54	53	9.5	0	
Line 49	12	58	32.991	16.6	
Line 50	58	13	6.4935	16.6	
Line 51	59	27	386.5	0	

Line 52	34	35	50.4	0	
Line 53	29	59	75.5	90	
Line 54	22	23	5.6896	4.76	
Line 55	23	59	8.632	90	

Regions

	Material	Points	Area (ft²)
Region 1	Foundation Rock (Impenetrable)	28,30,29,59,27,25,33,32	70,612
Region 2	Zone I	38,36,34,35,31,37,15,14,13	8,311
Region 3	Glacial Till	37,55,51,49,50,52,56,26,18,19,20,21,22,23,59,27,25,33,24,35,31	6,567.4
Region 4	Glacial Till	32,34,36,38,2,1,28	15,383
Region 5	Zone II	2,3,4,5,6,7,8,9,10,11,12,58,13,38	9,776.3
Region 6	Zone III	15,16,17,18,26,56,54,53,55,37	5,973
Region 7	Drainfill	53,54,56,52,50,49,51,55	49.413
Region 8	Zone I	34,35,24,33,32	693.85

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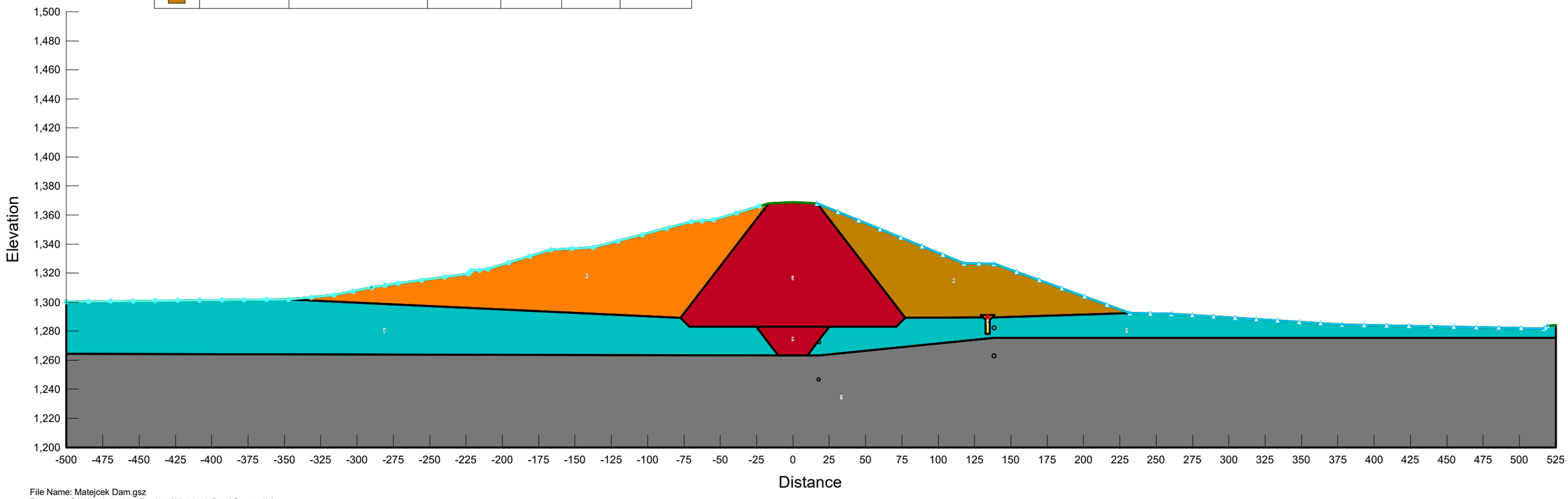
Excellence Delivered As Promised

Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Steady-State Seepage, Flood Surcharge Pool

Color	Name	Model	K-Function	Vol. WC. Function	Sat Kx (ft/sec)	Volumetric Water Content (ft^3/ft^3)
	Drainfill	Saturated / Unsaturated	Drainfill	Drainfill		
	Foundation Rock (Impenetrable)	Saturated Only			1.9e-007	0.41
	Glacial Till	Saturated / Unsaturated	Glacial Till	Glacial Till		
	Zone I	Saturated / Unsaturated	Zone I	Zone I		
	Zone II	Saturated / Unsaturated	Zone II	Zone II		
	Zone III	Saturated / Unsaturated	Zone III	Zone III		



File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Gannett Fleming

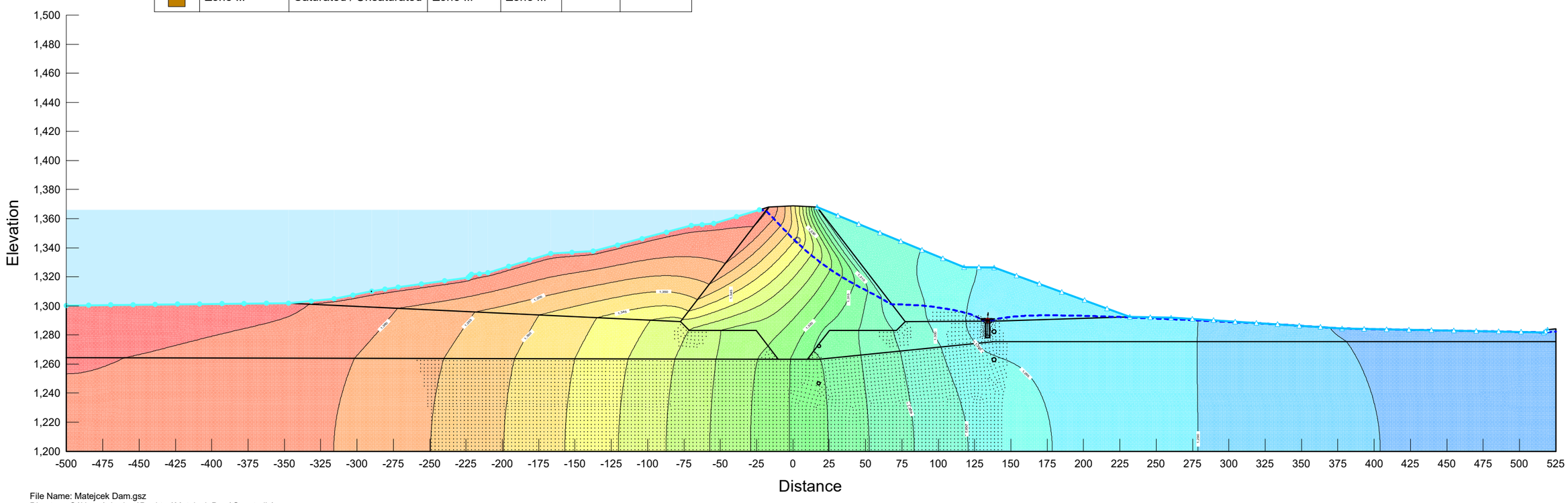
Excellence Delivered As Promised

Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Steady-State Seepage, Flood Surcharge Pool

Color	Name	Model	K-Function	Vol. WC. Function	Sat Kx (ft/sec)	Volumetric Water Content (ft^3/ft^3)
	Drainfill	Saturated / Unsaturated	Drainfill	Drainfill		
	Foundation Rock (Impenetrable)	Saturated Only			1.9e-007	0.41
	Glacial Till	Saturated / Unsaturated	Glacial Till	Glacial Till		
	Zone I	Saturated / Unsaturated	Zone I	Zone I		
	Zone II	Saturated / Unsaturated	Zone II	Zone II		
	Zone III	Saturated / Unsaturated	Zone III	Zone III		



File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Steady-State Seepage, Flood Surcharge Pool

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File Information

File Version: 8.16
Created By: Christensen, Karl
Last Edited By: Barben, Edward J.
Revision Number: 87
Date: 10/15/2019
Time: 3:37:50 PM
Tool Version: 8.16.2.14053
File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Mass(M) Units: Pounds
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Flood Surcharge

Kind: SEEP/W
Method: Steady-State
Settings
    Include Air Flow: No
Control
    Apply Runoff: Yes
Convergence
    Maximum Number of Iterations: 500
    Minimum Pressure Head Difference: 0.005
    Significant Digits: 2
    Max # of Reviews: 10
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1
        Under-Relaxation Min. Rate: 0.1

Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 0 sec
Duration: 0 sec
Ending Time: 0 sec

Materials

Foundation Rock (Impenetrable)

Model: Saturated Only
Hydraulic
Sat Kx: 1.9e-007 ft/sec
Ky'/Kx' Ratio: 1
Rotation: 0 °
Volumetric Water Content: 0.41 ft^3/ft^3
Mv: 2.4e-005 /psf

Zone I

Model: Saturated / Unsaturated
Hydraulic
K-Function: Zone I
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Zone I

Zone II

Model: Saturated / Unsaturated
Hydraulic
K-Function: Zone II
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Zone II

Zone III

Model: Saturated / Unsaturated
Hydraulic
K-Function: Zone III
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Zone III

Drainfill

Model: Saturated / Unsaturated
Hydraulic

K-Function: Drainfill
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Drainfill

Glacial Till

Model: Saturated / Unsaturated
Hydraulic
K-Function: Glacial Till
Ky'/Kx' Ratio: 1
Rotation: 0 °
Vol. WC. Function: Glacial Till

Boundary Conditions

Zero Pressure

Type: Pressure Head 0
Review: No

Potential Seepage Face

Type: Total Flux (Q) 0
Review: Yes

Flood Surcharge Pool

Type: Head (H) 1366.2
Review: No

K Functions

Zone I

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 1.3e-009
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 1.3e-009)
Data Point: (0.018329807, 1.2707744e-009)
Data Point: (0.033598183, 1.2379453e-009)
Data Point: (0.061584821, 1.2012348e-009)
Data Point: (0.11288379, 1.1602307e-009)
Data Point: (0.20691381, 1.1145476e-009)
Data Point: (0.37926902, 1.0638037e-009)
Data Point: (0.6951928, 1.0076356e-009)
Data Point: (1.274275, 9.4572429e-010)

Data Point: (2.3357215, 8.7782943e-010)
Data Point: (4.2813324, 8.0383301e-010)
Data Point: (7.8475997, 7.2381031e-010)
Data Point: (14.384499, 6.381188e-010)
Data Point: (26.366509, 5.4753312e-010)
Data Point: (48.329302, 4.5344496e-010)
Data Point: (88.586679, 3.5812231e-010)
Data Point: (162.37767, 2.6507067e-010)
Data Point: (297.63514, 1.7930848e-010)
Data Point: (545.55948, 1.0710333e-010)
Data Point: (1,000, 5.4231314e-011)

Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Zone I
Saturated Kx: 1.3e-009 ft/sec
Residual Water Content: 0.045 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Zone II

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 1.3e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 1.3e-008)
Data Point: (0.018329807, 1.2997411e-008)
Data Point: (0.033598183, 1.2993045e-008)
Data Point: (0.061584821, 1.2985731e-008)
Data Point: (0.11288379, 1.2973459e-008)
Data Point: (0.20691381, 1.2952867e-008)
Data Point: (0.37926902, 1.2918339e-008)
Data Point: (0.6951928, 1.2860467e-008)
Data Point: (1.274275, 1.2763576e-008)
Data Point: (2.3357215, 1.2601689e-008)
Data Point: (4.2813324, 1.233196e-008)
Data Point: (7.8475997, 1.1885202e-008)
Data Point: (14.384499, 1.1152775e-008)
Data Point: (26.366509, 9.9762931e-009)
Data Point: (48.329302, 8.1688758e-009)
Data Point: (88.586679, 5.6544344e-009)
Data Point: (162.37767, 2.8613334e-009)
Data Point: (297.63514, 8.7391842e-010)
Data Point: (545.55948, 1.4957748e-010)
Data Point: (1,000, 1.6816337e-011)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Zone II
Saturated Kx: 1.3e-008 ft/sec
Residual Water Content: 0.035 ft³/ft³
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Zone III

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 1.3e-007
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 1.3e-007)
Data Point: (0.018329807, 1.2720962e-007)
Data Point: (0.033598183, 1.2406236e-007)
Data Point: (0.061584821, 1.205286e-007)
Data Point: (0.11288379, 1.1656517e-007)
Data Point: (0.20691381, 1.1213095e-007)
Data Point: (0.37926902, 1.0718461e-007)
Data Point: (0.6951928, 1.0168605e-007)
Data Point: (1.274275, 9.5598954e-008)
Data Point: (2.3357215, 8.8894224e-008)
Data Point: (4.2813324, 8.1554451e-008)
Data Point: (7.8475997, 7.3581181e-008)
Data Point: (14.384499, 6.5004151e-008)
Data Point: (26.366509, 5.5895399e-008)
Data Point: (48.329302, 4.6390332e-008)
Data Point: (88.586679, 3.671539e-008)
Data Point: (162.37767, 2.722709e-008)
Data Point: (297.63514, 1.8443474e-008)
Data Point: (545.55948, 1.1020438e-008)
Data Point: (1,000, 5.5721357e-009)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Zone III
Saturated Kx: 1.3e-007 ft/sec
Residual Water Content: 0.045 ft³/ft³
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Drainfill

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %

Segment Curvature: 100 %
Saturated Kx: 1.3e-005
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 1.3e-005)
Data Point: (0.018329807, 1.2998725e-005)
Data Point: (0.033598183, 1.2997264e-005)
Data Point: (0.061584821, 1.2995465e-005)
Data Point: (0.11288379, 1.2993044e-005)
Data Point: (0.20691381, 1.2989491e-005)
Data Point: (0.37926902, 1.2982613e-005)
Data Point: (0.6951928, 1.2963134e-005)
Data Point: (1.274275, 1.2909372e-005)
Data Point: (2.3357215, 1.2764023e-005)
Data Point: (4.2813324, 1.2381818e-005)
Data Point: (7.8475997, 1.145568e-005)
Data Point: (14.384499, 9.4053329e-006)
Data Point: (26.366509, 5.8850044e-006)
Data Point: (48.329302, 2.0691894e-006)
Data Point: (88.586679, 3.3180832e-007)
Data Point: (162.37767, 3.0703117e-008)
Data Point: (297.63514, 2.4862045e-009)
Data Point: (545.55948, 1.8802165e-010)
Data Point: (1,000, 5.8991767e-012)
Estimation Properties
Hyd. K-Function Estimation Method: Fredlund-Xing Function
Volume Water Content Function: Drainfill
Saturated Kx: 1.3e-005 ft/sec
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Glacial Till

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 8.4e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.01, 8.4e-008)
Data Point: (0.018329807, 8.2111574e-008)
Data Point: (0.033598183, 7.9990311e-008)
Data Point: (0.061584821, 7.761825e-008)
Data Point: (0.11288379, 7.4968751e-008)
Data Point: (0.20691381, 7.2016924e-008)
Data Point: (0.37926902, 6.8738088e-008)
Data Point: (0.6951928, 6.510876e-008)
Data Point: (1.274275, 6.1108339e-008)
Data Point: (2.3357215, 5.6721286e-008)

Data Point: (4.2813324, 5.1939979e-008)
Data Point: (7.8475997, 4.6769281e-008)
Data Point: (14.384499, 4.1232292e-008)
Data Point: (26.366509, 3.5379063e-008)
Data Point: (48.329302, 2.9299521e-008)
Data Point: (88.586679, 2.3140211e-008)
Data Point: (162.37767, 1.7127643e-008)
Data Point: (297.63514, 1.1586086e-008)
Data Point: (545.55948, 6.9205232e-009)
Data Point: (1,000, 3.5041772e-009)

Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Glacial Till
Saturated Kx: 8.4e-008 ft/sec
Residual Water Content: 0.045 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Vol. Water Content Functions

Glacial Till

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.46146539 ft^3/ft^3
Residual Water Content: 0.046146539 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.46146539
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.45006379)
Data Point: (0.018329807, 0.45006379)
Data Point: (0.033598183, 0.45006379)
Data Point: (0.061584821, 0.45006379)
Data Point: (0.11288379, 0.45006379)
Data Point: (0.20691381, 0.45006379)
Data Point: (0.37926902, 0.45006379)
Data Point: (0.6951928, 0.45006379)
Data Point: (1.274275, 0.45006379)
Data Point: (2.3357215, 0.45006379)
Data Point: (4.2813324, 0.45006379)
Data Point: (7.8475997, 0.45006379)
Data Point: (14.384499, 0.45006379)
Data Point: (26.366509, 0.45006379)
Data Point: (48.329302, 0.45006379)

Data Point: (88.586679, 0.45006379)
Data Point: (162.37767, 0.45006379)
Data Point: (297.63514, 0.45006379)
Data Point: (545.55948, 0.44984191)
Data Point: (1,000, 0.42714254)
Estimation Properties
Vol. WC Estimation Method: Grain Size Function
Saturated Water Content: 0.45 ft³/ft³
Sample Material: Silty Sand
Liquid Limit: 45 %
Diameter at 10% passing: 0.001
Diameter at 60% passing: 0.066
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Zone I

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.46146539 ft³/ft³
Residual Water Content: 0.046146539 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.46146539
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.45006379)
Data Point: (0.018329807, 0.45006379)
Data Point: (0.033598183, 0.45006379)
Data Point: (0.061584821, 0.45006379)
Data Point: (0.11288379, 0.45006379)
Data Point: (0.20691381, 0.45006379)
Data Point: (0.37926902, 0.45006379)
Data Point: (0.6951928, 0.45006379)
Data Point: (1.274275, 0.45006379)
Data Point: (2.3357215, 0.45006379)
Data Point: (4.2813324, 0.45006379)
Data Point: (7.8475997, 0.45006379)
Data Point: (14.384499, 0.45006379)
Data Point: (26.366509, 0.45006379)
Data Point: (48.329302, 0.45006379)
Data Point: (88.586679, 0.45006379)
Data Point: (162.37767, 0.45006379)
Data Point: (297.63514, 0.45006379)
Data Point: (545.55948, 0.44984191)
Data Point: (1,000, 0.42714254)
Estimation Properties
Vol. WC Estimation Method: Grain Size Function

Saturated Water Content: 0.45 ft³/ft³
Sample Material: Clay
Liquid Limit: 45 %
Diameter at 10% passing: 0.002
Diameter at 60% passing: 0.055
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Zone II

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.35001097 ft³/ft³
Residual Water Content: 0.035001097 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.35001097
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.34999998)
Data Point: (0.018329807, 0.34999996)
Data Point: (0.033598183, 0.34999992)
Data Point: (0.061584821, 0.34999981)
Data Point: (0.11288379, 0.34999954)
Data Point: (0.20691381, 0.34999886)
Data Point: (0.37926902, 0.34999711)
Data Point: (0.6951928, 0.3499926)
Data Point: (1.274275, 0.3499808)
Data Point: (2.3357215, 0.34994978)
Data Point: (4.2813324, 0.34986789)
Data Point: (7.8475997, 0.34965114)
Data Point: (14.384499, 0.34907722)
Data Point: (26.366509, 0.34756257)
Data Point: (48.329302, 0.34361181)
Data Point: (88.586679, 0.33363431)
Data Point: (162.37767, 0.31039132)
Data Point: (297.63514, 0.26507967)
Data Point: (545.55948, 0.20055842)
Data Point: (1,000, 0.1384939)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.35 ft³/ft³
Sample Material: Silt
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01

Num. Points: 20

Zone III

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.37807833 ft³/ft³
Residual Water Content: 0.037807833 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.37807833
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.35022222)
Data Point: (0.018329807, 0.35022222)
Data Point: (0.033598183, 0.35022222)
Data Point: (0.061584821, 0.35022222)
Data Point: (0.11288379, 0.35022222)
Data Point: (0.20691381, 0.35022222)
Data Point: (0.37926902, 0.35022222)
Data Point: (0.6951928, 0.35022222)
Data Point: (1.274275, 0.35022222)
Data Point: (2.3357215, 0.35022222)
Data Point: (4.2813324, 0.35022222)
Data Point: (7.8475997, 0.35022222)
Data Point: (14.384499, 0.35022222)
Data Point: (26.366509, 0.35022222)
Data Point: (48.329302, 0.35022222)
Data Point: (88.586679, 0.35022222)
Data Point: (162.37767, 0.35022222)
Data Point: (297.63514, 0.35022222)
Data Point: (545.55948, 0.35022222)
Data Point: (1,000, 0.35022222)
Estimation Properties
Vol. WC Estimation Method: Grain Size Function
Saturated Water Content: 0.35 ft³/ft³
Sample Material: Clay
Liquid Limit: 57 %
Diameter at 10% passing: 0.001
Diameter at 60% passing: 0.168
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Drainfill

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 2.4e-005 /psf
Saturated Water Content: 0.20000216 ft³/ft³

Residual Water Content: 0.020000216 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.20000216
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.19999999)
Data Point: (0.018329807, 0.19999997)
Data Point: (0.033598183, 0.1999999)
Data Point: (0.061584821, 0.19999971)
Data Point: (0.11288379, 0.19999911)
Data Point: (0.20691381, 0.19999718)
Data Point: (0.37926902, 0.19999093)
Data Point: (0.6951928, 0.19997055)
Data Point: (1.274275, 0.19990402)
Data Point: (2.3357215, 0.19968668)
Data Point: (4.2813324, 0.19897883)
Data Point: (7.8475997, 0.19670167)
Data Point: (14.384499, 0.18966661)
Data Point: (26.366509, 0.17040155)
Data Point: (48.329302, 0.13128038)
Data Point: (88.586679, 0.083993776)
Data Point: (162.37767, 0.050440759)
Data Point: (297.63514, 0.032219908)
Data Point: (545.55948, 0.022430781)
Data Point: (1,000, 0.01672195)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.2 ft³/ft³
Sample Material: Sand
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)	Hydraulic Boundary
Point 1	-500	1,300.08	
Point 2	-347.1	1,301.82	
Point 3	-315.8	1,304.89	
Point 4	-289.74	1,310.23	
Point 5	-271.79	1,312.93	
Point 6	-223.46	1,319.5	

Point 7	-221.09	1,321.6	
Point 8	-209.94	1,322.92	
Point 9	-166.79	1,336.11	
Point 10	-137.54	1,337.58	
Point 11	-69.9	1,355.3	
Point 12	-54.59	1,356.75	
Point 13	-16.76	1,368.06	
Point 14	0	1,368.83	
Point 15	16.53	1,368.01	
Point 16	117.84	1,326.72	
Point 17	138.53	1,326.35	
Point 18	231.93	1,292.58	
Point 19	260.31	1,291.91	
Point 20	378	1,284.46	
Point 21	516.82	1,281.75	
Point 22	519.33	1,283.66	
Point 23	525	1,284.132	
Point 24	17.9	1,274.1	
Point 25	17.9	1,263.4	
Point 26	138.5	1,289.5	
Point 27	138.5	1,275.5	
Point 28	-500	1,264.3	
Point 29	525	1,200	
Point 30	-500	1,200	
Point 31	71.2	1,283.2	
Point 32	-10	1,263.4	
Point 33	10	1,263.4	
Point 34	-25.2	1,283.2	
Point 35	25.2	1,283.2	
Point 36	-71.4	1,283.2	
Point 37	77.2	1,289.2	
Point 38	-77.4	1,289.2	
Point 39	138.5	1,282.1	
Point 40	138.5	1,263.1	
Point 41	17.9	1,272.3	
Point 42	17.9	1,246.8	

Point 43	-550	1,150	
Point 44	-550	1,850	
Point 45	570	1,850	
Point 46	570	1,150	
Point 47	10	1,850	
Point 48	134	1,289.9	Zero Pressure
Point 49	132.5	1,278.2	
Point 50	135.5	1,278.2	
Point 51	132.5	1,287.9	
Point 52	135.5	1,287.9	
Point 53	129.25	1,291.15	
Point 54	138.75	1,291.15	
Point 55	130.937	1,289.463	
Point 56	137.093	1,289.493	
Point 57	-127.55	1,340.2	
Point 58	-22.9814	1,366.2	
Point 59	525	1,275.5	

Lines

	Start Point	End Point	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	28	30	64.3	90	
Line 2	30	29	1,025	0	
Line 3	27	25	121.21	5.73	
Line 4	34	32	24.962	-52.5	
Line 5	32	28	490	-0.105	
Line 6	25	33	7.9	0	
Line 7	33	32	20	0	
Line 8	36	34	46.2	0	
Line 9	33	24	13.3	53.6	
Line 10	24	35	11.666	51.3	
Line 11	35	31	46	0	
Line 12	38	36	8.4853	-45	
Line 13	31	37	8.4853	45	
Line 14	21	22	3.1541	37.3	Potential Seepage Face
Line 15	26	18	93.481	1.89	

Line 16	18	19	28.388	-1.35	Potential Seepage Face
Line 17	19	20	117.93	-3.62	Potential Seepage Face
Line 18	20	21	138.85	-1.12	Potential Seepage Face
Line 19	2	3	31.45	5.6	Flood Surcharge Pool
Line 20	3	4	26.601	11.6	Flood Surcharge Pool
Line 21	4	5	18.152	8.55	Flood Surcharge Pool
Line 22	5	6	48.775	7.74	Flood Surcharge Pool
Line 23	6	7	3.1665	41.5	Flood Surcharge Pool
Line 24	7	8	11.228	6.75	Flood Surcharge Pool
Line 25	8	9	45.121	17	Flood Surcharge Pool
Line 26	9	10	29.287	2.88	Flood Surcharge Pool
Line 27	10	11	69.923	14.7	Flood Surcharge Pool
Line 28	11	12	15.379	5.41	Flood Surcharge Pool
Line 29	38	2	270	-2.68	
Line 30	1	28	35.78	90	
Line 31	2	1	152.91	0.652	Flood Surcharge Pool
Line 32	13	38	99.479	52.4	
Line 33	37	15	99.458	-52.4	
Line 34	15	14	16.55	-2.84	
Line 35	14	13	16.778	2.63	
Line 36	15	16	109.4	-22.2	Potential Seepage Face
Line 37	16	17	20.693	-1.02	Potential Seepage Face
Line 38	17	18	99.318	-19.9	Potential Seepage Face
Line 39	37	55	53.738	0.28	
Line 40	55	51	2.2104	-45	
Line 41	51	49	9.7	90	
Line 42	49	50	3	0	
Line 43	50	52	9.7	90	
Line 44	52	56	2.2528	45	
Line 45	56	26	1.407	0.285	
Line 46	56	54	2.3434	45	
Line 47	53	55	2.3858	-45	
Line 48	54	53	9.5	0	
Line 49	12	58	32.991	16.6	Flood Surcharge Pool
Line 50	58	13	6.4935	16.6	
Line 51	59	27	386.5	0	

Line 52	34	35	50.4	0	
Line 53	29	59	75.5	90	
Line 54	22	23	5.6896	4.76	
Line 55	23	59	8.632	90	

Regions

	Material	Points	Area (ft²)
Region 1	Foundation Rock (Impenetrable)	28,30,29,59,27,25,33,32	70,612
Region 2	Zone I	38,36,34,35,31,37,15,14,13	8,311
Region 3	Glacial Till	37,55,51,49,50,52,56,26,18,19,20,21,22,23,59,27,25,33,24,35,31	6,567.4
Region 4	Glacial Till	32,34,36,38,2,1,28	15,383
Region 5	Zone II	2,3,4,5,6,7,8,9,10,11,12,58,13,38	9,776.3
Region 6	Zone III	15,16,17,18,26,56,54,53,55,37	5,973
Region 7	Drainfill	53,54,56,52,50,49,51,55	49.413
Region 8	Zone I	34,35,24,33,32	693.85

Gannett Fleming

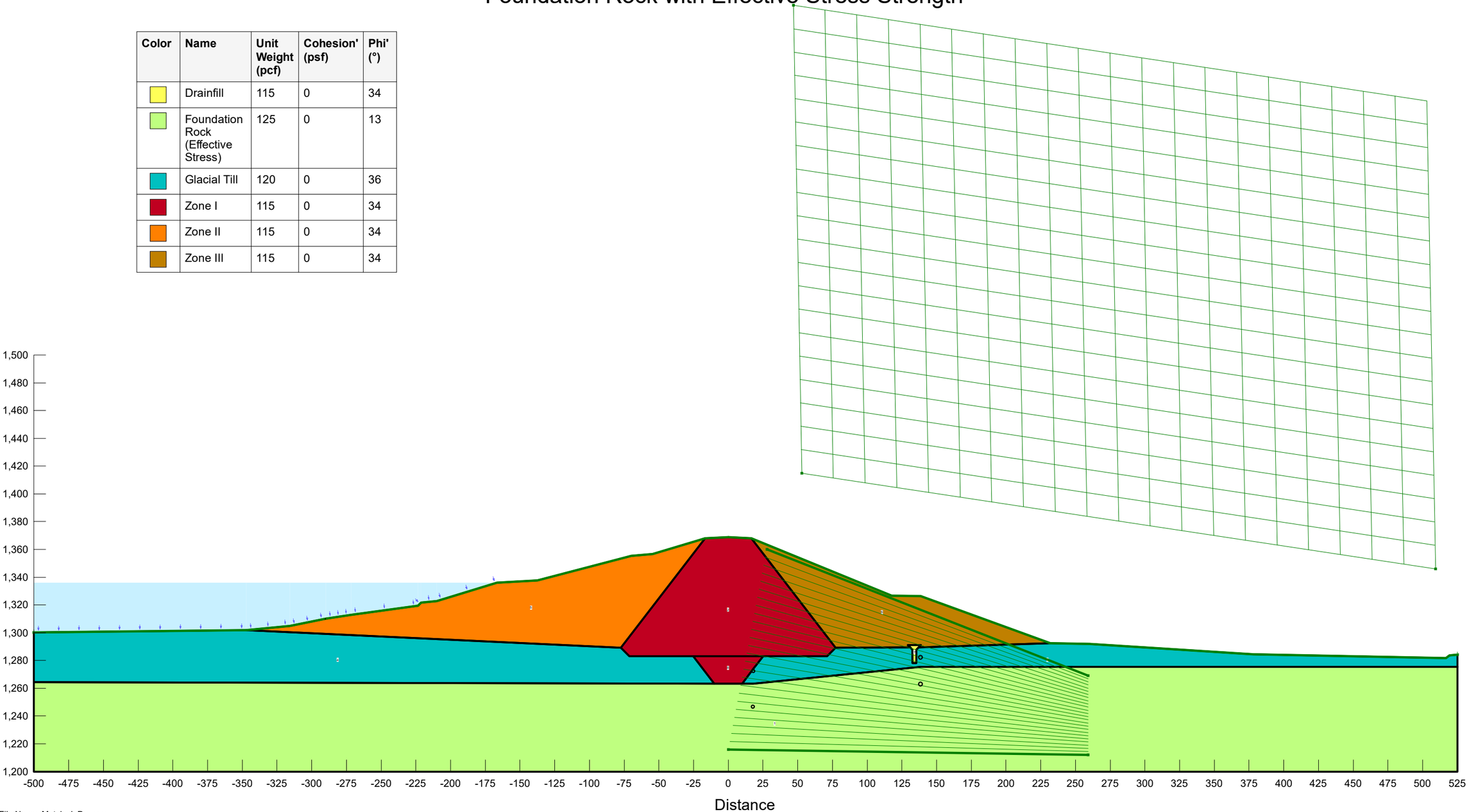
Excellence Delivered As Promised

Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Downstream Slope Stability, Normal Pool
Foundation Rock with Effective Stress Strength

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Drainfill	115	0	34
	Foundation Rock (Effective Stress)	125	0	13
	Glacial Till	120	0	36
	Zone I	115	0	34
	Zone II	115	0	34
	Zone III	115	0	34



File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Gannett Fleming

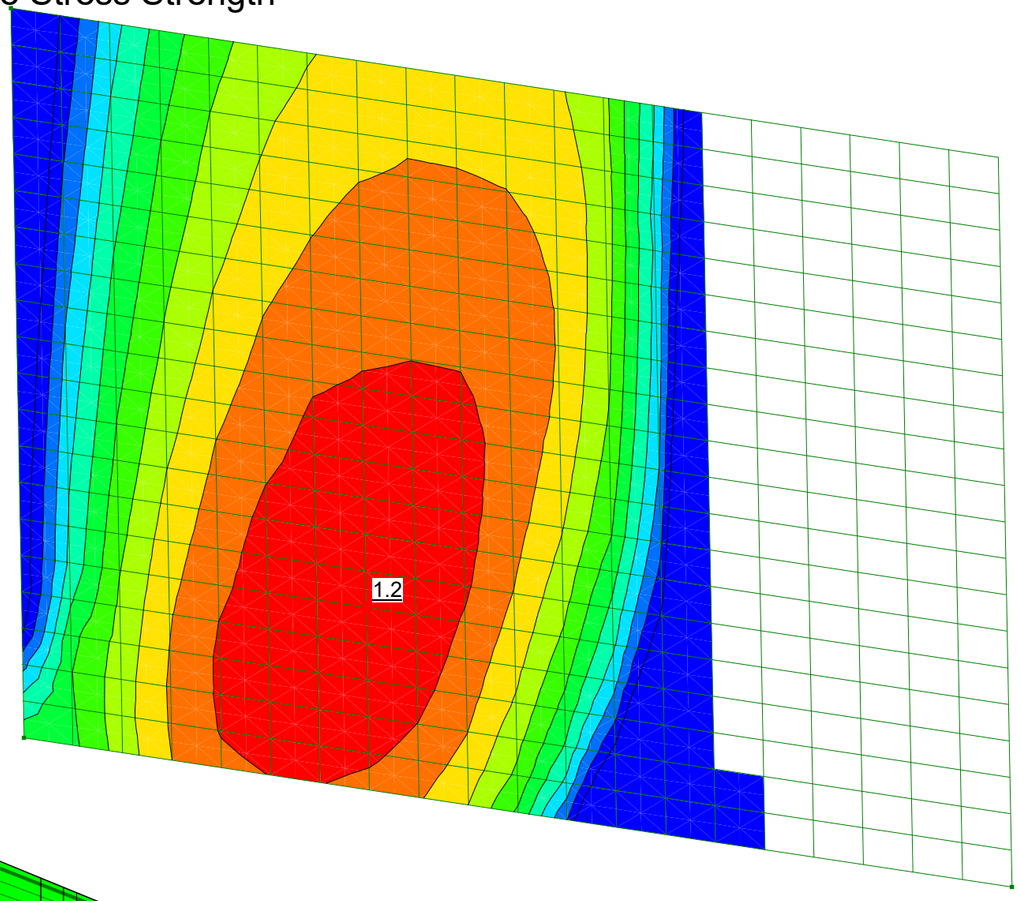
Excellence Delivered As Promised

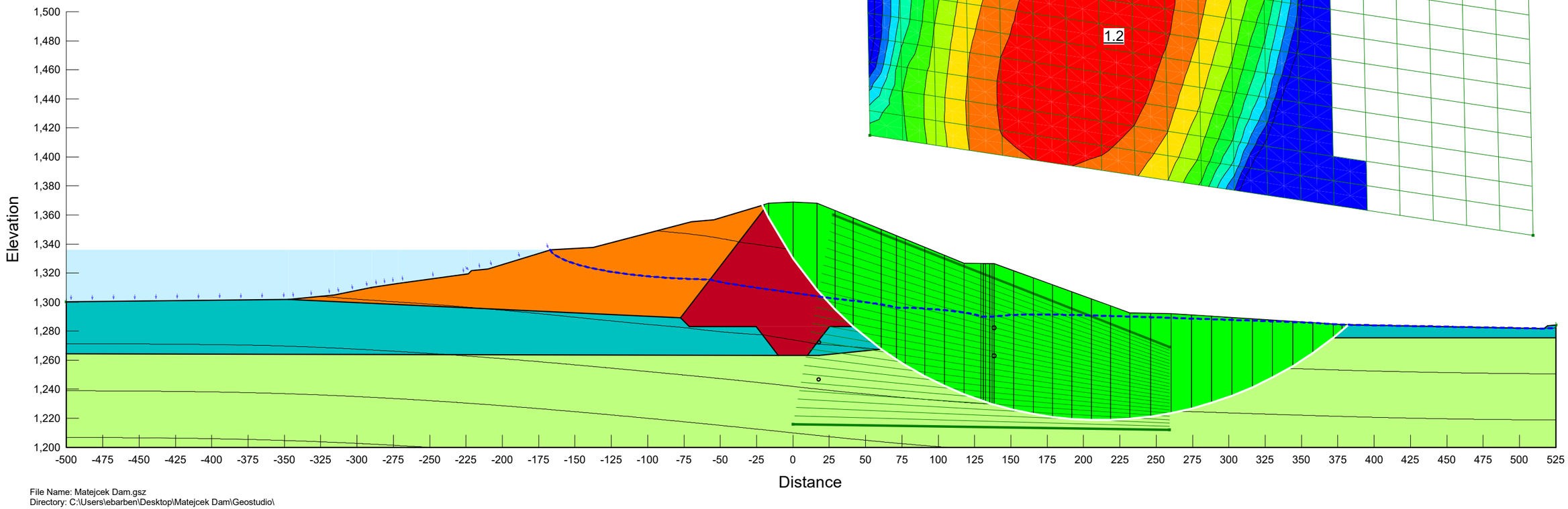
Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Downstream Slope Stability, Normal Pool
Foundation Rock with Effective Stress Strength

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Drainfill	115	0	34
	Foundation Rock (Effective Stress)	125	0	13
	Glacial Till	120	0	36
	Zone I	115	0	34
	Zone II	115	0	34
	Zone III	115	0	34





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Downstream Slope Stability, Normal Pool Foundation Rock with Effective Stress Strength

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File Information

File Version: 8.16
Created By: Christensen, Karl
Last Edited By: Barben, Edward J.
Revision Number: 87
Date: 10/15/2019
Time: 3:37:50 PM
Tool Version: 8.16.2.14053
File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability (Normal Pool)

Description: Remolded Shear strength parameters for rock
Kind: SLOPE/W
Parent: Normal Pool
Method: Spencer
Settings
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Grid and Radius
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 3 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Zone I

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Zone II

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Zone III

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Drainfill

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Glacial Till

Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °

Foundation Rock (Effective Stress)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 13 °
Phi-B: 0 °

Slip Surface Grid

Upper Left: (46.7944, 1,751.946) ft
Lower Left: (53.0631, 1,414.882) ft
Lower Right: (509.2323, 1,345.926) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (28, 1,360) ft
Upper Right Coordinate: (259, 1,269) ft
Lower Left Coordinate: (0, 1,216) ft
Lower Right Coordinate: (259, 1,212) ft
Number of Increments: 25
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, 1,300.08) ft
Right Coordinate: (525, 1,284.132) ft

Points

	X (ft)	Y (ft)
Point 1	-500	1,300.08
Point 2	-347.1	1,301.82
Point 3	-315.8	1,304.89

Point 4	-289.74	1,310.23
Point 5	-271.79	1,312.93
Point 6	-223.46	1,319.5
Point 7	-221.09	1,321.6
Point 8	-209.94	1,322.92
Point 9	-166.79	1,336.11
Point 10	-137.54	1,337.58
Point 11	-69.9	1,355.3
Point 12	-54.59	1,356.75
Point 13	-16.76	1,368.06
Point 14	0	1,368.83
Point 15	16.53	1,368.01
Point 16	117.84	1,326.72
Point 17	138.53	1,326.35
Point 18	231.93	1,292.58
Point 19	260.31	1,291.91
Point 20	378	1,284.46
Point 21	516.82	1,281.75
Point 22	519.33	1,283.66
Point 23	525	1,284.132
Point 24	17.9	1,274.1
Point 25	17.9	1,263.4
Point 26	138.5	1,289.5
Point 27	138.5	1,275.5
Point 28	-500	1,264.3
Point 29	525	1,200
Point 30	-500	1,200
Point 31	71.2	1,283.2
Point 32	-10	1,263.4
Point 33	10	1,263.4
Point 34	-25.2	1,283.2
Point 35	25.2	1,283.2
Point 36	-71.4	1,283.2
Point 37	77.2	1,289.2
Point 38	-77.4	1,289.2
Point 39	138.5	1,282.1

Point 40	138.5	1,263.1
Point 41	17.9	1,272.3
Point 42	17.9	1,246.8
Point 43	-550	1,150
Point 44	-550	1,850
Point 45	570	1,850
Point 46	570	1,150
Point 47	10	1,850
Point 48	134	1,289.9
Point 49	132.5	1,278.2
Point 50	135.5	1,278.2
Point 51	132.5	1,287.9
Point 52	135.5	1,287.9
Point 53	129.25	1,291.15
Point 54	138.75	1,291.15
Point 55	130.937	1,289.463
Point 56	137.093	1,289.493
Point 57	-127.55	1,340.2
Point 58	-22.9814	1,366.2
Point 59	525	1,275.5

Regions

	Material	Points	Area (ft^2)
Region 1	Foundation Rock (Effective Stress)	28,30,29,59,27,25,33,32	70,612
Region 2	Zone I	38,36,34,35,31,37,15,14,13	8,311
Region 3	Glacial Till	37,55,51,49,50,52,56,26,18,19,20,21,22,23,59,27,25,33,24,35,31	6,567.4
Region 4	Glacial Till	32,34,36,38,2,1,28	15,383
Region 5	Zone II	2,3,4,5,6,7,8,9,10,11,12,58,13,38	9,776.3

Region 6	Zone III	15,16,17,18,26,56,54,53,55,37	5,973
Region 7	Drainfill	53,54,56,52,50,49,51,55	49.413
Region 8	Zone I	34,35,24,33,32	693.85

Gannett Fleming

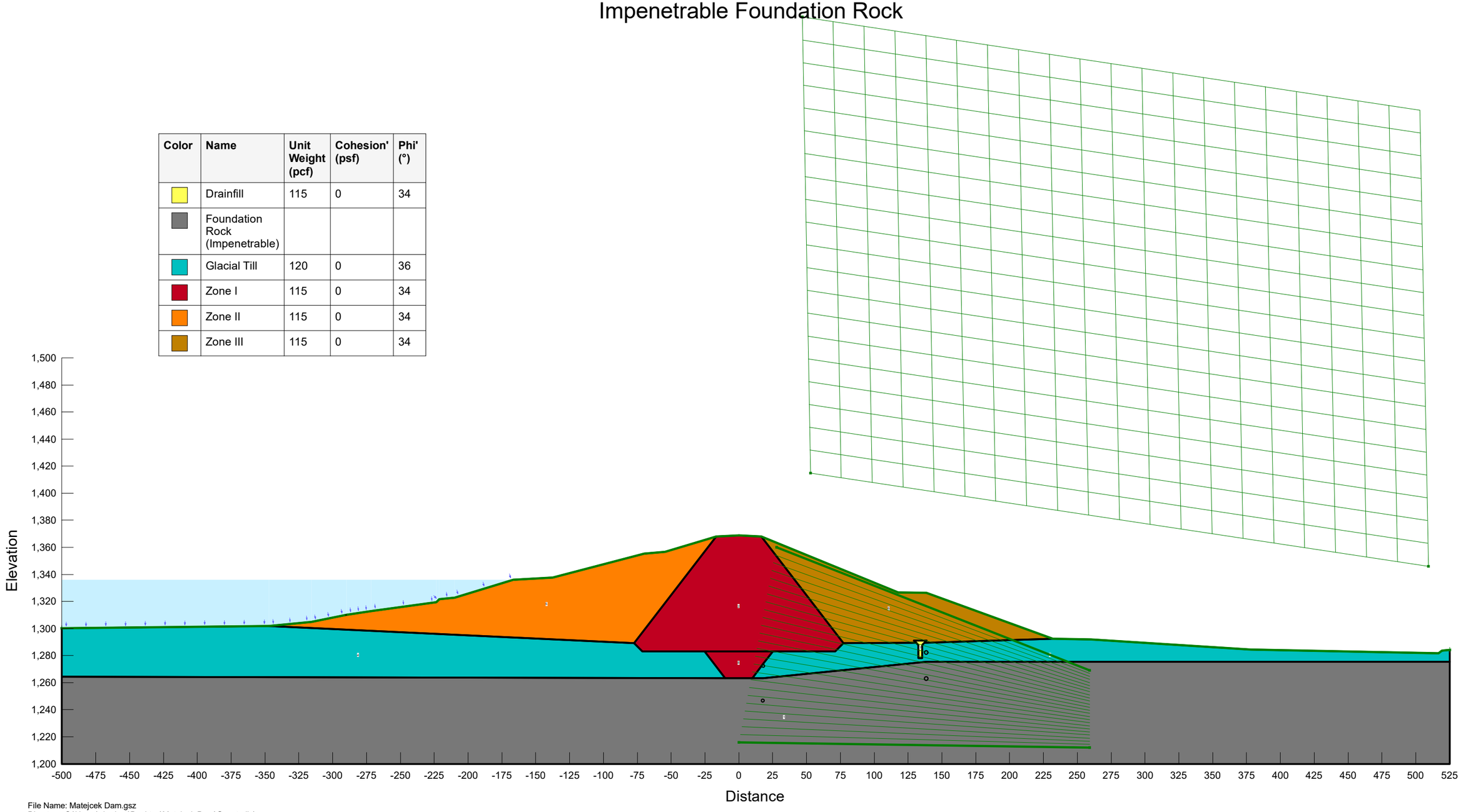
Excellence Delivered As Promised

Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Downstream Slope Stability, Normal Pool
Impenetrable Foundation Rock

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Drainfill	115	0	34
	Foundation Rock (Impenetrable)			
	Glacial Till	120	0	36
	Zone I	115	0	34
	Zone II	115	0	34
	Zone III	115	0	34



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Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Gannett Fleming

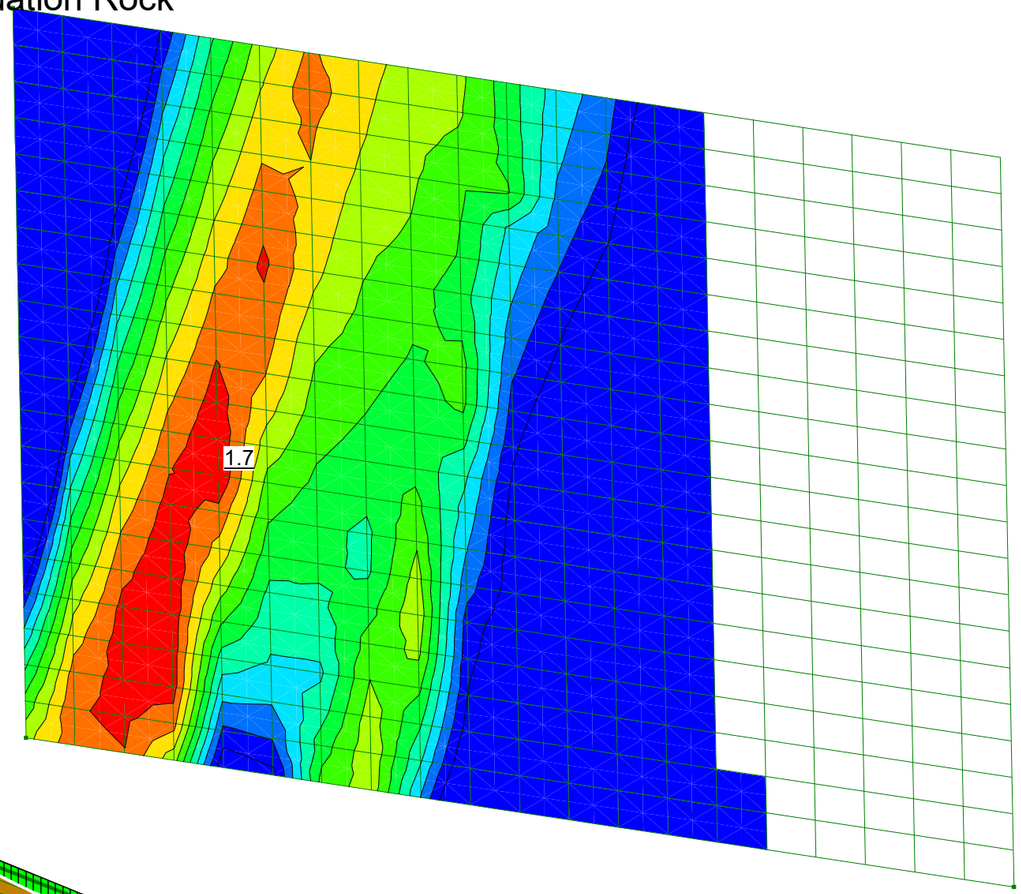
Excellence Delivered As Promised

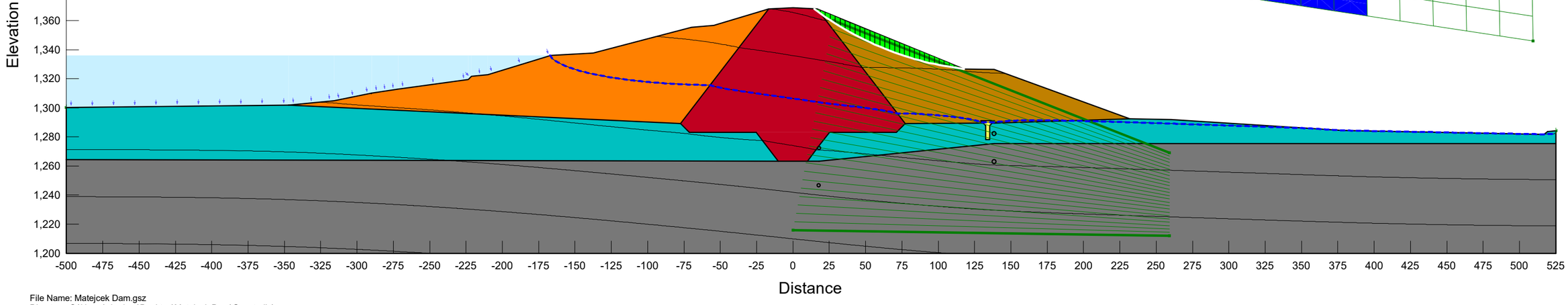
Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Downstream Slope Stability, Normal Pool
Impenetrable Foundation Rock

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Drainfill	115	0	34
	Foundation Rock (Impenetrable)			
	Glacial Till	120	0	36
	Zone I	115	0	34
	Zone II	115	0	34
	Zone III	115	0	34





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Downstream Slope Stability, Normal Pool Impenetrable Foundation Rock

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File Information

File Version: 8.16
Created By: Christensen, Karl
Last Edited By: Barben, Edward J.
Revision Number: 87
Date: 10/15/2019
Time: 3:37:50 PM
Tool Version: 8.16.2.14053
File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability (Normal Pool) (2)

Description: Impenetrable Foundation Rock
Kind: SLOPE/W
Parent: Normal Pool
Method: Spencer
Settings
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Grid and Radius
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 4 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Foundation Rock (Impenetrable)

Model: Bedrock (Impenetrable)

Zone I

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Zone II

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Zone III

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Drainfill

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Glacial Till

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °

Slip Surface Grid

Upper Left: (46.7944, 1,751.946) ft
Lower Left: (53.0631, 1,414.882) ft
Lower Right: (509.2323, 1,345.926) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (28, 1,360) ft
Upper Right Coordinate: (259, 1,269) ft
Lower Left Coordinate: (0, 1,216) ft
Lower Right Coordinate: (259, 1,212) ft
Number of Increments: 25
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, 1,300.08) ft
Right Coordinate: (525, 1,284.132) ft

Points

	X (ft)	Y (ft)
Point 1	-500	1,300.08
Point 2	-347.1	1,301.82
Point 3	-315.8	1,304.89
Point 4	-289.74	1,310.23
Point 5	-271.79	1,312.93
Point 6	-223.46	1,319.5

Point 7	-221.09	1,321.6
Point 8	-209.94	1,322.92
Point 9	-166.79	1,336.11
Point 10	-137.54	1,337.58
Point 11	-69.9	1,355.3
Point 12	-54.59	1,356.75
Point 13	-16.76	1,368.06
Point 14	0	1,368.83
Point 15	16.53	1,368.01
Point 16	117.84	1,326.72
Point 17	138.53	1,326.35
Point 18	231.93	1,292.58
Point 19	260.31	1,291.91
Point 20	378	1,284.46
Point 21	516.82	1,281.75
Point 22	519.33	1,283.66
Point 23	525	1,284.132
Point 24	17.9	1,274.1
Point 25	17.9	1,263.4
Point 26	138.5	1,289.5
Point 27	138.5	1,275.5
Point 28	-500	1,264.3
Point 29	525	1,200
Point 30	-500	1,200
Point 31	71.2	1,283.2
Point 32	-10	1,263.4
Point 33	10	1,263.4
Point 34	-25.2	1,283.2
Point 35	25.2	1,283.2
Point 36	-71.4	1,283.2
Point 37	77.2	1,289.2
Point 38	-77.4	1,289.2
Point 39	138.5	1,282.1
Point 40	138.5	1,263.1
Point 41	17.9	1,272.3
Point 42	17.9	1,246.8

Point 43	-550	1,150
Point 44	-550	1,850
Point 45	570	1,850
Point 46	570	1,150
Point 47	10	1,850
Point 48	134	1,289.9
Point 49	132.5	1,278.2
Point 50	135.5	1,278.2
Point 51	132.5	1,287.9
Point 52	135.5	1,287.9
Point 53	129.25	1,291.15
Point 54	138.75	1,291.15
Point 55	130.937	1,289.463
Point 56	137.093	1,289.493
Point 57	-127.55	1,340.2
Point 58	-22.9814	1,366.2
Point 59	525	1,275.5

Regions

	Material	Points	Area (ft^2)
Region 1	Foundation Rock (Impenetrable)	28,30,29,59,27,25,33,32	70,612
Region 2	Zone I	38,36,34,35,31,37,15,14,13	8,311
Region 3	Glacial Till	37,55,51,49,50,52,56,26,18,19,20,21,22,23,59,27,25,33,24,35,31	6,567.4
Region 4	Glacial Till	32,34,36,38,2,1,28	15,383
Region 5	Zone II	2,3,4,5,6,7,8,9,10,11,12,58,13,38	9,776.3
Region 6	Zone III	15,16,17,18,26,56,54,53,55,37	5,973
Region 7	Drainfill	53,54,56,52,50,49,51,55	49.413

Region 8	Zone I	34,35,24,33,32	693.85

Gannett Fleming

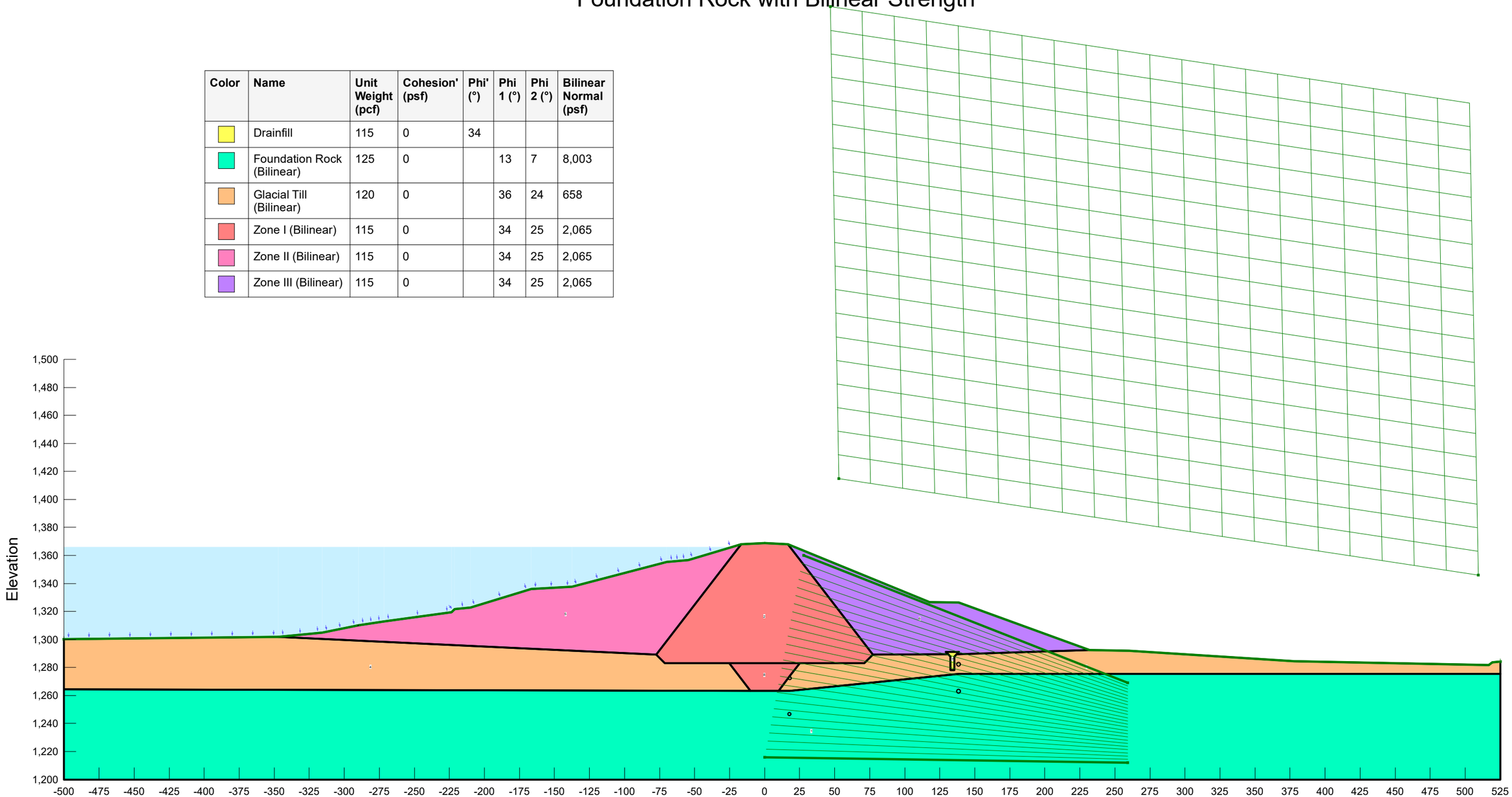
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Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Downstream Slope Stability, Flood Surcharge Pool
Foundation Rock with Bilinear Strength

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)
	Drainfill	115	0	34			
	Foundation Rock (Bilinear)	125	0		13	7	8,003
	Glacial Till (Bilinear)	120	0		36	24	658
	Zone I (Bilinear)	115	0		34	25	2,065
	Zone II (Bilinear)	115	0		34	25	2,065
	Zone III (Bilinear)	115	0		34	25	2,065



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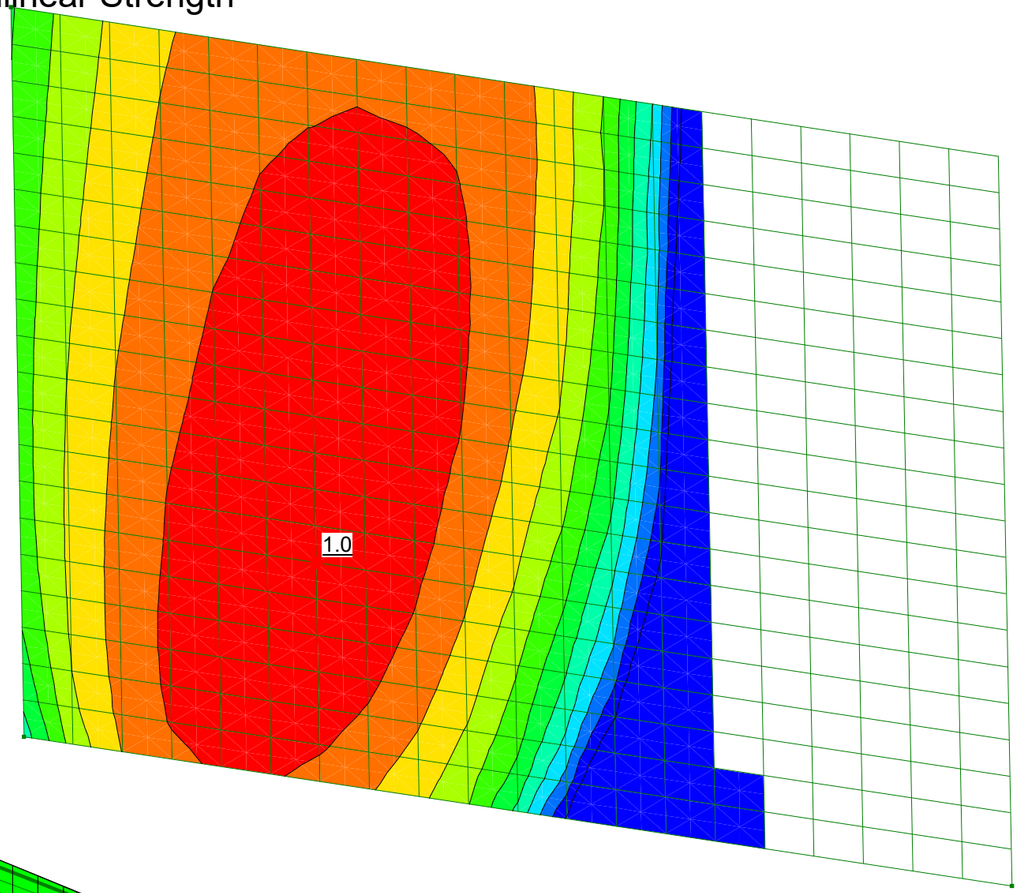
Excellence Delivered As Promised

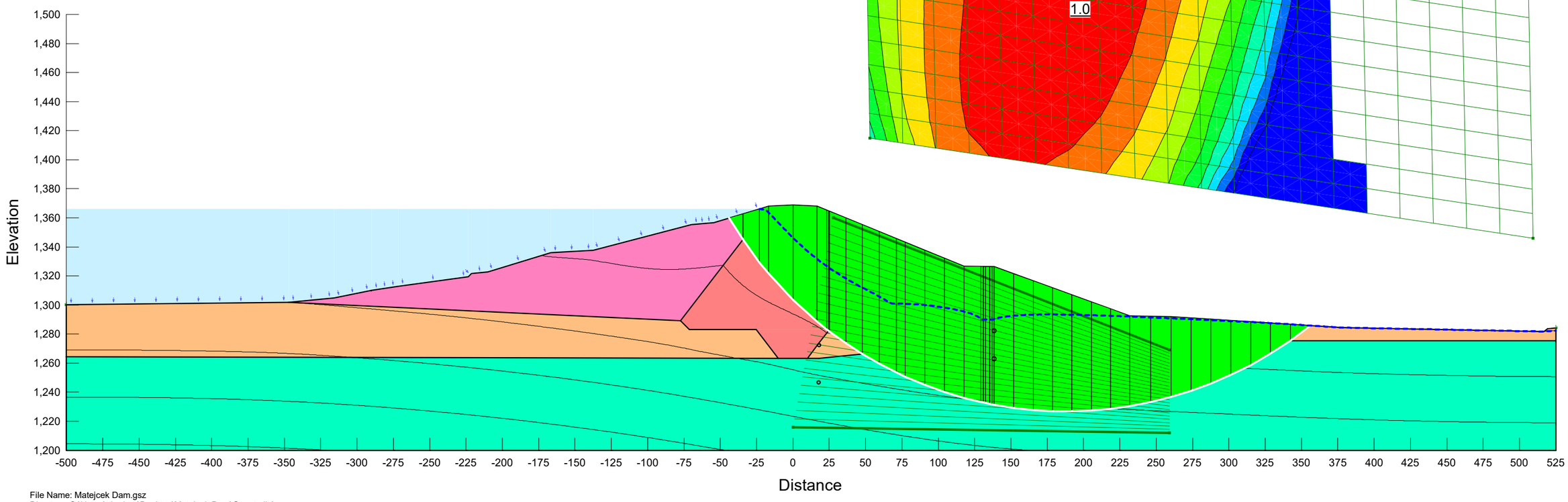
Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Downstream Slope Stability, Flood Surcharge Pool
Foundation Rock with Bilinear Strength

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)
	Drainfill	115	0	34			
	Foundation Rock (Bilinear)	125	0		13	7	8,003
	Glacial Till (Bilinear)	120	0		36	24	658
	Zone I (Bilinear)	115	0		34	25	2,065
	Zone II (Bilinear)	115	0		34	25	2,065
	Zone III (Bilinear)	115	0		34	25	2,065





File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Downstream Slope Stability, Flood Pool Foundation Rock with Bilinear Strength

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File Information

File Version: 8.16
Created By: Christensen, Karl
Last Edited By: Barben, Edward J.
Revision Number: 87
Date: 10/15/2019
Time: 3:37:50 PM
Tool Version: 8.16.2.14053
File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability (Flood Pool)

Description: Remolded shear strength parameters for rock
Kind: SLOPE/W
Parent: Flood Surcharge
Method: Spencer
Settings
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Grid and Radius
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 3 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Drainfill

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Zone III (Bilinear)

Model: Bilinear
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 25 °
Bilinear Normal: 2,065 psf
Phi-B: 0 °

Zone II (Bilinear)

Model: Bilinear
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 25 °
Bilinear Normal: 2,065 psf
Phi-B: 0 °

Zone I (Bilinear)

Model: Bilinear
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi 1: 34 °

Phi 2: 25 °
Bilinear Normal: 2,065 psf
Phi-B: 0 °

Glacial Till (Bilinear)

Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 36 °
Phi 2: 24 °
Bilinear Normal: 658 psf
Phi-B: 0 °

Foundation Rock (Bilinear)

Model: Bilinear
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi 1: 13 °
Phi 2: 7 °
Bilinear Normal: 8,003 psf
Phi-B: 0 °

Slip Surface Grid

Upper Left: (46.7944, 1,751.946) ft
Lower Left: (53.0631, 1,414.882) ft
Lower Right: (509.2323, 1,345.926) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (28, 1,360) ft
Upper Right Coordinate: (259, 1,269) ft
Lower Left Coordinate: (0, 1,216) ft
Lower Right Coordinate: (259, 1,212) ft
Number of Increments: 25
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, 1,300.08) ft
Right Coordinate: (525, 1,284.132) ft

Points

	X (ft)	Y (ft)
Point 1	-500	1,300.08
Point 2	-347.1	1,301.82
Point 3	-315.8	1,304.89
Point 4	-289.74	1,310.23
Point 5	-271.79	1,312.93
Point 6	-223.46	1,319.5
Point 7	-221.09	1,321.6
Point 8	-209.94	1,322.92
Point 9	-166.79	1,336.11
Point 10	-137.54	1,337.58
Point 11	-69.9	1,355.3
Point 12	-54.59	1,356.75
Point 13	-16.76	1,368.06
Point 14	0	1,368.83
Point 15	16.53	1,368.01
Point 16	117.84	1,326.72
Point 17	138.53	1,326.35
Point 18	231.93	1,292.58
Point 19	260.31	1,291.91
Point 20	378	1,284.46
Point 21	516.82	1,281.75
Point 22	519.33	1,283.66
Point 23	525	1,284.132
Point 24	17.9	1,274.1
Point 25	17.9	1,263.4
Point 26	138.5	1,289.5
Point 27	138.5	1,275.5
Point 28	-500	1,264.3
Point 29	525	1,200

Point 30	-500	1,200
Point 31	71.2	1,283.2
Point 32	-10	1,263.4
Point 33	10	1,263.4
Point 34	-25.2	1,283.2
Point 35	25.2	1,283.2
Point 36	-71.4	1,283.2
Point 37	77.2	1,289.2
Point 38	-77.4	1,289.2
Point 39	138.5	1,282.1
Point 40	138.5	1,263.1
Point 41	17.9	1,272.3
Point 42	17.9	1,246.8
Point 43	-550	1,150
Point 44	-550	1,850
Point 45	570	1,850
Point 46	570	1,150
Point 47	10	1,850
Point 48	134	1,289.9
Point 49	132.5	1,278.2
Point 50	135.5	1,278.2
Point 51	132.5	1,287.9
Point 52	135.5	1,287.9
Point 53	129.25	1,291.15
Point 54	138.75	1,291.15
Point 55	130.937	1,289.463
Point 56	137.093	1,289.493
Point 57	-127.55	1,340.2
Point 58	-22.9814	1,366.2
Point 59	525	1,275.5

Regions

	Material	Points	Area (ft^2)

Region 1	Foundation Rock (Bilinear)	28,30,29,59,27,25,33,32	70,612
Region 2	Zone I (Bilinear)	38,36,34,35,31,37,15,14,13	8,311
Region 3	Glacial Till (Bilinear)	37,55,51,49,50,52,56,26,18,19,20,21,22,23,59,27,25,33,24,35,31	6,567.4
Region 4	Glacial Till (Bilinear)	32,34,36,38,2,1,28	15,383
Region 5	Zone II (Bilinear)	2,3,4,5,6,7,8,9,10,11,12,58,13,38	9,776.3
Region 6	Zone III (Bilinear)	15,16,17,18,26,56,54,53,55,37	5,973
Region 7	Drainfill	53,54,56,52,50,49,51,55	49.413
Region 8	Zone I (Bilinear)	34,35,24,33,32	693.85

Gannett Fleming

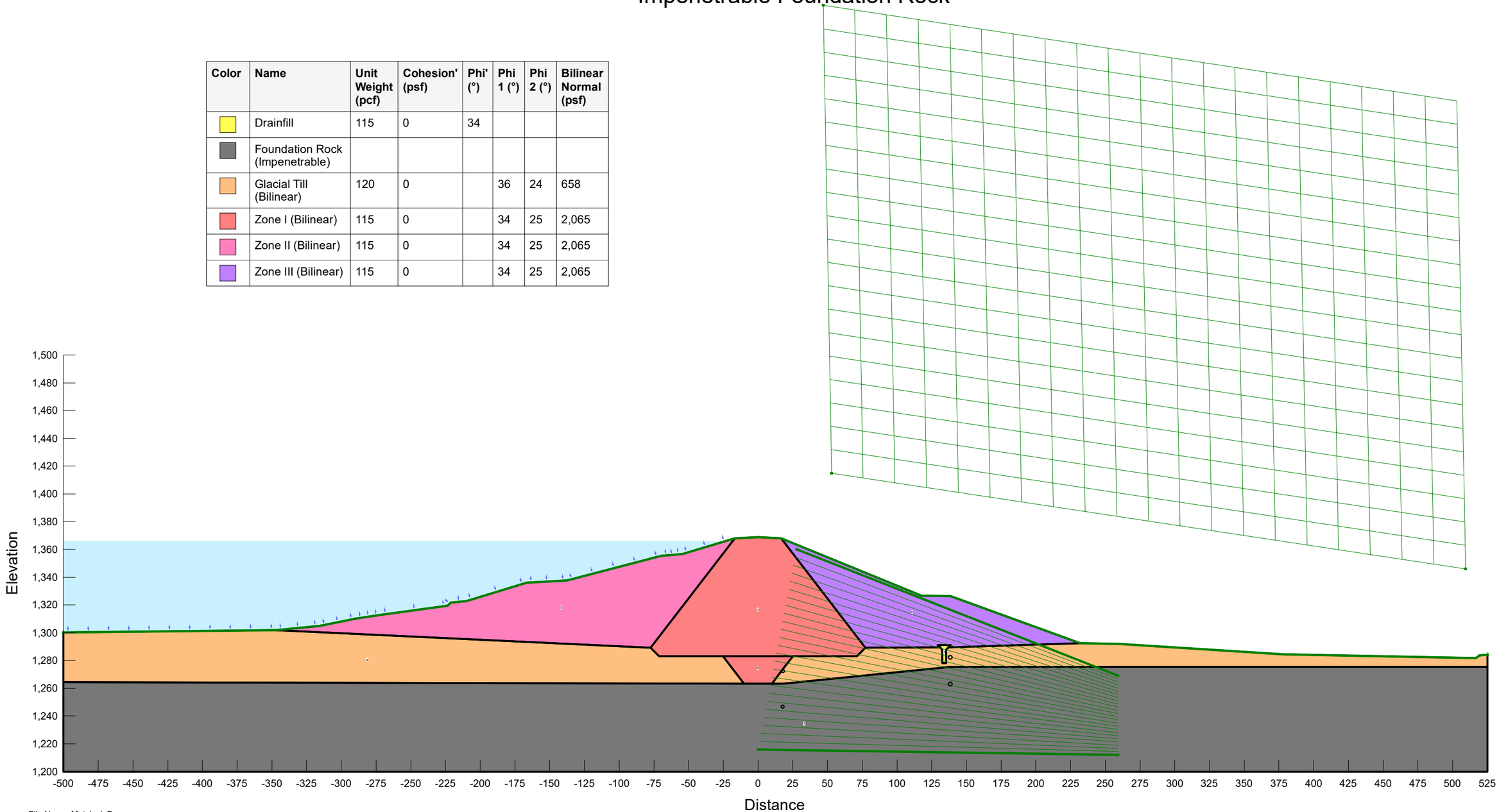
Excellence Delivered As Promised

Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Downstream Slope Stability, Flood Surcharge Pool
Impenetrable Foundation Rock

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)
	Drainfill	115	0	34			
	Foundation Rock (Impenetrable)						
	Glacial Till (Bilinear)	120	0		36	24	658
	Zone I (Bilinear)	115	0		34	25	2,065
	Zone II (Bilinear)	115	0		34	25	2,065
	Zone III (Bilinear)	115	0		34	25	2,065



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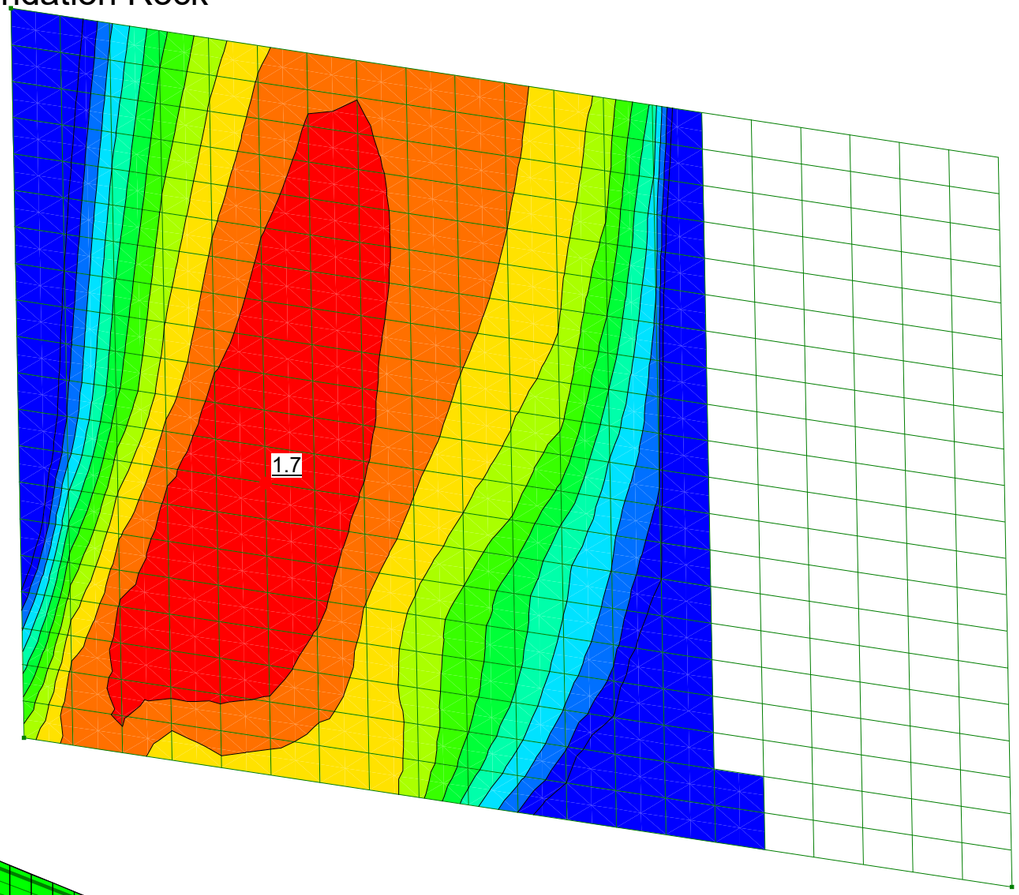
Excellence Delivered As Promised

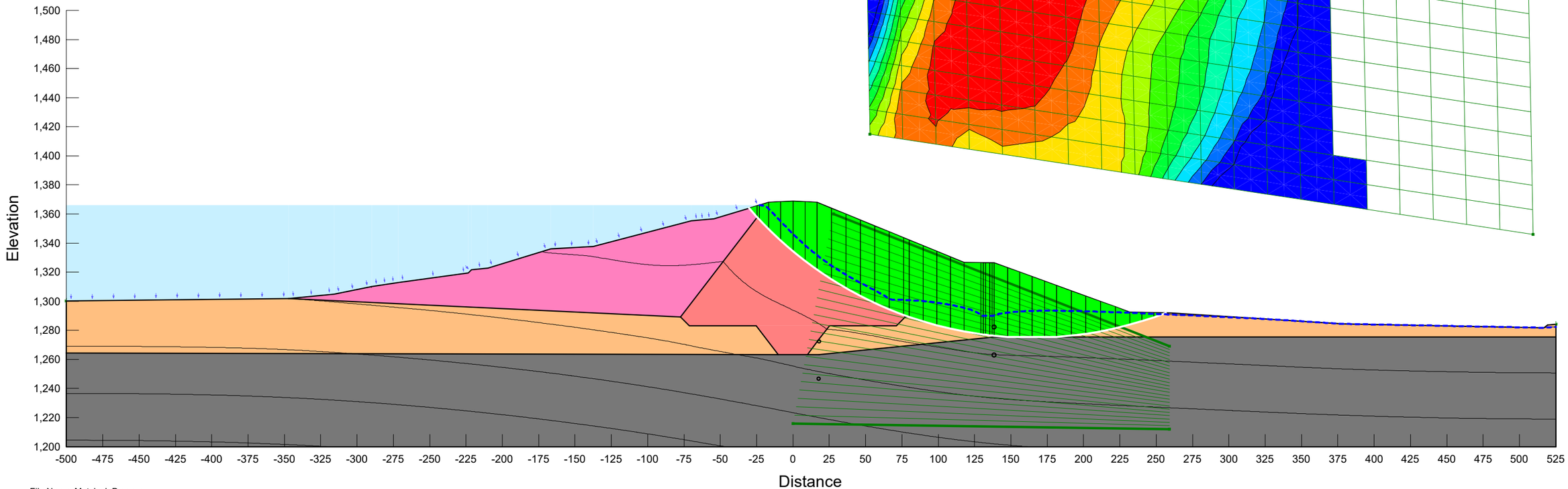
Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Downstream Slope Stability, Flood Surcharge Pool
Impenetrable Foundation Rock

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)
	Drainfill	115	0	34			
	Foundation Rock (Impenetrable)						
	Glacial Till (Bilinear)	120	0		36	24	658
	Zone I (Bilinear)	115	0		34	25	2,065
	Zone II (Bilinear)	115	0		34	25	2,065
	Zone III (Bilinear)	115	0		34	25	2,065





File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Downstream Slope Stability, Flood Pool Impenetrable Foundation Rock

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File Information

File Version: 8.16
Created By: Christensen, Karl
Last Edited By: Barben, Edward J.
Revision Number: 87
Date: 10/15/2019
Time: 3:37:50 PM
Tool Version: 8.16.2.14053
File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability (Flood Pool) (2)

Description: Impenetrable Rock
Kind: SLOPE/W
Parent: Flood Surcharge
Method: Spencer
Settings
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Grid and Radius
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 4 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Foundation Rock (Impenetrable)

Model: Bedrock (Impenetrable)

Drainfill

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Zone III (Bilinear)

Model: Bilinear
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 25 °
Bilinear Normal: 2,065 psf
Phi-B: 0 °

Zone II (Bilinear)

Model: Bilinear
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 25 °
Bilinear Normal: 2,065 psf
Phi-B: 0 °

Zone I (Bilinear)

Model: Bilinear

Unit Weight: 115 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 25 °
Bilinear Normal: 2,065 psf
Phi-B: 0 °

Glacial Till (Bilinear)

Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 36 °
Phi 2: 24 °
Bilinear Normal: 658 psf
Phi-B: 0 °

Slip Surface Grid

Upper Left: (46.7944, 1,751.946) ft
Lower Left: (53.0631, 1,414.882) ft
Lower Right: (509.2323, 1,345.926) ft
Grid Horizontal Increment: 20
Grid Vertical Increment: 20
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (28, 1,360) ft
Upper Right Coordinate: (259, 1,269) ft
Lower Left Coordinate: (0, 1,216) ft
Lower Right Coordinate: (259, 1,212) ft
Number of Increments: 25
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, 1,300.08) ft
Right Coordinate: (525, 1,284.132) ft

Points

	X (ft)	Y (ft)

Point 1	-500	1,300.08
Point 2	-347.1	1,301.82
Point 3	-315.8	1,304.89
Point 4	-289.74	1,310.23
Point 5	-271.79	1,312.93
Point 6	-223.46	1,319.5
Point 7	-221.09	1,321.6
Point 8	-209.94	1,322.92
Point 9	-166.79	1,336.11
Point 10	-137.54	1,337.58
Point 11	-69.9	1,355.3
Point 12	-54.59	1,356.75
Point 13	-16.76	1,368.06
Point 14	0	1,368.83
Point 15	16.53	1,368.01
Point 16	117.84	1,326.72
Point 17	138.53	1,326.35
Point 18	231.93	1,292.58
Point 19	260.31	1,291.91
Point 20	378	1,284.46
Point 21	516.82	1,281.75
Point 22	519.33	1,283.66
Point 23	525	1,284.132
Point 24	17.9	1,274.1
Point 25	17.9	1,263.4
Point 26	138.5	1,289.5
Point 27	138.5	1,275.5
Point 28	-500	1,264.3
Point 29	525	1,200
Point 30	-500	1,200
Point 31	71.2	1,283.2
Point 32	-10	1,263.4
Point 33	10	1,263.4
Point 34	-25.2	1,283.2
Point 35	25.2	1,283.2
Point 36	-71.4	1,283.2

Point 37	77.2	1,289.2
Point 38	-77.4	1,289.2
Point 39	138.5	1,282.1
Point 40	138.5	1,263.1
Point 41	17.9	1,272.3
Point 42	17.9	1,246.8
Point 43	-550	1,150
Point 44	-550	1,850
Point 45	570	1,850
Point 46	570	1,150
Point 47	10	1,850
Point 48	134	1,289.9
Point 49	132.5	1,278.2
Point 50	135.5	1,278.2
Point 51	132.5	1,287.9
Point 52	135.5	1,287.9
Point 53	129.25	1,291.15
Point 54	138.75	1,291.15
Point 55	130.937	1,289.463
Point 56	137.093	1,289.493
Point 57	-127.55	1,340.2
Point 58	-22.9814	1,366.2
Point 59	525	1,275.5

Regions

	Material	Points	Area (ft²)
Region 1	Foundation Rock (Impenetrable)	28,30,29,59,27,25,33,32	70,612
Region 2	Zone I (Bilinear)	38,36,34,35,31,37,15,14,13	8,311
Region 3	Glacial Till (Bilinear)	37,55,51,49,50,52,56,26,18,19,20,21,22,23,59,27,25,33,24,35,31	6,567.4
Region 4	Glacial Till (Bilinear)	32,34,36,38,2,1,28	15,383

Region 5	Zone II (Bilinear)	2,3,4,5,6,7,8,9,10,11,12,58,13,38	9,776.3
Region 6	Zone III (Bilinear)	15,16,17,18,26,56,54,53,55,37	5,973
Region 7	Drainfill	53,54,56,52,50,49,51,55	49.413
Region 8	Zone I (Bilinear)	34,35,24,33,32	693.85

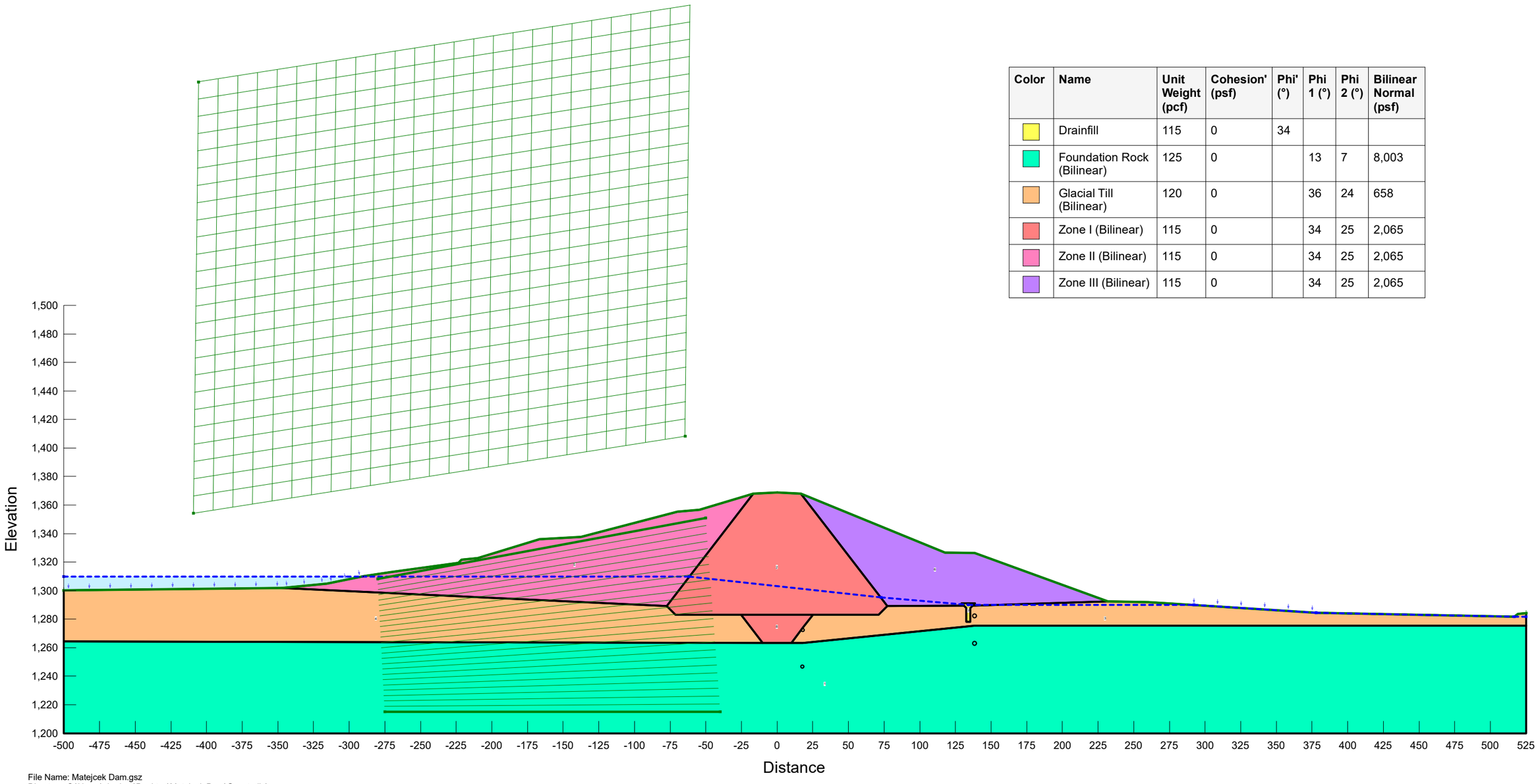
Gannett Fleming

Excellence Delivered As Promised

Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Upstream Slope Stability, Normal Pool
Rapid Drawdown with Bilinear Strength



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)
	Drainfill	115	0	34			
	Foundation Rock (Bilinear)	125	0		13	7	8,003
	Glacial Till (Bilinear)	120	0		36	24	658
	Zone I (Bilinear)	115	0		34	25	2,065
	Zone II (Bilinear)	115	0		34	25	2,065
	Zone III (Bilinear)	115	0		34	25	2,065

File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

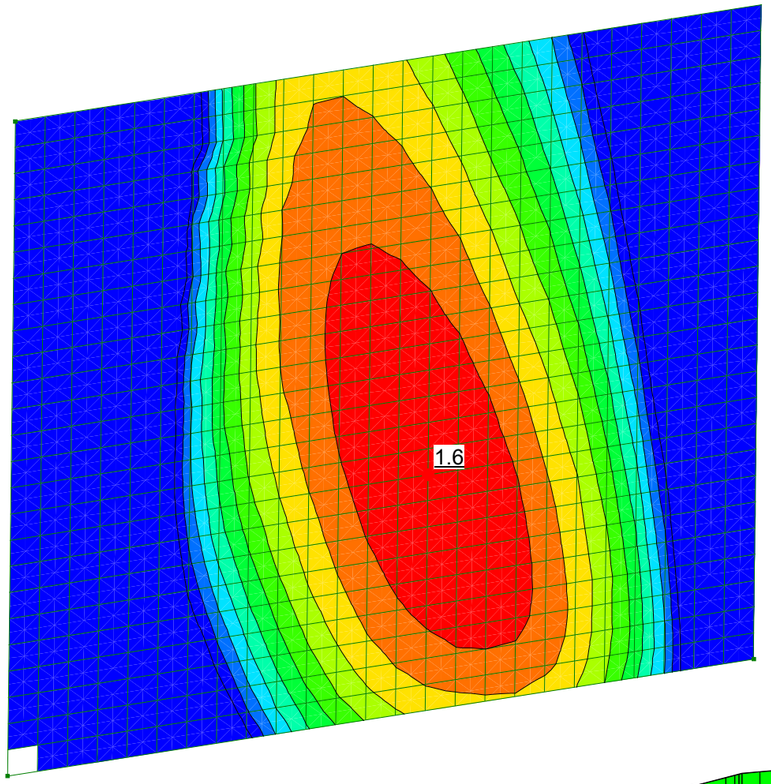
Gannett Fleming

Excellence Delivered As Promised

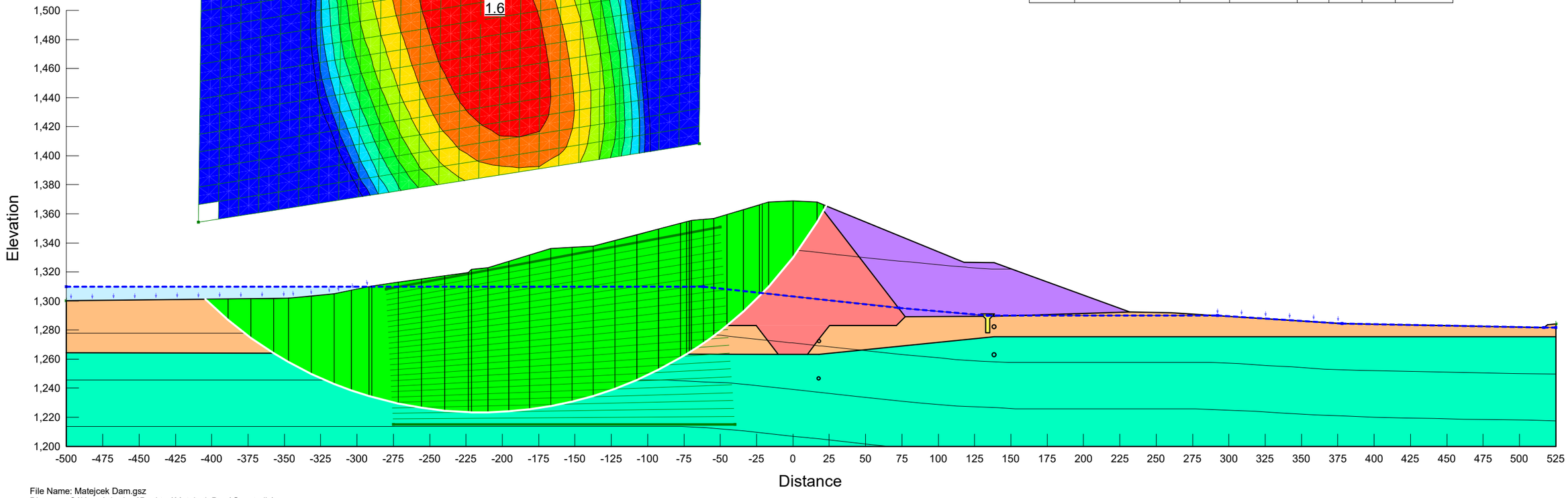
Matejcek Dam

Calc By: EJB, Oct 2019
Checked By: RAP, Oct 2019

Upstream Slope Stability, Normal Pool
Rapid Drawdown with Bilinear Strength



Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)
	Drainfill	115	0	34			
	Foundation Rock (Bilinear)	125	0		13	7	8,003
	Glacial Till (Bilinear)	120	0		36	24	658
	Zone I (Bilinear)	115	0		34	25	2,065
	Zone II (Bilinear)	115	0		34	25	2,065
	Zone III (Bilinear)	115	0		34	25	2,065



File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Upstream Slope Stability, Normal Pool Rapid Drawdown with Bilinear Strength

Report generated using GeoStudio 2016. Copyright © 1991-2017 GEO-SLOPE International Ltd.

File Information

File Version: 8.16
Created By: Christensen, Karl
Last Edited By: Barben, Edward J.
Revision Number: 87
Date: 10/15/2019
Time: 3:37:50 PM
Tool Version: 8.16.2.14053
File Name: Matejcek Dam.gsz
Directory: C:\Users\ebarben\Desktop\Matejcek Dam\Geostudio\

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Rapid Drawdown (Bilinear)

Kind: SLOPE/W
Method: Spencer
Settings
    PWP Conditions Source: Piezometric Line
    Apply Phreatic Correction: No
    Use Staged Rapid Drawdown: No
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Grid and Radius
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 3 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Drainfill

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Zone III (Bilinear)

Model: Bilinear
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 25 °
Bilinear Normal: 2,065 psf
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Zone II (Bilinear)

Model: Bilinear
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 25 °
Bilinear Normal: 2,065 psf
Phi-B: 0 °
Pore Water Pressure

Piezometric Line: 1

Zone I (Bilinear)

Model: Bilinear
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 25 °
Bilinear Normal: 2,065 psf
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Glacial Till (Bilinear)

Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 36 °
Phi 2: 24 °
Bilinear Normal: 658 psf
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Foundation Rock (Bilinear)

Model: Bilinear
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi 1: 13 °
Phi 2: 7 °
Bilinear Normal: 8,003 psf
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (-405.4685, 1,656.604) ft
Lower Left: (-409.0848, 1,354.219) ft
Lower Right: (-64.5066, 1,408.133) ft
Grid Horizontal Increment: 25
Grid Vertical Increment: 25
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (-280, 1,308.323) ft
Upper Right Coordinate: (-50, 1,350.795) ft
Lower Left Coordinate: (-275, 1,215) ft
Lower Right Coordinate: (-40, 1,215) ft
Number of Increments: 25
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (-500, 1,300.08) ft
Right Coordinate: (525, 1,284.132) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-500	1,309.86
Coordinate 2	-61.59	1,309.76
Coordinate 3	72.93	1,295.33
Coordinate 4	134	1,289.9
Coordinate 5	292.07	1,289.9
Coordinate 6	378	1,284.46
Coordinate 7	516.82	1,281.75
Coordinate 8	525	1,281.75

Points

	X (ft)	Y (ft)
Point 1	-500	1,300.08
Point 2	-347.1	1,301.82
Point 3	-315.8	1,304.89
Point 4	-289.74	1,310.23
Point 5	-271.79	1,312.93

Point 6	-223.46	1,319.5
Point 7	-221.09	1,321.6
Point 8	-209.94	1,322.92
Point 9	-166.79	1,336.11
Point 10	-137.54	1,337.58
Point 11	-69.9	1,355.3
Point 12	-54.59	1,356.75
Point 13	-16.76	1,368.06
Point 14	0	1,368.83
Point 15	16.53	1,368.01
Point 16	117.84	1,326.72
Point 17	138.53	1,326.35
Point 18	231.93	1,292.58
Point 19	260.31	1,291.91
Point 20	378	1,284.46
Point 21	516.82	1,281.75
Point 22	519.33	1,283.66
Point 23	525	1,284.132
Point 24	17.9	1,274.1
Point 25	17.9	1,263.4
Point 26	138.5	1,289.5
Point 27	138.5	1,275.5
Point 28	-500	1,264.3
Point 29	525	1,200
Point 30	-500	1,200
Point 31	71.2	1,283.2
Point 32	-10	1,263.4
Point 33	10	1,263.4
Point 34	-25.2	1,283.2
Point 35	25.2	1,283.2
Point 36	-71.4	1,283.2
Point 37	77.2	1,289.2
Point 38	-77.4	1,289.2
Point 39	138.5	1,282.1
Point 40	138.5	1,263.1
Point 41	17.9	1,272.3

Point 42	17.9	1,246.8
Point 43	-550	1,150
Point 44	-550	1,850
Point 45	570	1,850
Point 46	570	1,150
Point 47	10	1,850
Point 48	134	1,289.9
Point 49	132.5	1,278.2
Point 50	135.5	1,278.2
Point 51	132.5	1,287.9
Point 52	135.5	1,287.9
Point 53	129.25	1,291.15
Point 54	138.75	1,291.15
Point 55	130.937	1,289.463
Point 56	137.093	1,289.493
Point 57	-127.55	1,340.2
Point 58	-22.9814	1,366.2
Point 59	525	1,275.5

Regions

	Material	Points	Area (ft²)
Region 1	Foundation Rock (Bilinear)	28,30,29,59,27,25,33,32	70,612
Region 2	Zone I (Bilinear)	38,36,34,35,31,37,15,14,13	8,311
Region 3	Glacial Till (Bilinear)	37,55,51,49,50,52,56,26,18,19,20,21,22,23,59,27,25,33,24,35,31	6,567.4
Region 4	Glacial Till (Bilinear)	32,34,36,38,2,1,28	15,383
Region 5	Zone II (Bilinear)	2,3,4,5,6,7,8,9,10,11,12,58,13,38	9,776.3
Region 6	Zone III (Bilinear)	15,16,17,18,26,56,54,53,55,37	5,973
Region 7	Drainfill	53,54,56,52,50,49,51,55	49.413

Region 8	Zone I (Bilinear)	34,35,24,33,32	693.85

APPENDIX F

Site Inspection Supporting Information

- Conduit Section Numbering
- Inspection Report Checklist
- Site Inspection Photos

DRAFT

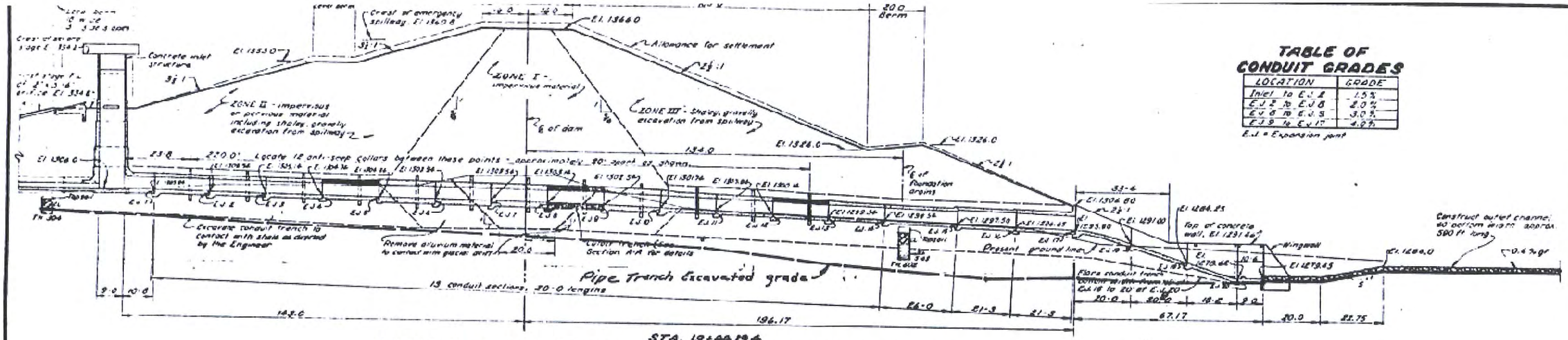
CONDUIT SECTION NUMBERING

DRAFT

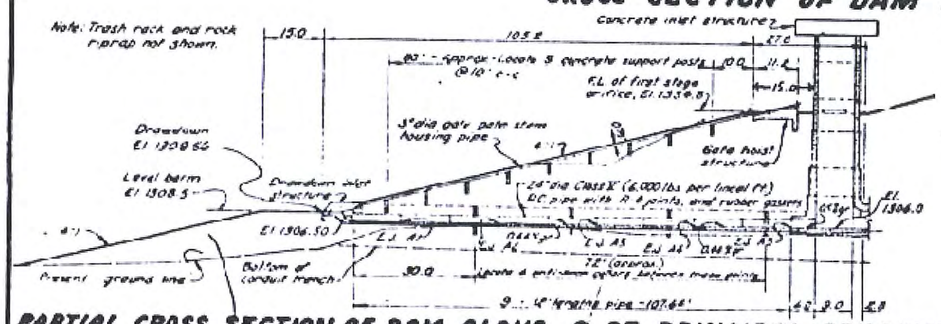
TABLE OF CONDUIT GRADES

LOCATION	GRADE
Inlet to E.J. 2	1.5%
E.J. 2 to E.J. 6	2.0%
E.J. 6 to E.J. 9	3.0%
E.J. 9 to E.J. 17	4.0%

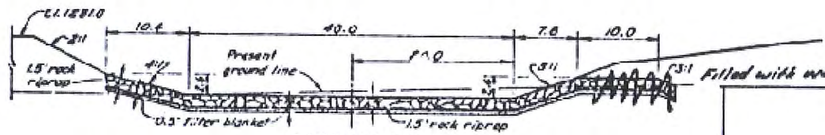
E.J. = Expansion joint



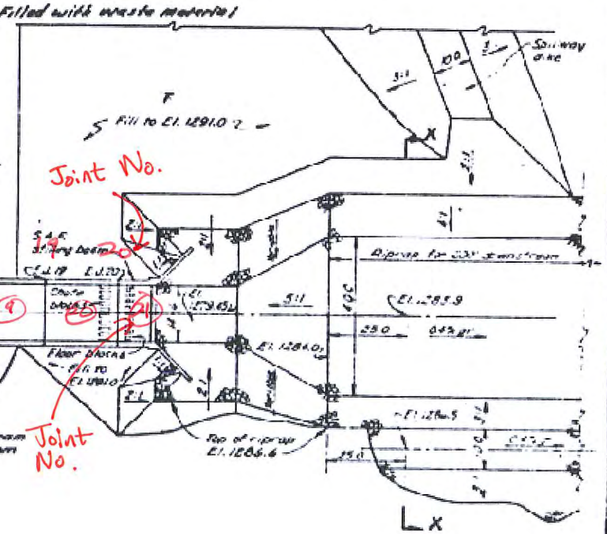
CROSS SECTION OF DAM ALONG ℄ OF PRINCIPAL SPILLWAY
STA. 19+66.4
Scale: 1" = 20'

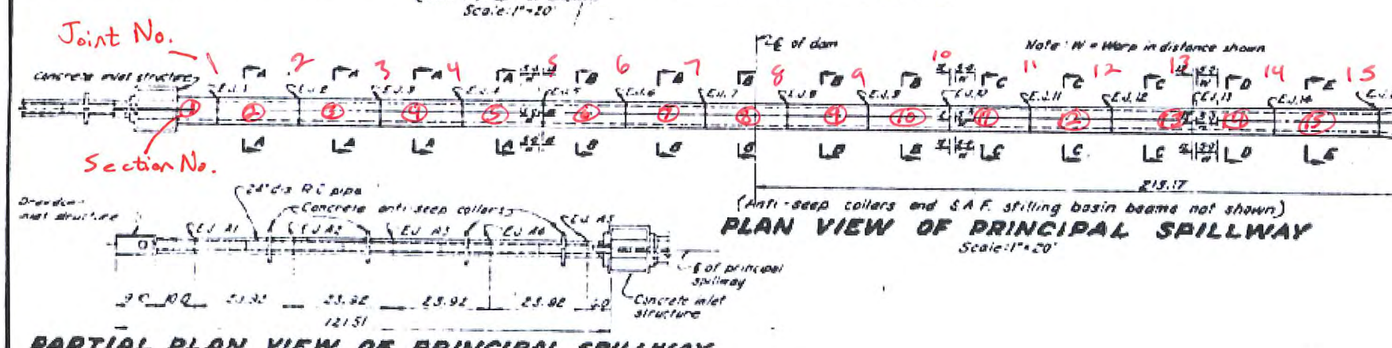


PARTIAL CROSS SECTION OF DAM ALONG ℄ OF PRINCIPAL SPILLWAY
(Rock riprap not shown)
Scale: 1" = 20'



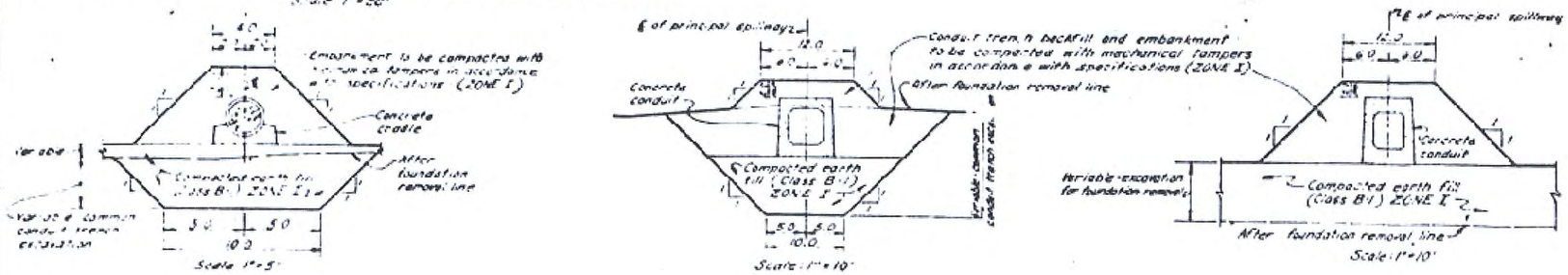
SECTION X-X
CROSS SECTION OF PRINCIPAL SPILLWAY OUTLET CHANNEL
Scale: 1" = 10'





PLAN VIEW OF PRINCIPAL SPILLWAY
Scale: 1" = 20'

PARTIAL PLAN VIEW OF PRINCIPAL SPILLWAY
Scale: 1" = 20'



DIAGRAMS OF CONDUIT TRENCH - EXCAVATION, BACKFILL AND EMBANKMENT

"As Built"

FLOOD RETARDING-FISH AND WILDLIFE DAM No. 1
MIDDLE-SOUTH BRANCH FOREST RIVER WATERSHED
Walsh County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed JMM, CEM Date
Drawn
Approved by
Title
Title

N.D.S.P. PHASE I INSPECTION REPORT PLATE C-15

INSPECTION REPORT CHECKLIST

DRAFT

U.S. Department of Agriculture
Natural Resources Conservation Service

WATERSHED STRUCTURE INSPECTION REPORT

Date of Inspection Aug 29 and Oct 9, 2019 Common Name Matejcek Dam

County Walsh Watershed Forest River Site Dam #1

Field Office Sponsor

Legal Description, Sec 23 T 155N R 57W

"Yes" responses need explanation added to "Remarks" section. (i.e.: What? Where? Extent?)
"No" responses indicate problems not observed during inspection.
Views ("left" and "right") are as if looking downstream.

ITEM	YES	NO	REMARKS
1. General Conditions			
a. Alterations to dam?		X	
b. Development in downstream floodplain?		X	See additional remarks 1.b.
c. Development around reservoir?		X	
2. Embankment			
a. Is vegetative cover inadequate?		X	
b. Are trees growing on either slope?	X		See additional remarks 2.b.
c. Is brush/weed control needed?	X		See additional remarks 2.b.
d. Are trees growing at waterline?	X		See additional remarks 2.b.
e. Is drift debris present?		X	
f. Are cracks, settlement, or bulges present?		X	
g. Are animal burrows present?		X	
h. Are trails present?	X		Vehicle tracks on downstream bench.
3. Front Slope Protection			
a. Any wave damage observed?		X	
b. Is riprap inadequate?		X	
c. Are rodent holes present?		X	
4. Inlet Structure and Gate Valves			
a. Does concrete exhibit deterioration?		X	
b. Is concrete reinforcement exposed?		X	
c. Was leakage observed inside inlet?		X	
d. Any corrosion of metal appurtenances?	X		Minor corrosion present on trash racks.
e. Is debris guard obstructed?		X	
f. Is debris guard corroded?	X		Minor corrosion present on trash racks.
g. Is gate stem broken or bent?	X		Draw down gate stem is inoperable.
h. Are components missing?		X	
i. Was gate determined not operational?	X		Gate last opened 40+ years ago.
j. Has inlet been modified to alter water surface?		X	
5. Principal Spillway Conduit			
a. Is concrete conduit deteriorated?			Conduit inspection not performed. See additional remarks 5.a.
b. Is metal conduit corroded?			N/A
c. Was leakage observed at pipe joints?			Conduit inspection not performed. See additional remarks 5.c.
6. Auxiliary Spillway			
a. Is vegetative cover inadequate?		X	
b. Any animal trails observed?		X	
c. Any vehicular trails observed?		X	
d. Is flow area obstructed?	X		See additional remarks 6.d.
e. Is control section disturbed?		X	

7. Principal Spillway Release Channel			
a. Does scour hole appear unstable?			N/A – SAF Stilling Basin.
b. Any boils observed?			N/A – SAF Stilling Basin.
c. Is riprap inadequate?		X	
d. Any seepage observed?		X	
e. Is conduit outlet submerged?		X	Conduit discharges into SAF Stilling Basin.
f. Is conduit outlet not properly supported?		X	
g. Is outlet channel obstructed?		X	
h. Is outlet channel degrading?	X		See additional remarks 7.h.
i. Is foundation drain submerged?		X	See additional remarks 7.i.
j. Is foundation drain rodent barrier missing?		X	
k. Is foundation drain not functional?		X	See additional remarks 7.i.
8. Access Road and Parking Areas			
a. Is surface erosion present?	X		Some erosion of beach and parking area noted.
b. Is gravel surfacing inadequate?		X	
9. Boat Ramp			
a. Is sedimentation/erosion present?		X	
b. Is concrete slab deteriorated?		X	
10. Swimming Beaches			
a. Any wave damage observed?		X	
b. Is sidewalk/perimeter concrete deteriorated?	N/A	N/A	
11. Easements/Landrights			
a. Are terms of landrights out of compliance?		X	
b. Are landrights boundaries being encroached upon?		X	

Additional Remarks (includes reference to above section, if applicable):

1.b No major development occurred in the downstream floodplain. Some additional agricultural buildings appear to have been built in the floodplain since the dam was constructed.

2.b Scattered small trees along waterline. Small willows near lower, left end of upstream embankment. Small trees encroaching right end of upstream embankment. Two small trees growing at headwall of SAF stilling basin.

5.a. Joint separation, concrete spalling, and hairline cracking observed in walls of concrete spillway. Description of observations located in Table 7-1 of the Matejcek Dam Existing Conditions Assessment Report.

5.c. Conduit joint inspection not performed due to water flow. Stilling basin joints inspected. Joint 20 – 2” joint separation and failed waterstop observed. Evident migration of sediment through joint. See Table 7-1 of the Matejcek Dam Existing Conditions Assessment Report for additional joint information.

6.d. Seventeen large, round hay bales scattered upstream of the axillary spillway control section.

7.h. Chute, floor baffle blocks, and end sill of the SAF stilling basin were submerged and not observed. Chute, baffle blocks, and end sill have been reported to be completely deteriorated to the point that only the rebar remains.

7.i. Foundation drain (6” asbestos cement, non-perforated pipe) outlet located in SAF stilling basin wall was dry and appeared to have vegetative growth behind animal guard. 12” steel pipe observed next to end of SE wingwall of SAF stilling basin. Animal guard intact. Approximately 1 gpm discharge observed. All other auxiliary drain outlets downstream were not able to be located and are completely covered with vegetation.

Sponsor Representative

NRCS Representative

SITE INSPECTION PHOTOS

DRAFT

GENERAL



1. PRINCIPLE SPILLWAY RISER STRUCTURE



2. PRINCIPLE SPILLWAY RISER STRUCTURE OVERVIEW

GENERAL



3. PRINCIPLE SPILLWAY CONDUIT AND SAF STILLING BASIN

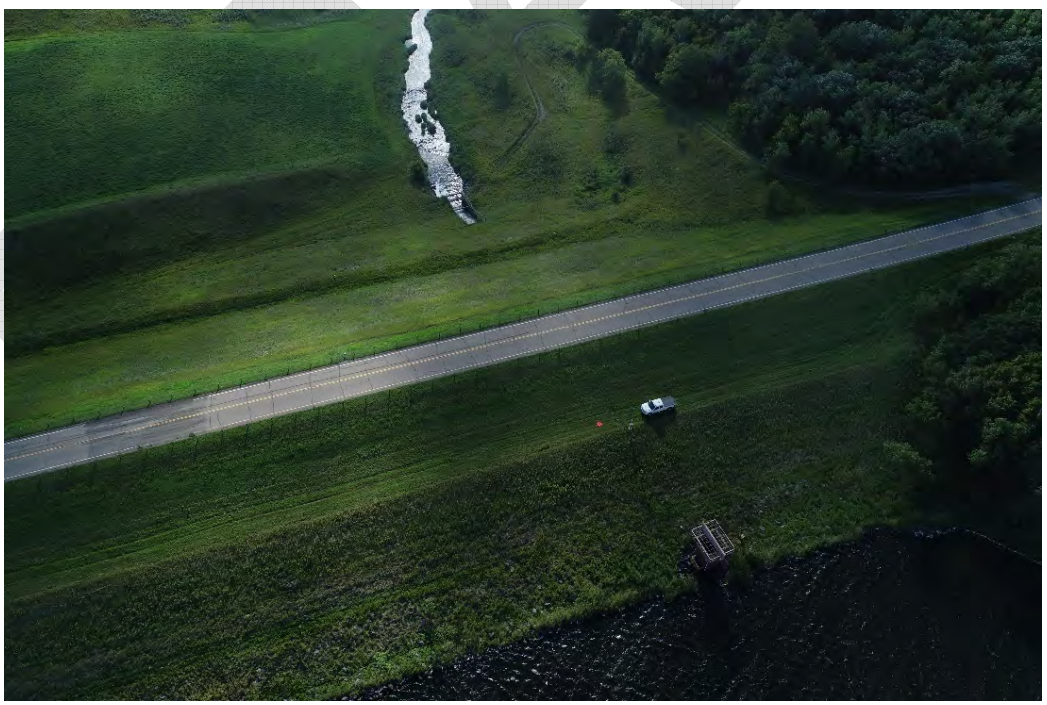


4. SAF STILLING BASIN (DOWNSTREAM)

GENERAL



5. AUXILIARY SPILLWAY



6. PRINCIPAL RISER/SPILLWAY OVERVIEW

GENERAL



7. UPSTREAM SLOPE OF EMBANKMENT



8. DOWNSTREAM SLOPE OF EMBANKMENT

GENERAL



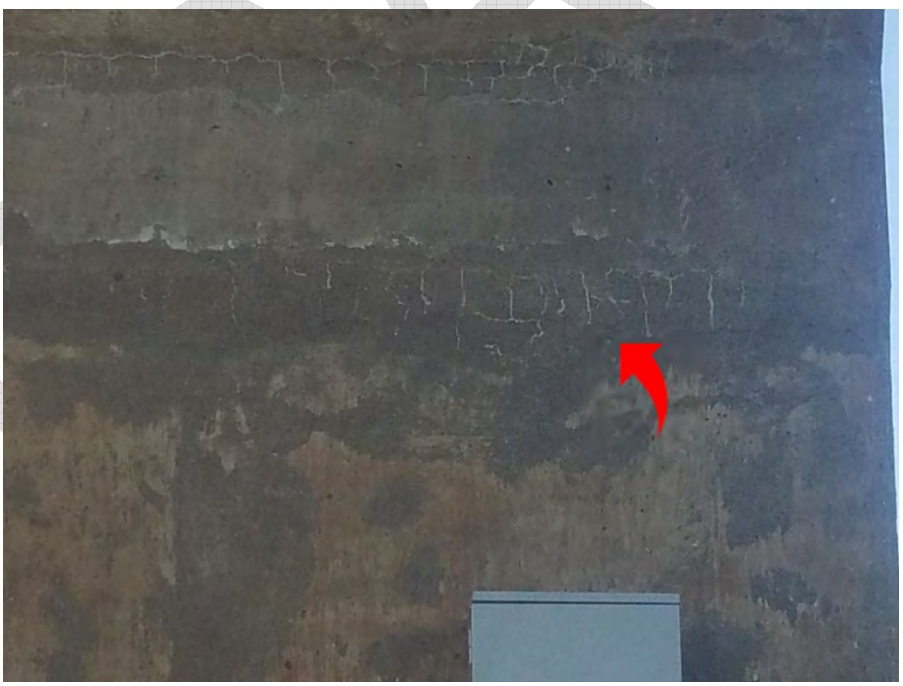
9. BOAT RAMP, BEACH, AND PARKING AREA

DRAFT

OBSERVED DEFICIENCIES



10. PRINCIPAL RISER HAIRLINE CRACK LOCATIONS



11. PRINCIPAL RISER HAIRLINE CRACKS

OBSERVED DEFICIENCIES



12. PRINCIPAL RISER TRASH RACK CORROSION



13. INOPERABLE DRAWDOWN GATE OPERATOR

OBSERVED DEFICIENCIES



14. SAF STILLING BASIN SE WINGWALL – BACKFILL EROSION



15. SAF STILLING BASIN NE WINGWALL – BACKFILL EROSION

OBSERVED DEFICIENCIES



16. SAF STILLING BASIN – JOINT 20 (SPALLED CONCRETE & FAILED WATERSTOP)



17. SAF STILLING BASIN – JOINT 20 (2" SEPERATION)

OBSERVED DEFICIENCIES



18. SAF STILLING BASIN – JOINT 20 (VOID IN BACKFILL MATERIAL)



19. SAF STILLING BASIN – JOINT 20 (VOID IN BACKFILL MATERIAL)

OBSERVED DEFICIENCIES



20. SAF STILLING BASIN – JOINT 19 NORTH (1 ¾" SEPERATION)



21. SAF STILLING BASIN – JOINT 19 SOUTH (SPALLED CONCRETE)

OBSERVED DEFICIENCIES



22. SAF STILLING BASIN – SECTION 19 NORTH (DAMAGED CORBEL)

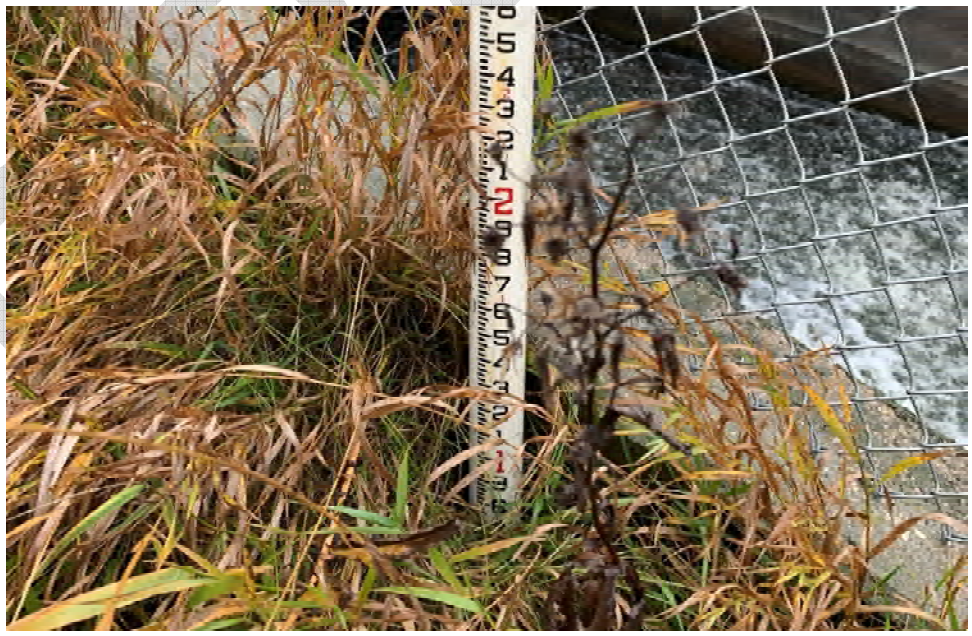


23. SAF STILLING BASIN – SECTION 20 NORTH (HAIRLINE CRACKING)

OBSERVED DEFICIENCIES



24. SAF STILLING BASIN – SECTION 19 NORTH (HAIRLINE CRACKING)



25. SAF STILLING BASIN – SECTION 19 SOUTH (VOID IN BACKFILL MATERIAL)

OBSERVED DEFICIENCIES



26. SAF STILLING BASIN – JOINT 18 NORTH (SPALLED CONCRETE)



27. SAF STILLING BASIN – JOINT 17 NORTH (SPALLED CONCRETE & EXPOSED JOINT FILLER MATERIAL)

OBSERVED DEFICIENCIES



28. SAF STILLING BASIN – JOINT 17 SOUTH (SPALLED CONCRETE)



29. SAF STILLING BASIN – SECTION 19/18 SOUTH (DRAIN OUTLET