USDA

United States Department of Agriculture

Heavy Use Area Protection - 561

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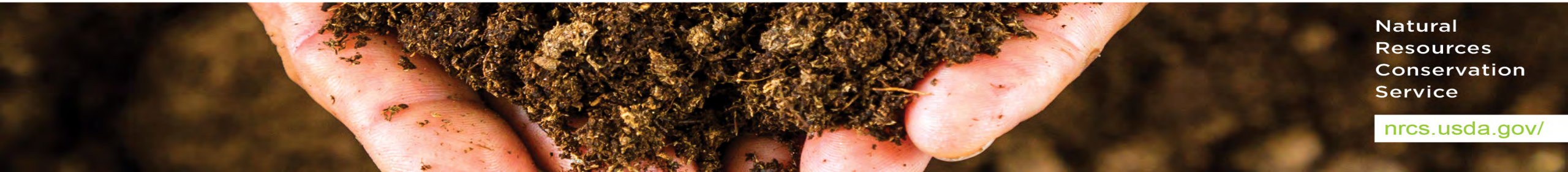

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Definition

Heavy use area protection is used to stabilize a ground surface that is frequently and intensively used by people, animals, or vehicles.

Figure 1: Farm road highly eroded. Jayuya, PR

Purpose

This practice is used to accomplish one or more of the following purposes:

- To provide a stable, noneroding surface for areas frequently used by animals, people, or vehicles.
- To protect or improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where a frequently or intensively used area requires treatment to address one or more resource concerns.

Figure 2: Steep farm road highly eroded. Jayuya,PR

Areas frequently used by animals

Around barns or agricultural building accesses having erosion and/or water contamination concerns

Figure 3: Poor drainage, erosion, water quality issues and poor animal health. USDA site.

Figure 4: HUAP implemented. USDA site.

Feeding areas frequently used by animals

Figure 5: HUAP, concrete, inside a feeding area. Hatillo, PR.

Figure 6: Soft soils on animal feeding area, online resource.

Areas frequently use by people or vehicles

In this case a farmer has a culvert, and the inlet is clogged with big rocks that are coming down with the water flow and is eroding the farm road. Heavy Use Area Protection (HUAP) is recommended. Concrete.

Figure 7: HUAP, concrete recommended. Jayuya, PR.

Areas frequently used by people or vehicles.

Low spot on the farm road.

HUAP is recommended.

Very important to change the grades to be sure it drains properly before installing the HUAP.

Figure 8: HUAP, concrete or crusher run aggregate (mogolla)w/ geotextile recommended. Jayuya, PR.

Criteria: Foundation

- Evaluate the site foundation to ensure that the presumptive bearing capacity of the soil meets the intended design load and frequency of use. Where necessary, prepare the foundation by removal and disposal of materials that are not adequate to support the design loads.
- Use a base course of gravel, crushed stone, other suitable material, geotextile, or a combination of materials on all sites that need increased load-bearing strength, drainage, separation of material, and soil reinforcement.
- Refer to NRCS Technical Note (Title 210), Design Engineering, Design Note 24, "Guide for the Use of Geotextiles," or other State-approved reference for geotextile.

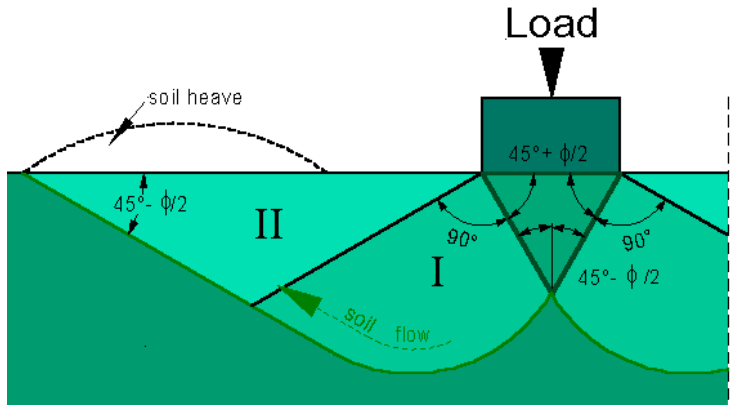

Figure 9: Load transfer to soil

soil-flow.gif (578×317) (boeingconsult.com)

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Criteria: Surface treatment

Select a surface treatment that is stable and appropriate to the purpose of the heavy use area. Surface treatments must meet the following requirements according to the material used.

- **Concrete**
- **Aggregates**
  - Aggregate Design. Aggregate surfaces for expected wear and intended use. In lieu of a site-specific design for areas that will be subject to light nonvehicular use, install a minimum combined thickness for aggregate surfacing and base course of 6 inches for livestock and 4 inches for other applications.
  - Geotextiles

SOIL TYPE	DENSITY OF STATE	Tons/ft (s)	PSF	PSI
Rock (not shale unless hard)	Bedrock	60	120,000	833
	Layers	15	30,000	208
	Soft	8	16,000	111
Hardpan, cemented sand or gravel		10	20,000	139
Gravel or sand	Compact	8	16,000	111
	Firm	6	12,000	83
	Loose	4	8,000	56
Sand, coarse to medium	Compact	6	12,000	83
	Firm	4.5	9,000	63
	Loose	3	6,000	42
Sand, fine, silty, or with trace of clay	Compact	4	8,000	56
	Firm	3	6,000	42
	Loose	2	4,000	28
Silt	Compact	3	6,000	42
	Firm	2.5	5,000	35
	Loose	2	4,000	28
Clay	Compact	4	8,000	56
	Firm	2.5	5,000	35
	Loose	1	2,000	14

SoilBearingCapacity.png (1706×1259) (dicausa.com)

Figure 10: Soil bearing strengths

What is a geotextile?

Geotextile is a synthetic permeable textile material used to improve the soil characteristics. It has the ability to separate, filter, reinforce, protect and drain when used in association with soils.

Geotextiles are made up of polymers such as polyester or polypropylene.

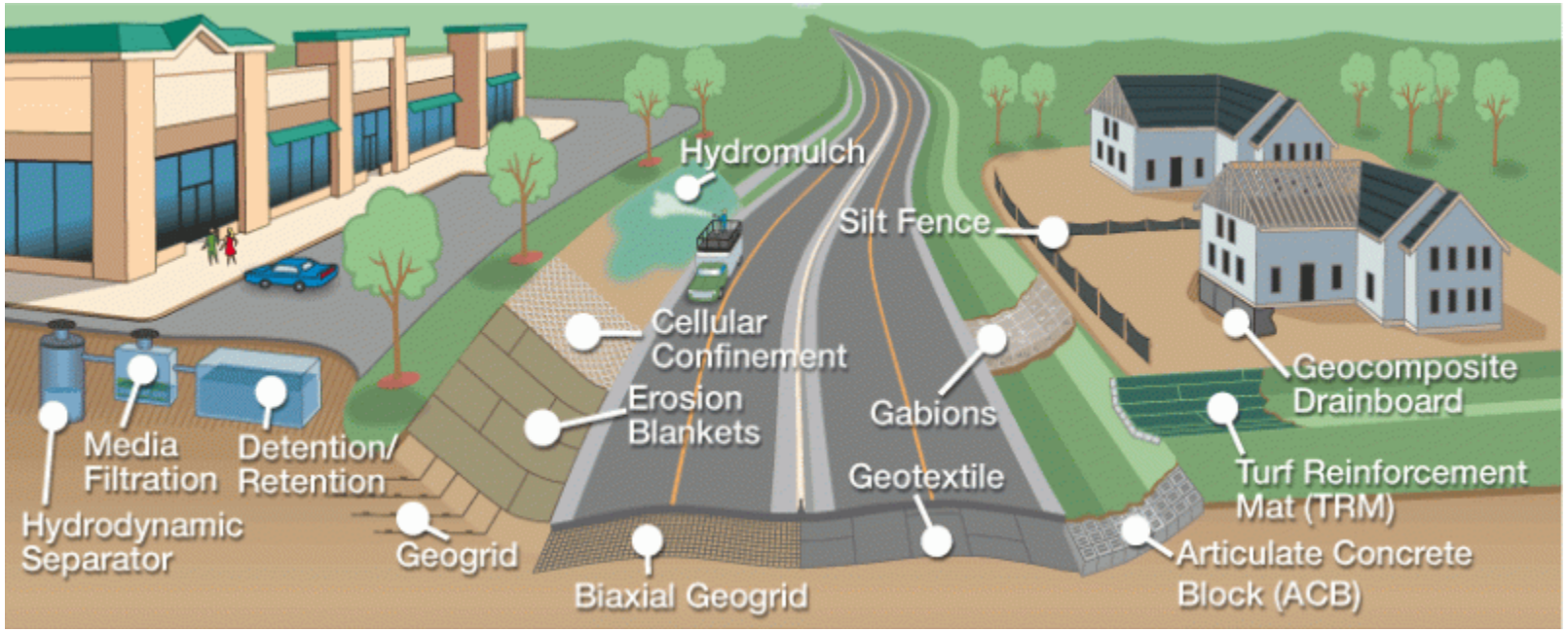


Figure 11: Geotextile uses

https://theconstructor.org/building/geotextiles-types-functions-uses/1163/#:~:text=Geotextiles%20are%20made%20up%20of%20polymers%20such%20as,%3A%201%29%20Woven%20Fabric%20Geotextiles%202%29%20Non-Woven%20Geotextiles

Geotextile Functions

6 main functions:

1. **Separation**

The separation function of geotextile is primarily used in road construction. Geotextile prevents the intermixing of two adjacent soils. For example, by separating fine subgrade soil from the aggregates of the base course, the geotextile preserves the drainage and the strength characteristics of the aggregate material.

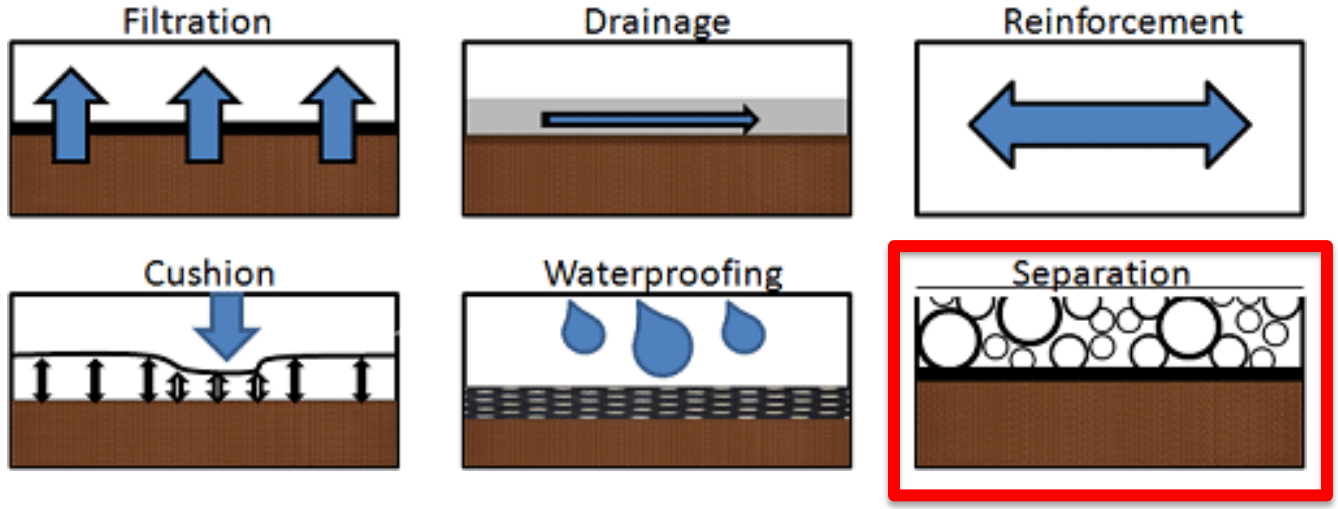


Figure 11: Geotextile functions

https://theconstructor.org/building/geotextiles-types-functions-uses

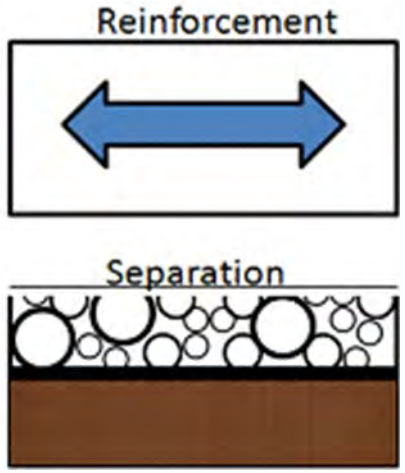
Geotextiles

- Woven
- Non woven

Geotextiles

Woven

- Similar to weaving usual clothing textiles. This type has the characteristic appearance of two sets of parallel threads or yarns.
- separating dissimilar soils;
- reinforced soil structures



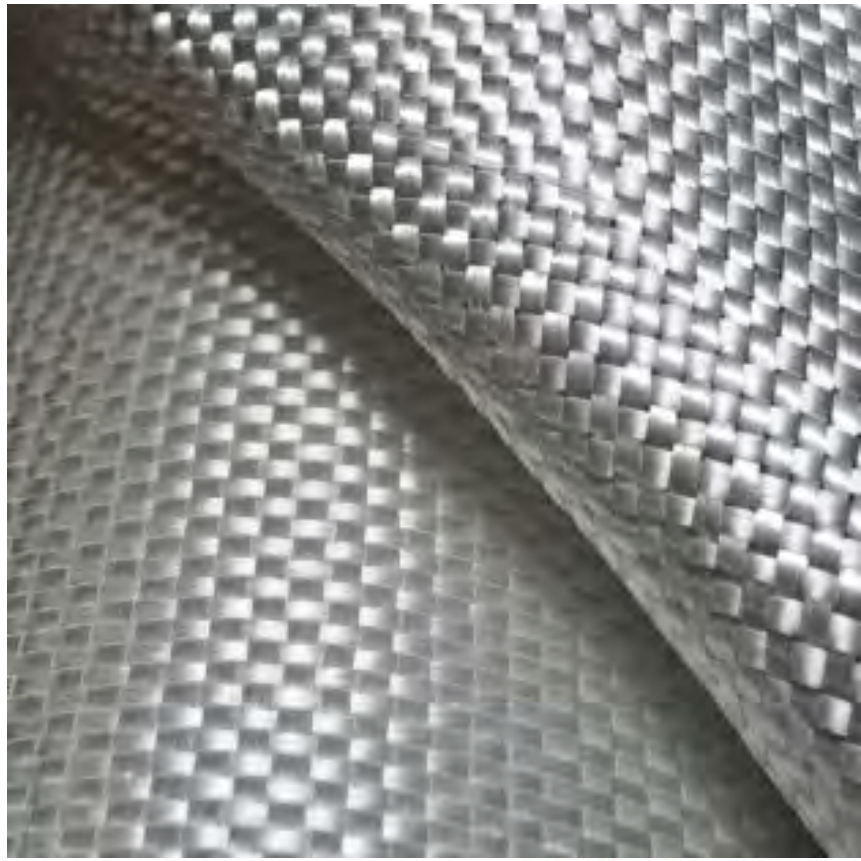


Figure 12:
Geotextile Woven

https://theconstructor.org/building/geotextiles-types-functions-uses

Non-woven Geotextile

Non-woven geotextiles are manufactured from either continuous filament yarn or short staple fiber. Fibers are not aligned; they are in all directions. The bonding of fibers is done using thermal, chemical or mechanical techniques or a combination of techniques.

Main Functions:

- filtration and
- separation

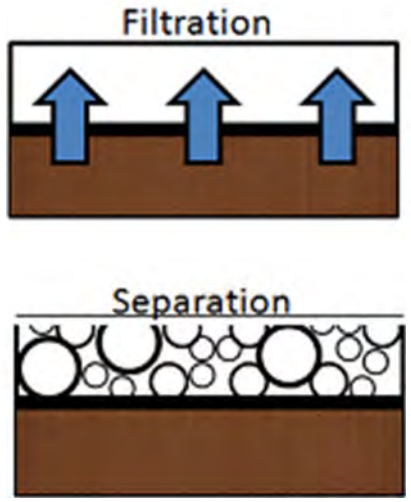


Figure 12: Non – Woven Geotextile

https://theconstructor.org/building/geotextiles-types-functions-uses

Selection of Geotextile specifications

TABLE 1 - REQUIREMENTS FOR WOVEN GEOTEXTILES BY USE

Property	Test Method	Slope Protection Unprotected Class I and Protected Class II	Road Stabilization Class IV
Tensile Strength - Lbs 1/	ASTM D 4632	250 min.	200 min.
Bursting Strength - psi 1/	ASTM D 3786	450 min.	450 min.
Elongation - % 1/	ASTM D 4632	35 max.	35 max.
Puncture - lbs. 1/	ASTM D 4833	100 min.	100 min.
Ultraviolet Light Resistance - % 1/	ASTM D 4355 150 hrs. exposure	70% min. tensile strength retained	70% min. tensile strength retained
Apparent Opening Size (AOS) - mm	ASTM D 4751	Less than or equal to 0.212 (#70) 2/	Less than or equal to 0.600 (#30) 2/
Percent Open Area	CORPS AD-745-085 3/	4.0% min.	1.0% min.

1/ Minimum roll value (weakest principal direction): average minus two standard deviations (only 2 ½ percent will be lower).
2/ U.S. standard sieve size.
3/ Test methods prepared by U.S. Army Corps of Engineers.

TABLE 2 - REQUIREMENTS FOR NONWOVEN GEOTEXTILES BY USE

Property	Test Method	Slope Protection		Subsurface Drainage Class III	Road Stabilization Class IV	Stream Crossing & Surface Water Livestock Access Watering Facility
		Unprotected Class I	Protected/Bedding Class II			
Tensile Strength - lbs 1/	ASTM D 4632	200 min.	100 min.	100 min.	150 min.	250 min.
Bursting Strength - psi 1/	ASTM D 3786	350 min.	210 min.	210 min.	300 min.	450 min.
Elongation - % 1/	ASTM D 4632	100 max.	100 max.	100 max.	100 max.	50 max.
Puncture - lbs. 1/	ASTM D 4833	90 min.	50 min.	50 min.	80 min.	100 min.
Ultraviolet Light Resistance - % 1/	ASTM D 4355 150 hrs. exposure	70% min. tensile strength retained	70% min. tensile strength retained	70% min. tensile strength retained	70% min. tensile strength retained	70% min. tensile strength retained
Apparent Opening Size (AOS) - mm	ASTM D 4751	Less than or equal to 0.212 (70#) 2/	Less than or equal to 0.212 (70#) 2/	Less than or equal to 0.212 (70#) 2/	Less than or equal to 0.212 (70#) 2/	Less than or equal to 0.212 (#70) 2/
Permittivity - sec.-1 1/	ASTM D 4491	0.70	0.70	0.70	0.70	0.70

1/ Minimum roll value (weakest principal direction): average minus two standard deviations (only 2 ½ percent will be lower).
2/ U.S. standard sieve size.

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_024324.pdf

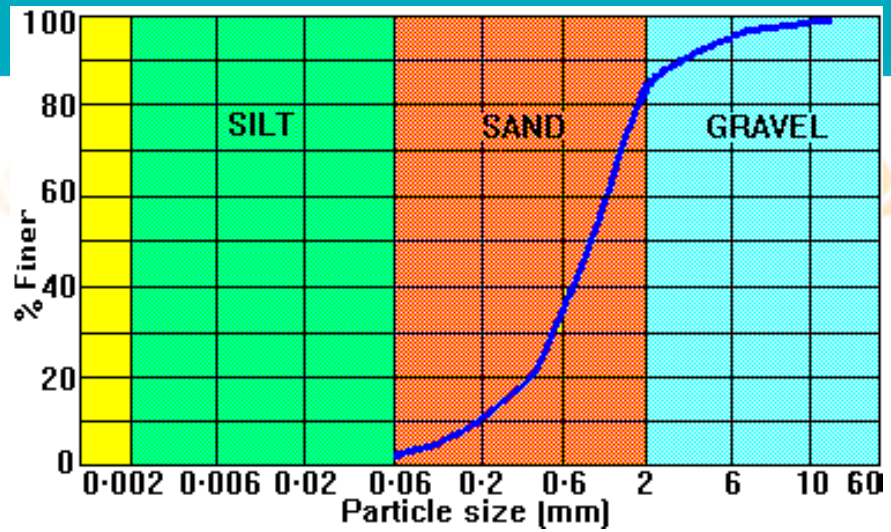
NRCS-MI-165-5
(10-08)

Soil Gradation

Soil gradation is a classification of a coarse-grained soil that ranks the soil based on the different particle sizes contained in the soil.
Soil gradation is an important aspect of soil mechanics and geotechnical engineering because it is an indicator of other engineering properties such as compressibility, shear strength, and hydraulic conductivity.

https://are-review.blogspot.com/2011/10/soil-analysis.html

Figure 13: Sieve analysis



classivg.gif (378×226) (uwe.ac.uk)

Figure 14: Soil Gradation Graph

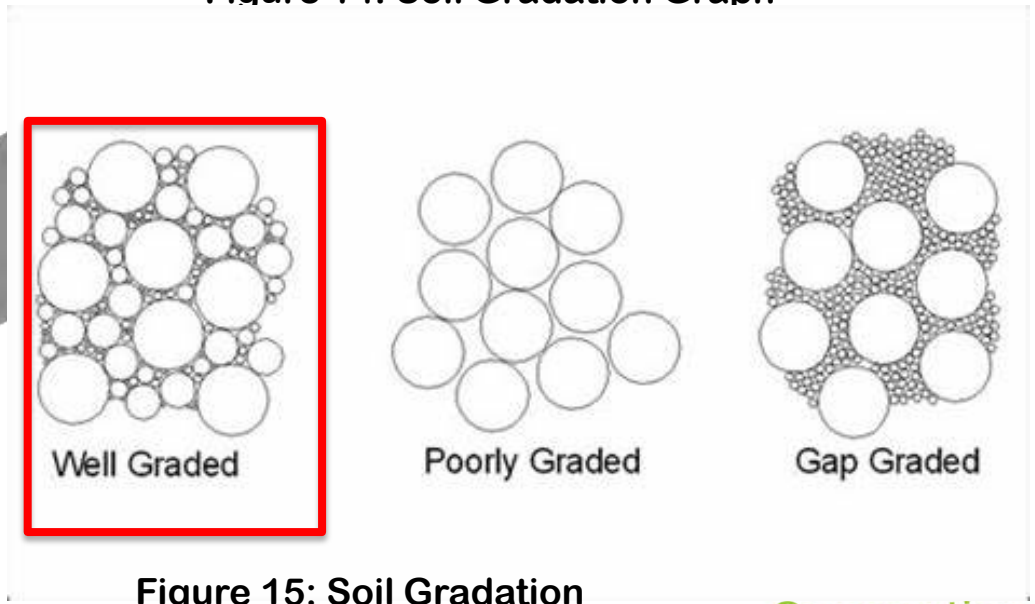


Figure 15: Soil Gradation

AASHTO Soil Classification

The **AASHTO Soil Classification System** was developed by the American Association of State Highway and Transportation Officials, and is used as a guide for the classification of soils and soil-aggregate mixtures for highway construction purposes. The classification system was first developed by Hogentogler and Terzaghi in 1929,[1] but has been revised several times since.

AASHTO Soil Classification System (from AASHTO M 145 or ASTM D3282)

General Classification	Granular Materials (35% or less passing the 0.075 mm (No. 200) sieve)							Silt-Clay Materials (>35% passing the 0.075 mm (No. 200) sieve)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis, % passing											
2.00 mm (No. 10)	50 max	…	…	…	…	…	…	…	…	…	…
0.4255 mm (No. 40)	30 max	50 max	51 min	…	…	…	…	…	…	…	…
0.0755 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid Limit	…		…	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min[1]
Usual types of significant constituent materials	stone fragments, gravel and sand		fine sand	silty or clayey gravel and sand				silty soils		clayey soils	
General rating as a subgrade	excellent to good							fair to poor			

Plasticity index of A-7-5 subgroup is equal to or less than the LL - 30. Plasticity index of A-

Figures 16 & 17: Pictures of soils. We want the one in the red box. Well graded, multiple size aggregate.

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For HUAP of gravel / aggregate

It's recommended to use:

- **Limestone base aggregate.**
  - Top material will crush and create a smooth surface for the animals.
- **A-2-4 to A-2-7 under the AASHTO Soil Classification System.**
- **6 in. minimum thickness.**
- **Use compaction,**
  - Roller preferred.
  - Or 5 passes with track or tire equipment with thickness of lifts no more than 4 inches of loose material.
- **Use Separation Geotextile.**
- **Proper drainage!!!**

Figure 18: Aggregate compacted with roller.

Proper Drainage

Farm Road/animal trail treated with HUAP.

- **Collect water with water bars**
  - Water bars minimize the erosion

Figure 19: Water bar formed with aggregate and compacted with roller.

Water Bars

Guidelines.

22 Forest Roads

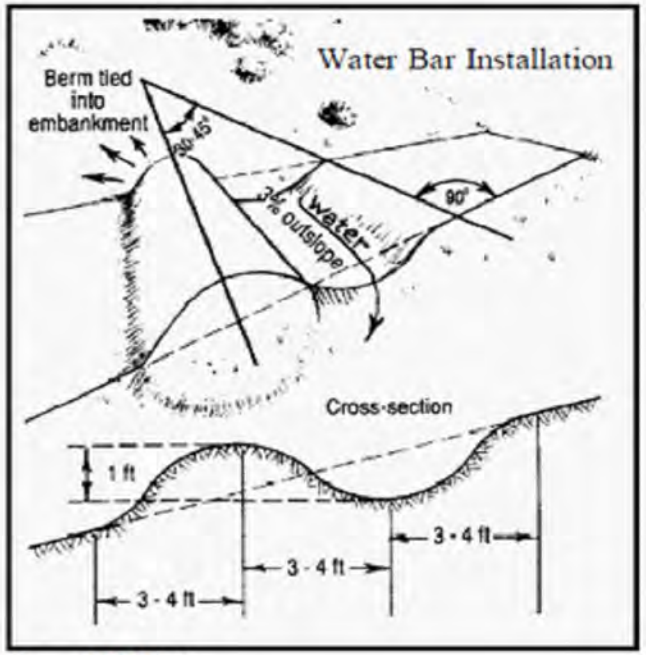

Figure ROAD-8

Table ROAD-2

Water Bar Spacing

Grade	Spacing between dips or upland culverts
2%	250 ft
5%	130 ft
10%	80 ft
15%	50 ft
25%+	40 ft

Figure 20: Water bar gidelines

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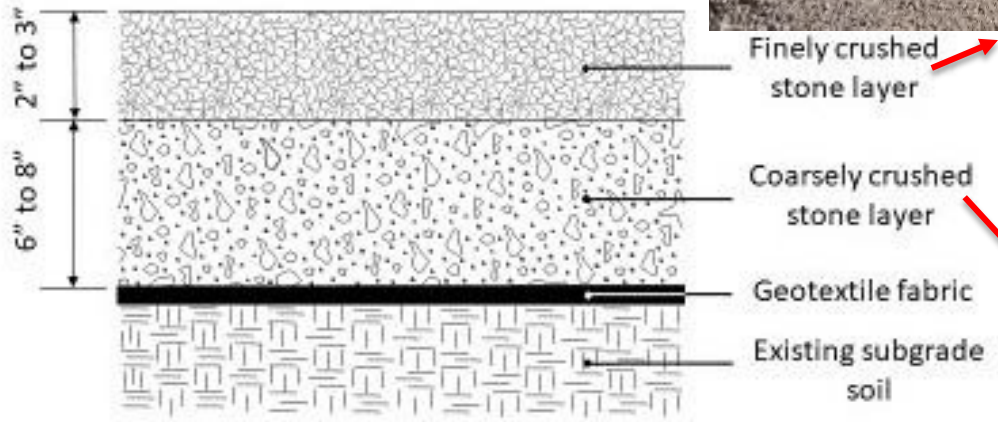
Another option: 2-layer stone

- Coarsely crushed stone layer below
- Finely crushed stone layer



HUAP with 2 layers of stone

https://extension.psu.edu/heavy-use-area-pads-for-cattle

Figure 22: Layers of stones

https://extension.psu.edu/heavy-use-area-pads-for-cattle

Figure 21: Stone over geotextile

Scenario: #3 - Rock/Gravel on Geotextile

Practice: 561 - Heavy Use Area Protection

Scenario Description:

The stabilization of areas around facilities that are frequently and intensively used by people, animals or vehicles by surfacing with rock and or gravel on a geotextile fabric foundation to provide a stable, non-eroding surface.

Figure 22: Geotextile bellow aggregate

Figures 23 & 24: Installed HUAP with geotextile and aggregate.

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Watering facility drawing

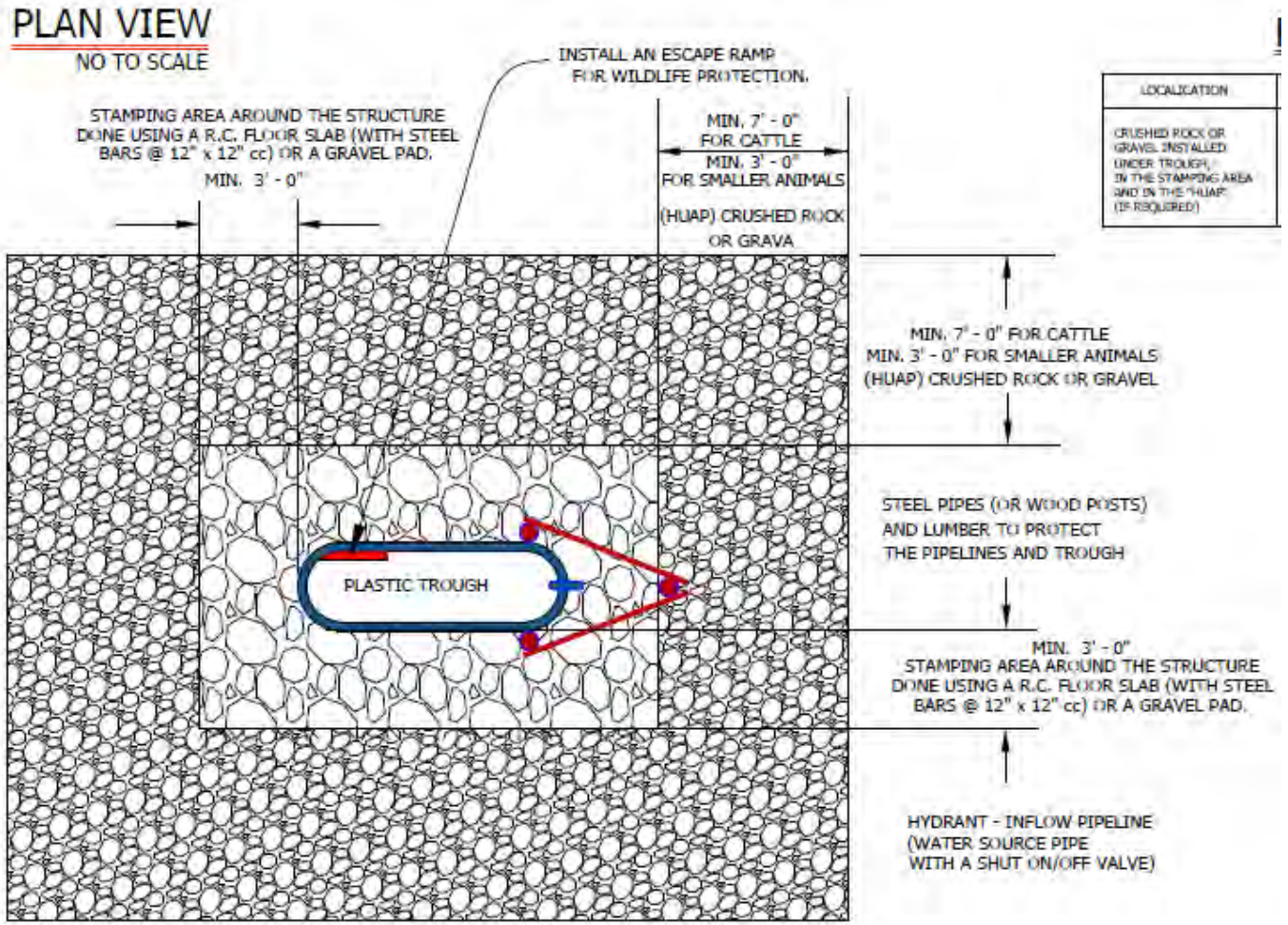


Figure 25. HUAP areas for cattle.

Watering facility drawing

From plastic trough

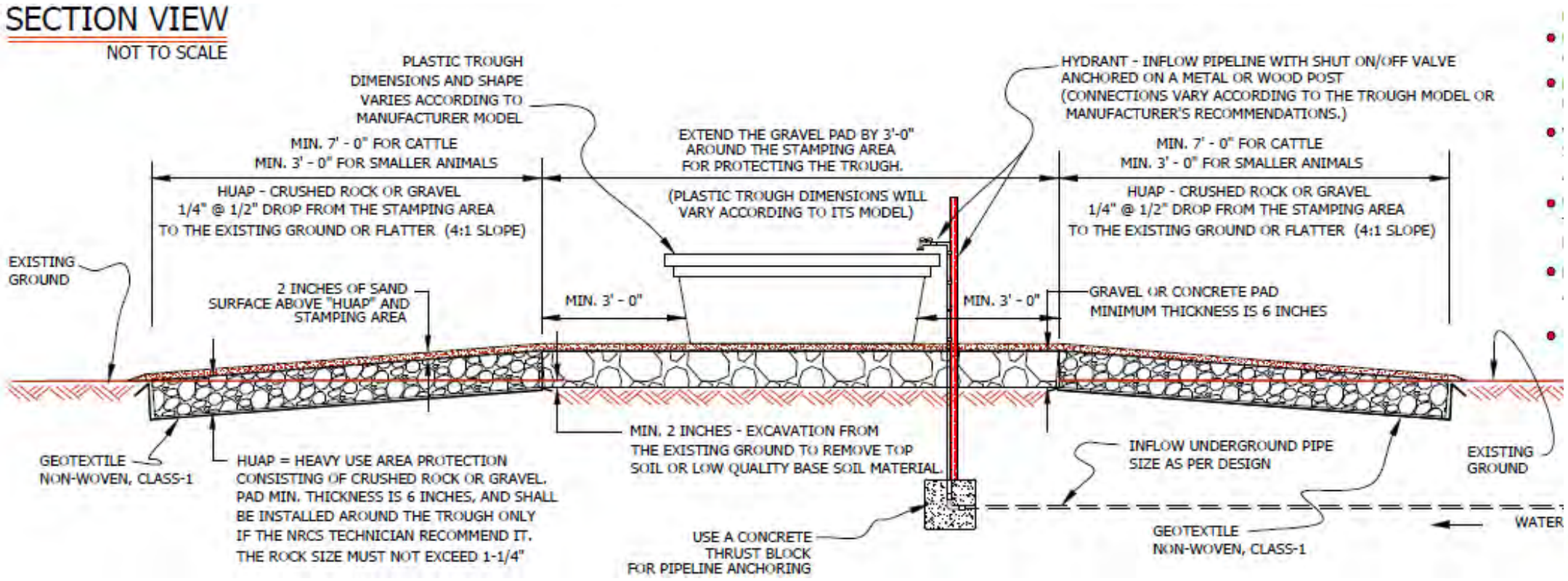


Figure 26. HUAP areas for cattle. Plastic trough standard drawing

Where to find plastic trough drawing

Go to Field Office Technical Guide

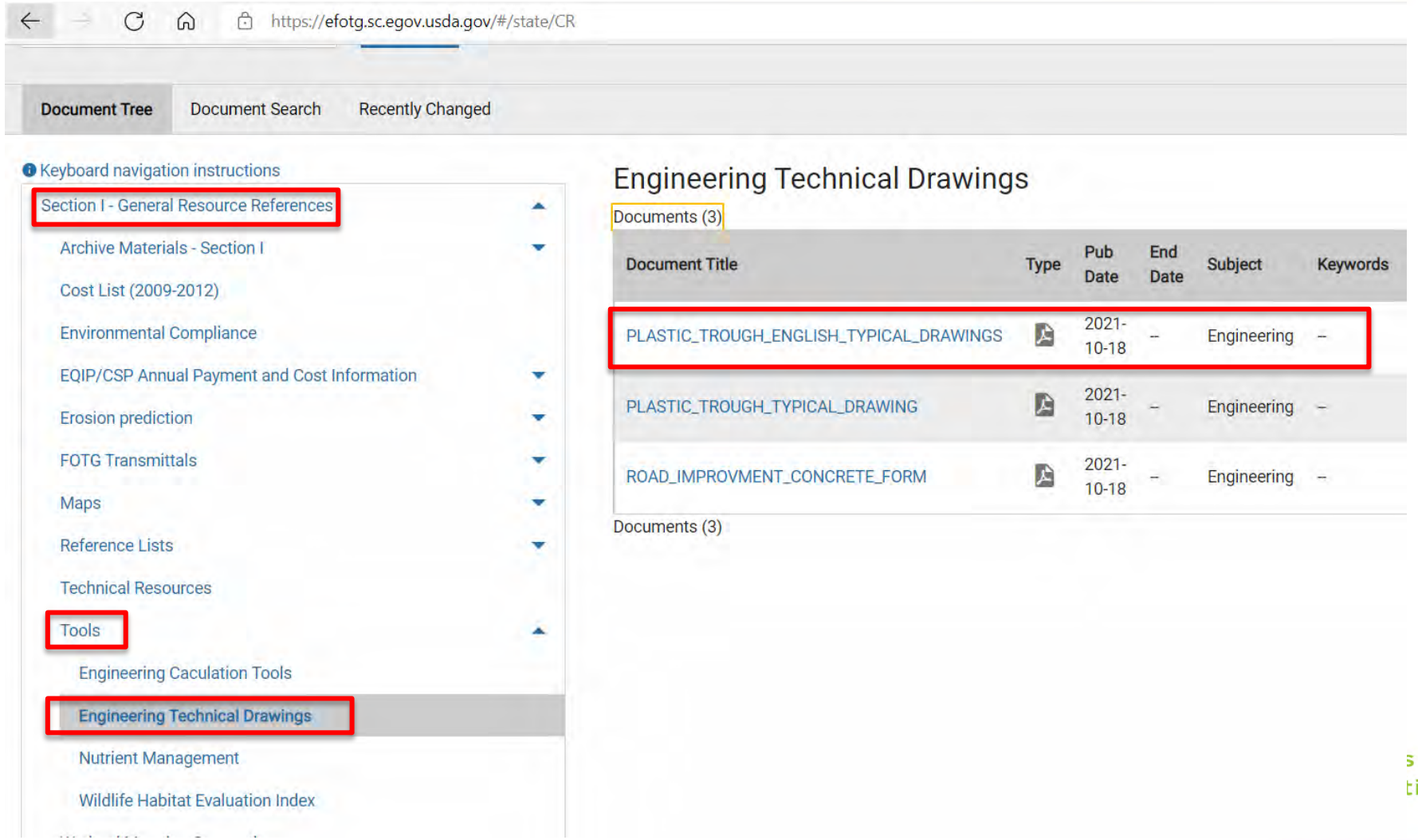


Figure 27. eFOTG

Figure 28. HUAP area for cattle. 3ft with concrete and 7ft with compacted aggregate.

Figure 29. After a few years grass will cover the aggregate but will still do its function.

Scenario: #1 - Reinforced Concrete

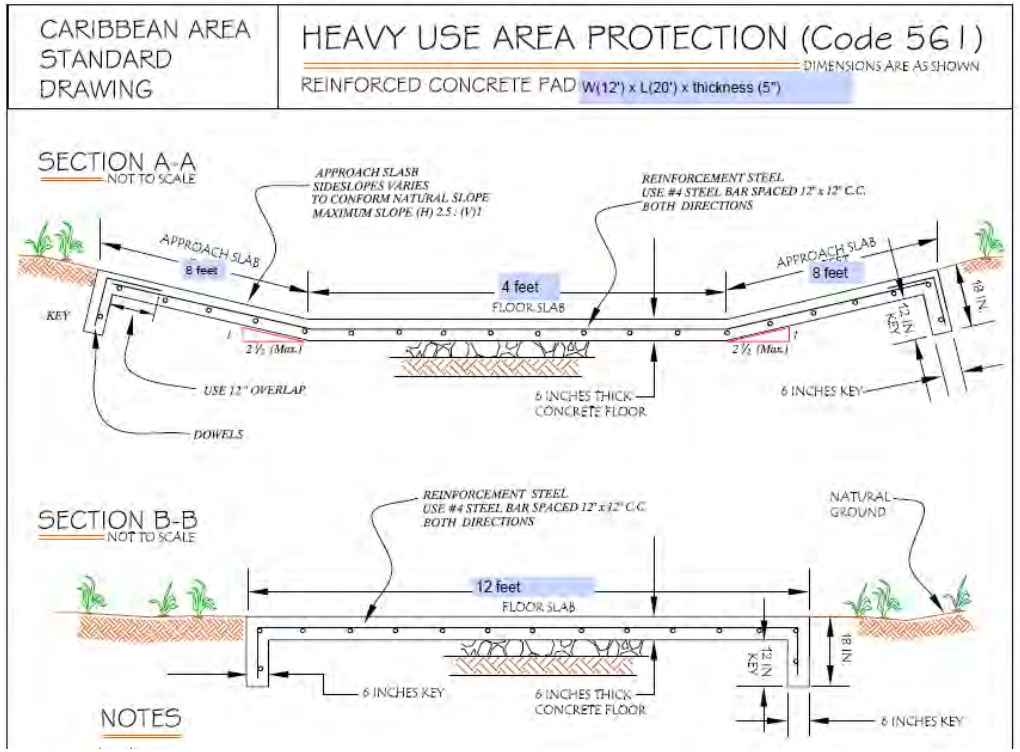
Practice: 561 - Heavy Use Area Protection

Scenario Description:

The stabilization of areas around facilities that are frequently and intensively used by people, animals or vehicles by surfacing with reinforced concrete on a sand or gravel foundation to provide a stable, non-eroding surface.

Caribbean Area Standard drawing

- **There is a 2-page standard drawing for concrete slabs.**



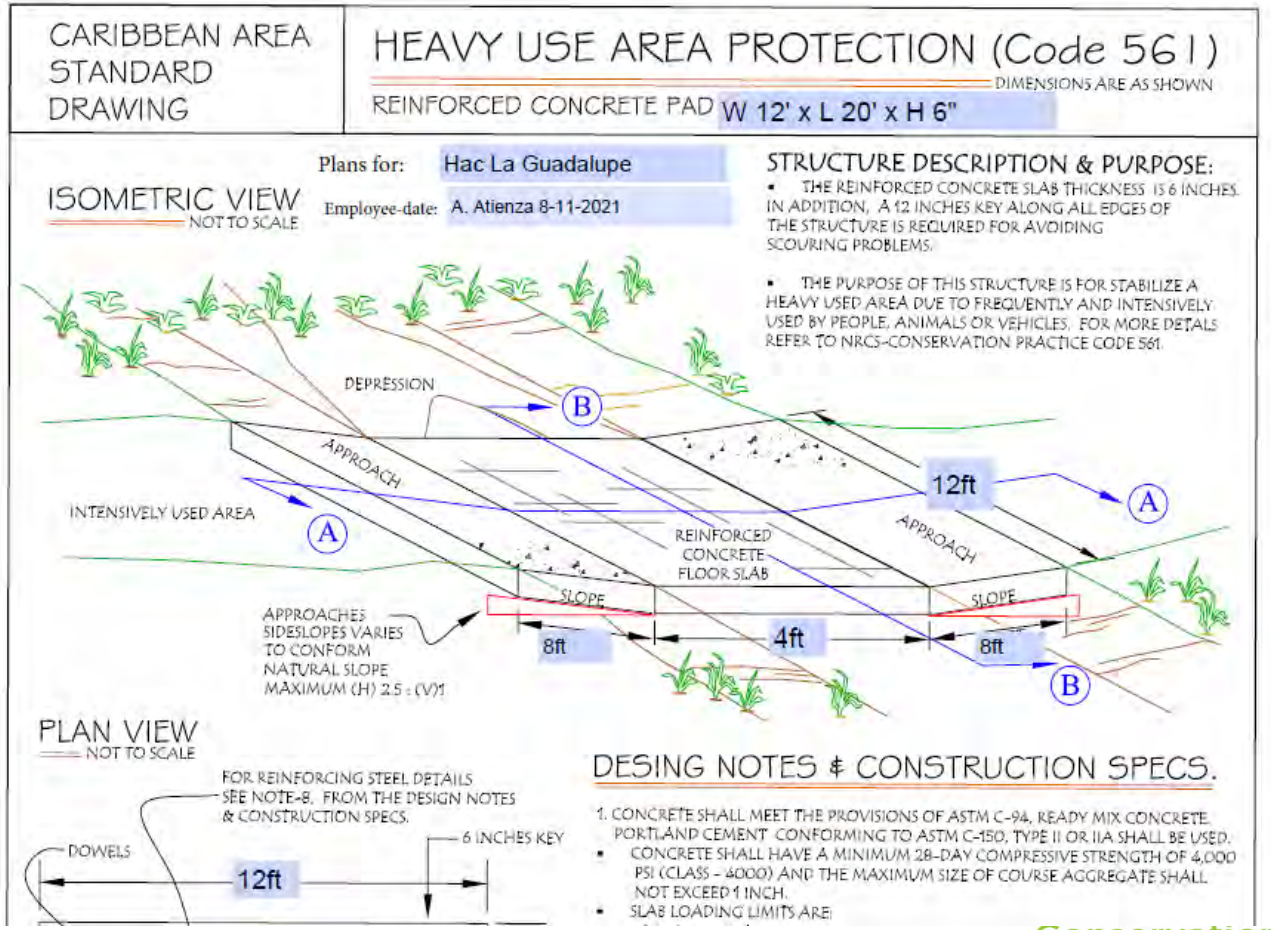


Figure 30. HUAP concrete standard drawing.

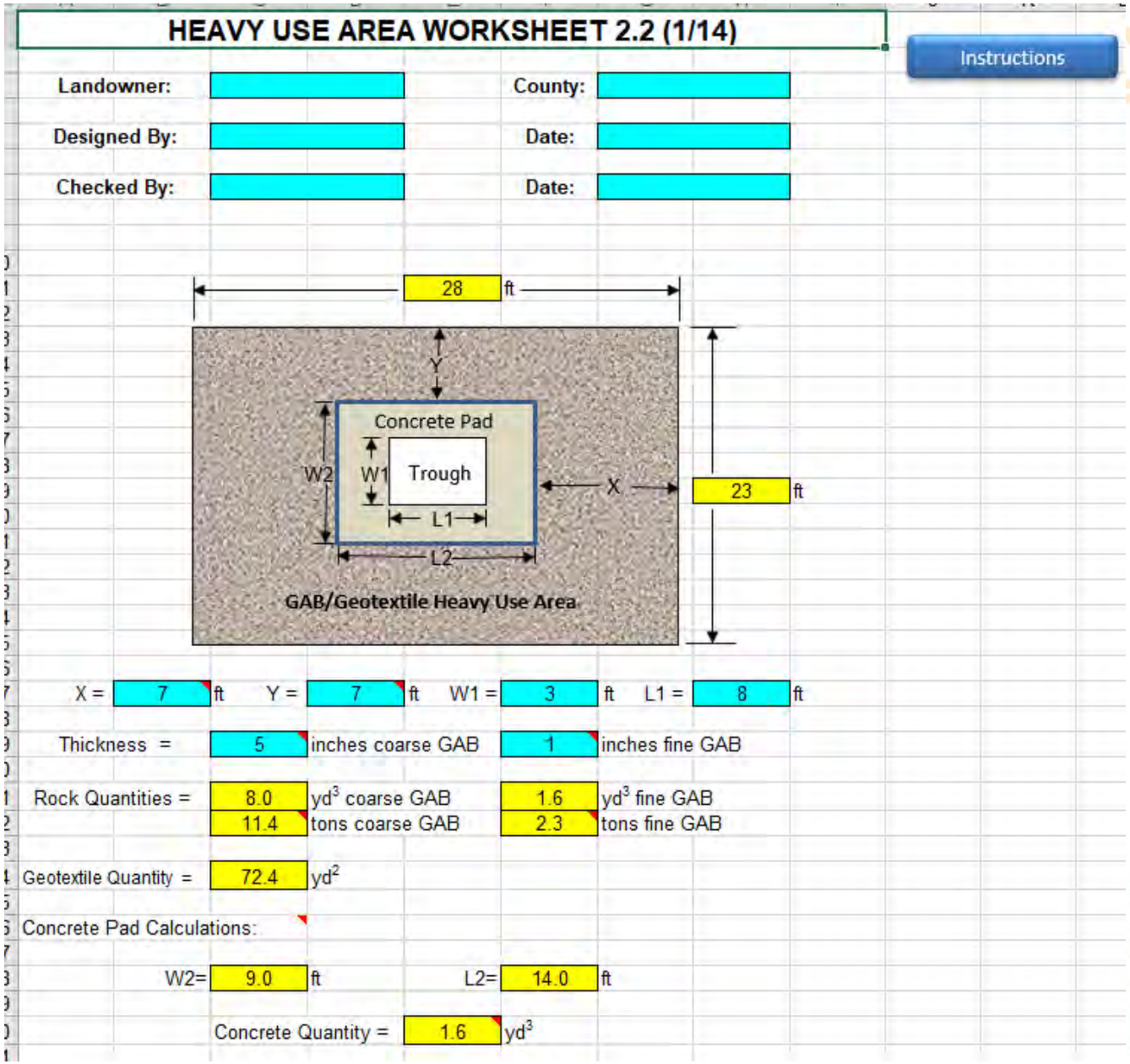
Caribbean Area Standard drawing

Let's talk about the notes on this drawing.

Calculations

Calculation Sheet

- Helps to calculate volume of rock, concrete and geotextile.
- Blue are inputs.
- Yellow are results.



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Where to find HUAP calc tool

Go to Field Office Technical Guide

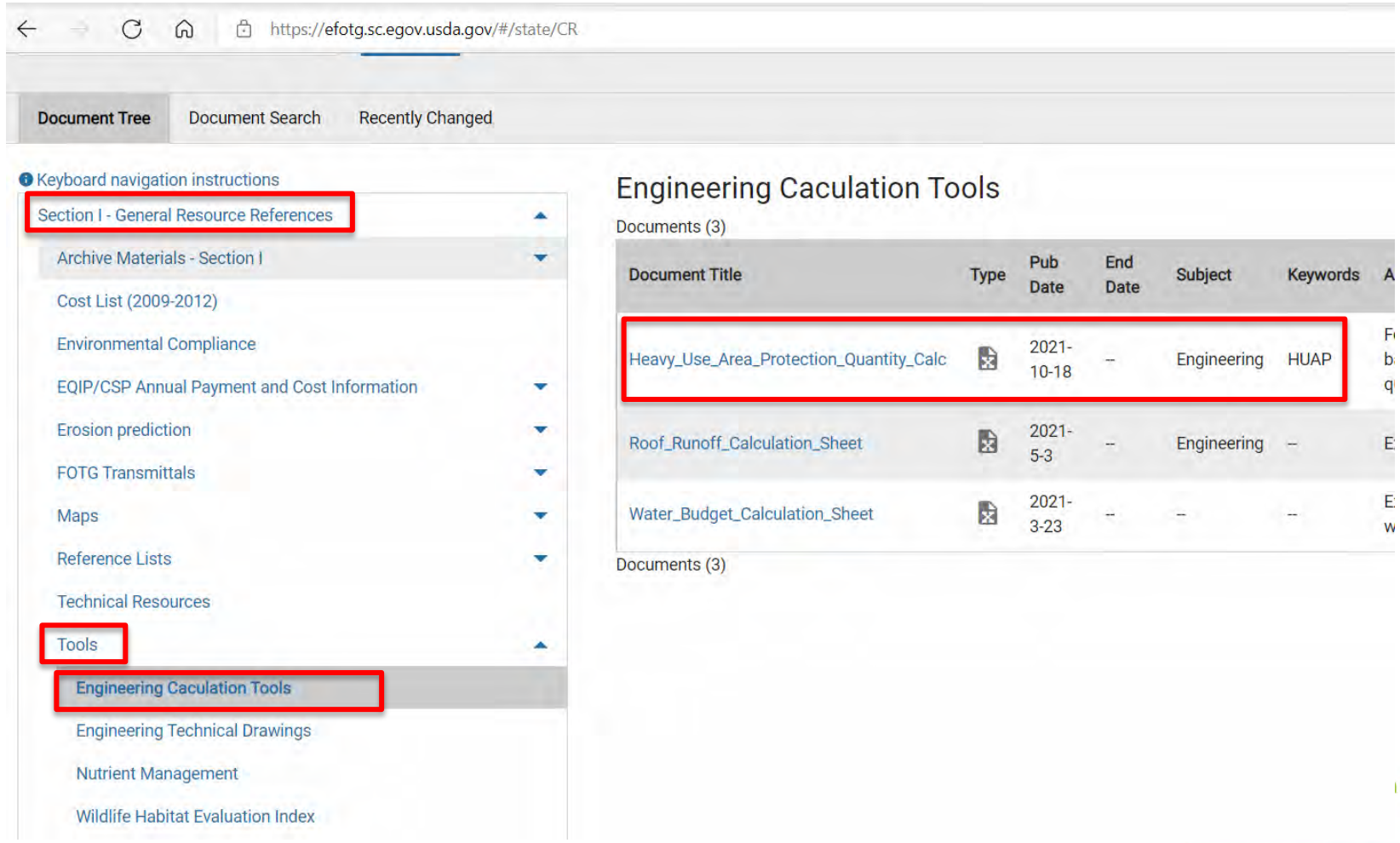

Figure 31. eFOTG

Before and After

Figure 32. Picture before HUAP implementation

Figure 33. Picture before HUAP implementation

Figure 34. Picture after 1 year of HUAP implementation. Performing well. Drainage is Really Important

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Before and After

Figure 35. Picture before HUAP implementation

Figure 36. Picture before HUAP implementation

Figure 37. Picture after 1 year of HUAP implementation. Performing well. Drainage is Really Important

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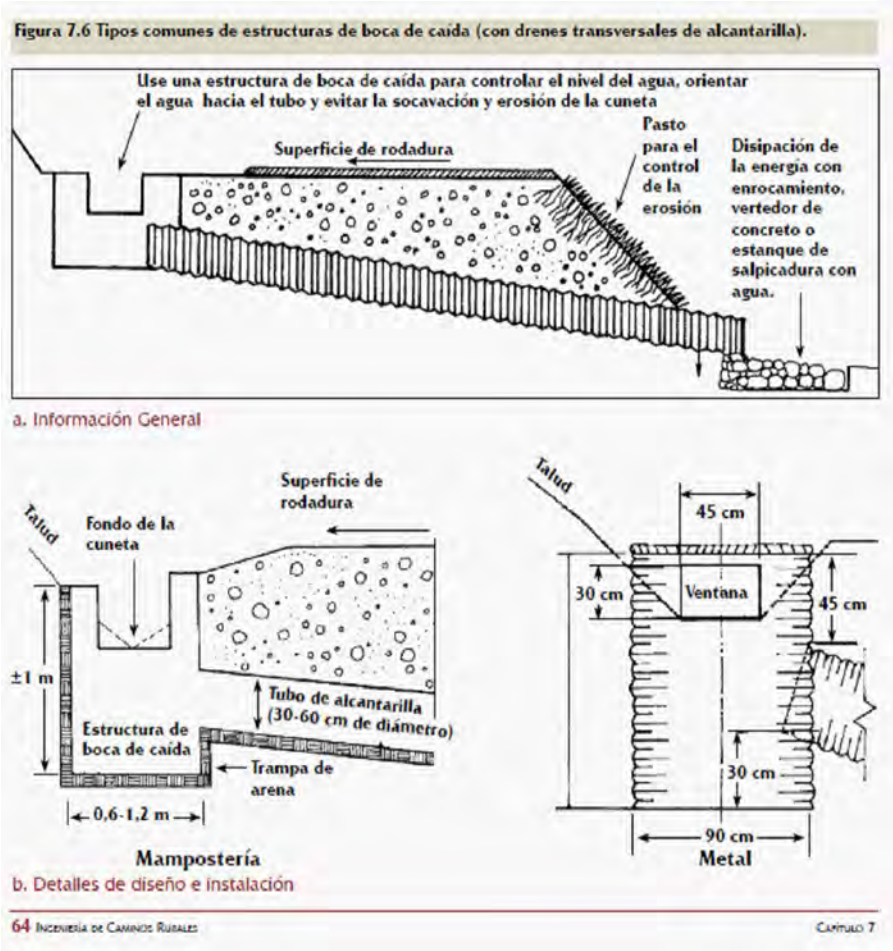
HUAP can be used in combination with other practices

1) Vegetative barriers (601)
2) Underground outlet (620)
3) Trails and walkways (575) - Water bars
4) Grade stabilization structures (410) - Log structures
5) Lined water ways (468) - Concrete



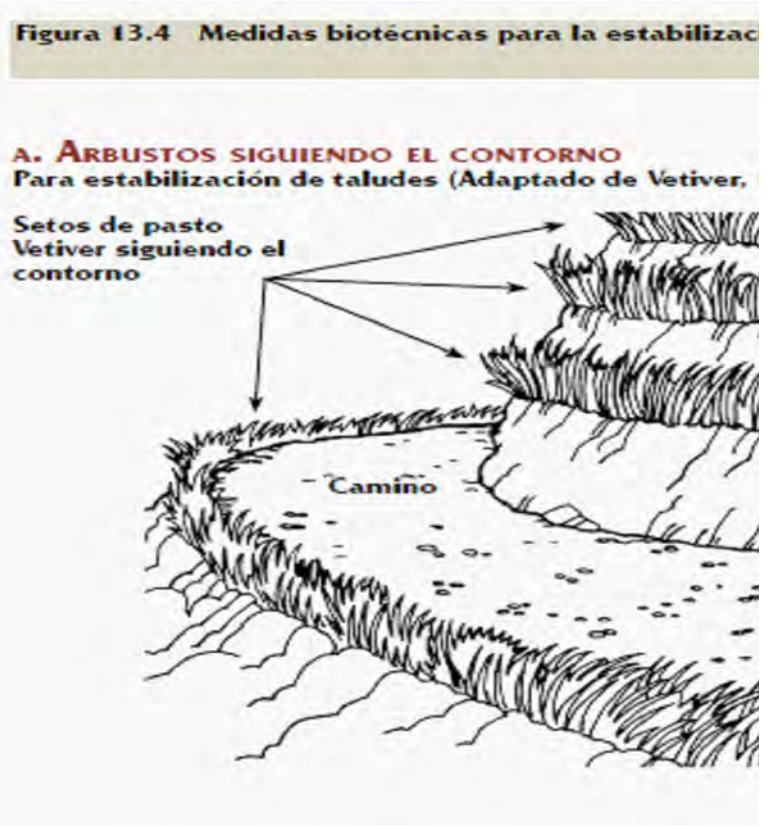


Figure 38. Picture before HUAP implementation

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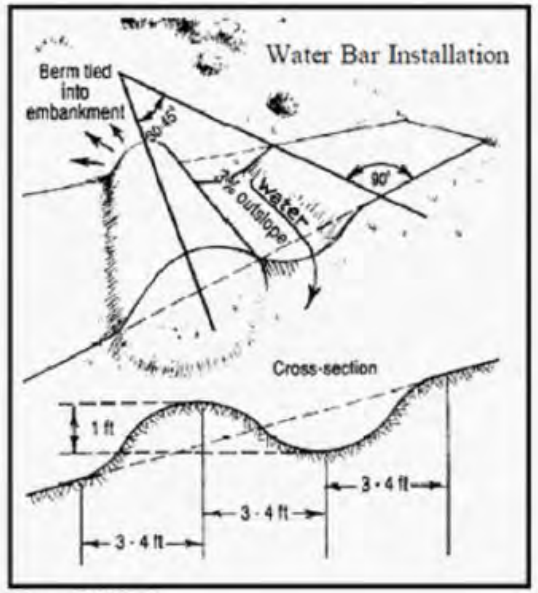


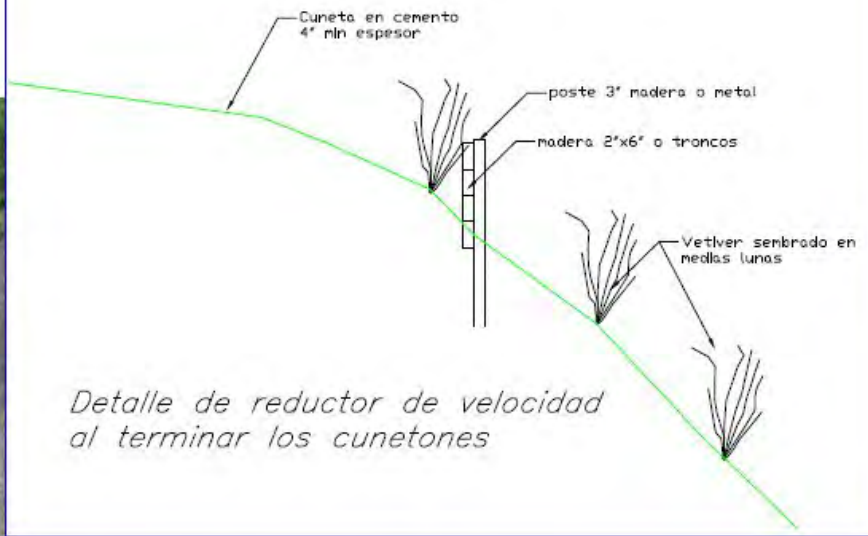
Figure ROAD-8

Table ROAD-2

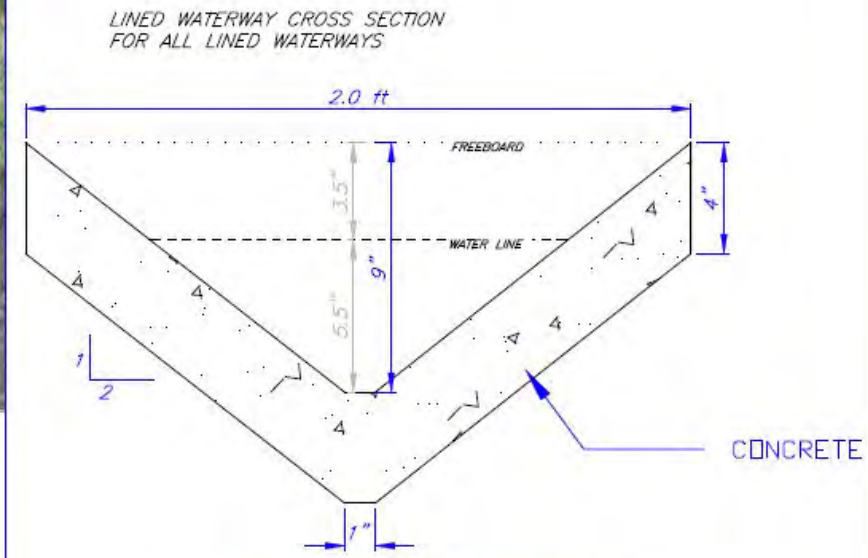
Water Bar Spacing

Grade	Spacing between dips or upland culverts
2%	250 ft
5%	130 ft
10%	80 ft
15%	50 ft
25%+	40 ft

Ejemplo de instalacion de troncos para reducir velocidad del agua. El vetiver se debe instalar en medias lunas, subiendo parte del talud para que agua se mantenga en el centro del desague.



Detalle de reductor de velocidad al terminar los cunetones



Nota: Juntas a no mas de 10ft

Figure 39. Ideas of associated practices to HUAP

Associated Pr

1) Vegetative barriers (6
2) Underground outlet (620)
3) Trails and walkways (575) - Water bars
4) Grade stabilization structures (410) - Log structures
5) Lined water ways (46 Concrete

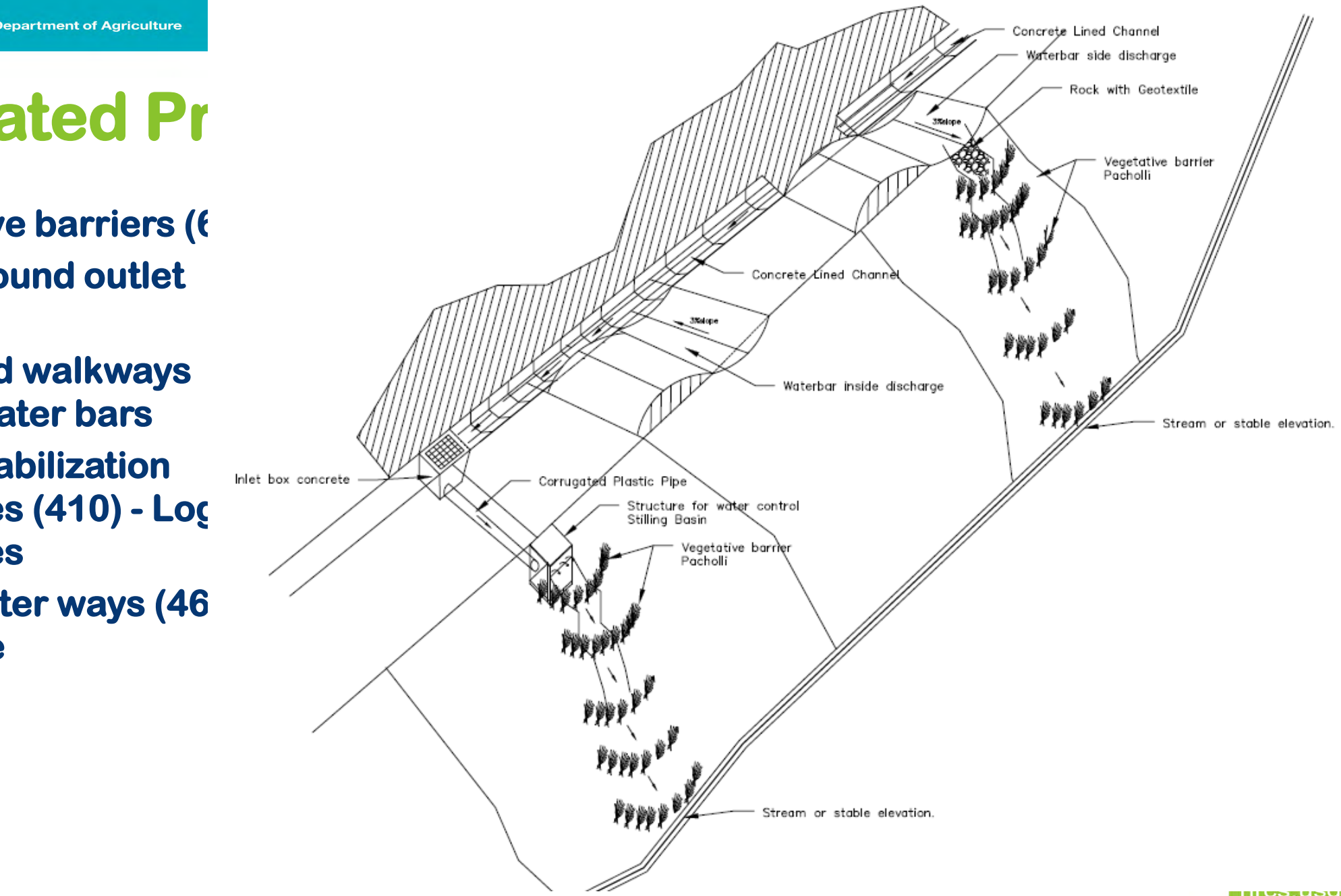


Figure 40. Ideas of associated practices to HUAP

Farm roads

Farm roads with steep slopes and sandy soils.

Figures 41& 42 : HUAP, concrete or crusher run (mogolla) w/ geotextile recommended only on the steepest and worst areas. Jayuya, PR.

Questions???

Thank you so much for your attention!

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