WEST VIRGINIA EROSION AND SEDIMENT CONTROL FIELD MANUAL

West Virginia
Division of Environmental Protection
Office of Oil and Gas

Charleston, W.Va.

3/92/500

INTRODUCTION

Presented herein are best management practices (BMP) for alleviating soil-disturbing operations conducted during oil and gas industry activities in the state of West Virginia. These practices are required by the Division of Environmental Protection (DEP), Office of Oil and Gas.

The manual is divided into five sections, each with its own index as applicable:

I. Planning
II. Construction
III. Reclamation
IV. Revegetation
V. Maintenance

BMP discussed herein are to be used as required; certain practices may not always be applicable in all situations. Also, the DEP may, from time to time, require additional practices not discussed here.

In the case of an uncontrolled site condition, a waiver may be required from the DEP to change a standard on a site-specific basis. Variation from the practices outlined in the manual may only be employed upon approval and documentation of such a variance from the district oil and gas inspector.

Section I
PLANNING

Prior to beginning construction of roads and well locations for oil and gas drilling a plan must be developed. Planning involves a preplanning stage and development of the "Construction and Reclamation Plan," Form WW-9 (Figure I-1 on pages 3-4) is to be used.

During the preplanning stage an effort should be made to meet with and work with landowners to determine the best access routes and minimize damage and inconvenience to the landowner. This critical contact can make the ensuing development of the well a much easier job.

A. Preplanning Guide

1. Locate available maps of the area, such as USGS topo sheets, soils maps (SCS), aerial maps or photos (ASCS, DOH, etc.).
2. Locate wellsite and nearest available road on a USGS topographic map.
3. Contact landowner
4. Determine the different types of soil that may be encountered in developing the site.
5. Identify significant features that may control plan elements:
   a. Streams and wetlands
   b. Utilities
   c. Roads
   d. Drainageways
   e. Ridges
   f. Steep areas
   g. Soil limitations - slips, erodible, undrainable clays, etc
   h. Stream crossings
   i. Rock outcrops
   j Land use and cover
   k. Property boundaries and fence lines
6. Lay out access road on topo map:
   a. Plan road from state route to the location.
   b. Plan roads within 20 percent grade.
   c. Avoid long continuous erodible road grades.
   d. Road drainage - side ditches, culverts, broad-based dips, adequate outlets.
   e. Hill slope 60 percent or greater will cause the road to be in all cut.
7. Determine surface water control for site areas by diverting or conveying runoff:
   a. Diversion
   b. Drainage ditches
   c. Land grading
   d. Adequate outlets

8. Determine need for sediment controls:
   a. Hay or straw bales
   b. Earth or stone berms or dikes
   c. Sediment basins
   d. Silt fences
   e. Vegetative filter strips
   f. Brush piles
9. Determine revegetation needs:
   a. Temporary vegetation
      (1) Prepare seedbed
      (2) Seed mixture from Table IV-1.
   b. Permanent vegetation
      (1) Apply lime and fertilizer according to Table IV-3.
      (2) Prepare seedbed
      (3) Apply seed mixture from Table IV-2.
      (4) Mulch all seedings from Table IV-4.
      (5) Maintain as needed.

B. Construction and Reclamation Plan Preparation

The Construction and Reclamation Plan is drawn up and submitted on Form WW-9 to the West Virginia Division of Environmental Protection (DEP), Office of Oil and Gas, with a well work permit application. This plan must include drawings of the access road showing total road distance and slope and/or well location showing existing and proposed structures in accordance with the legend on said plan. Once the plan is completed the district oil and gas inspector must be notified for field review and/or approval of the plan.

FIGURE I-1

STATE OF WEST VIRGINIA FORM WW-9

Form WW-9
Rev. 10/91

Page ____ of ____
API Number 47 - _____ - _____
Operator's Well # _____

STATE OF WEST VIRGINIA
DIVISION OF ENVIRONMENTAL PROTECTION, OFFICE OF OIL AND GAS
CONSTRUCTION AND RECLAMATION PLAN AND SITE REGISTRATION APPLICATION FORM
GENERAL PERMIT FOR OIL AND GAS DRILLING PIT WASTE DISCHARGE

Operator Name _____ OP Code _____

Watershed _____ Quadrangle _____

Elevation _____ County _____ District _____

Proposed Disposal Method for Treated Drilling Pit Wastes:

____ Land Application

____ Underground Injection (UIC Permit Number _____)

____ Reuse (at API Number _____)

____ Off Site Disposal (Supply form WW-9 for disposal location)

____ Other (Explain: _____)

I certify that I understand and agree to the terms and conditions of the GENERAL WATER POLLUTION CONTROL PERMIT issued on January 15, 1988, by the Office of Oil and Gas of the West Virginia Division of Environmental Protection. I understand that the provisions of the permit are enforceable by law. Violations of any term or condition of the general permit and/or other applicable law or regulation can lead to enforcement action.

I certify under penalty of law that I have personally examined and am familiar with the information submitted on this application form and all attachments thereto and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Company Official Signature _____

Company Official (Typed name) _____

Company Official Title _____

Subscribed and sworn to before me this ____ day of _____, 19 ____

_____ Notary Public

commission expires _____

LEGEND

Property Boundary

Road

Existing Fence —X—X—X—X—X—

Planned Fence —/—/—/—/—/—

Stream

Open Ditch

Rock

North N

Buildings

Water wells W

Drill site

Diversion

Spring

Wet Spot

Drain pipe with size in inches 12

Waterway

Cross Drain

Artificial Filter Strip

Pit: cut walls

Pit: Compacted fill walls

Area for Land Application of Pit Waste

Proposed Revegetation Treatment: Acres Disturbed _____ Prevegetation pH___

Lime _____ _Tons/acre or to correct to pH _____

Fertilizer (10-20-20 or equivalent) _____ lbs/acre (500 lbs minimum)

Mulch _____Tons/acre

Seed Mixtures

Area I Seed type	lbs/acre	Area II Seed type	lbs/acre

Attach:
Drawing(s) of road and location, and proposed area for land application.

Photocopied section of involved 7.5' topographic sheet.

Plan Approved by: _____

Title: _____ Date: _____

Field Reviewed? (____) Yes (____) No

CONSTRUCTION

Section II
Erosion & Sediment Control For Access Road & Wellsite Construction

INDEX

Tables

These are Best Management Practices (BMP), as related to the oil & gas industry in West Virginia, prepared for average conditions. The BMPs are to be used as requirements and the DEP may, from time to time, require additional practices not discussed here. Also a request for a waiver to change a standard, due to an uncontrolled site condition, may be made to DEP, on a site-specific basis.

It is recognized that some of the following standards for structures may not be utilized during the actual drilling operation, while a large amount of heavy equipment traffic is occurring, but rather will be utilized during the reclamation phase.

There are at least two types of erosion and sediment control structures, vegetative and mechanical. These control measures must be designed to fit the topography, soils, rainfall, and the land use of the area they are to protect.

The erosion and sedimentation control structures described here offer an effective means of reducing erosion and preventing damage to both the construction areas and off-site properties.

All structures should be inspected regularly and repairs of any damage should be completed as promptly as possible. With correct installation and proper maintenance, the erosion and sedimentation control structures should provide effective control of accelerated erosion and the resulting sedimentation.

A. Access Road Construction

1. Access Roadway

Description: A roadway constructed to provide access to the wellsite. Any modification or reconstruction of an existing road, open to public use or private, shall be considered part of the access road and subject to the criteria defined herein.

a. Design Criteria:
   (1) Maximum grade will be 20%, Inspector may approve a waiver for grades in excess of 20% on a case by case basis.
   (2) Minimum width will be 10 feet for a single lane and 20 feet for a double lane.
   (3) Side slopes for excavated cuts will be in accordance with information listed in Table II-1.
   (4) Earth fill slopes will be no steeper than 2 to 1.
   (5) Side ditches will be installed on sections of roads, in cut where surface drainage impinges the fill areas.
   (6) Culverts will be installed under the road in natural drainageways. Bridges may be needed for larger drainage areas.
   (7) Cross ditches shall be installed to control road surface water. Refer to Table II-4.

b. Construction Specifications:
   (1) The areas to be excavated or occupied by fill, shall be cleared and grubbed of all trees, stumps, large roots, boulders, and debris. All such material will be disposed of by stacking, piling, windrowing, burning (in accordance with WV Forest Fire Laws), removal from site, or other methods approved by the Inspector.
   (2) Timber Clearing: Consideration should be given to clearing woody material back from the roadway far enough to allow entrance of sunlight and wind to assist in accelerated drying of the road surface.
   (3) Road surface stabilization may be required in excessively wet or soft areas, by use of stone and/or stone and fiber mat.
   (4) When crossing pipelines or other underground utilities, adequate protection should be provided. For assistance in locating underground utilities in WV, Call 1-800-245-4848 (Miss Utility of WV), Participants in this system will respond.
   (5) When leaving County or State Road Rights-of-Way, a "Road Approach Permit" is required by the WV Division of Highways. Refer to DOH Manual for specifications.

2. Drainage Ditch

Description: An open drainage ditch constructed to a specific size and grade, along the road, to collect and convey surface water.

a. Design Criteria:
   (1) Ditch side slopes will not be steeper than 2:1, when excavated in soil. Refer to Table II-1 for allowable side slopes in other types of material.
   (2) For allowable velocities, refer to Table II-2. Capacity of ditch shall be based on handling 0.1 cfs per acre of drainage. Refer to Table II-3 for sizing of ditch. Minimum depth shall be 1 foot.

(3) Cross section of the ditch shall be V - shaped.

(4) Where velocities exceed the permissible, the ditches will be lined to prevent erosion.

(5) Ditch outlets shall have adequate erosion and sediment control.

b. Construction Specifications:

(1) The ditch shall be cut to a designated line and grade. Spoil shall be spread and leveled, so that surface water can flow into the ditch.

(2) Excavated surfaces shall be reasonably uniform & smooth. Areas to be excavated shall be cleared of trees and brush.

3. Cross Drain/Waterbar

Description: An open ditch, constructed across the roadway, to carry off road surface water. They are not intended to replace culverts. See Figure II-1.

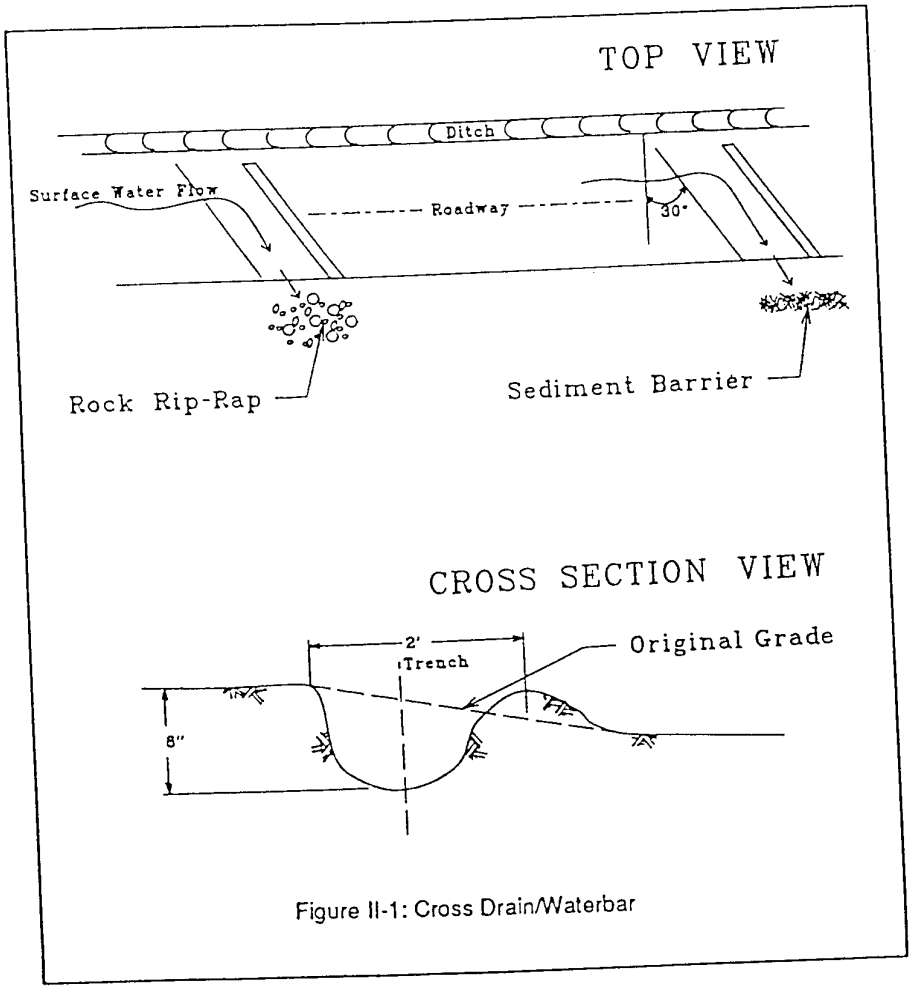


Figure II-1: Cross Drain/Waterbar

a. Design Criteria:

(1) Minimum depth - 8"

(2) Minimum width - 2'

(3) Ditch will be angled approximately 30 degrees at a grade of 1/2" per foot.

(4) Velocity will not exceed the permissible velocity listed for the particular soil type that is used. See Table II-2.

(5) A proper outlet will be provided to prevent erosion and control sedimentation, from the ditch discharge. Material for the outlet can be rock, logs, concrete, or metal with the appropriate sediment barrier.

(6) Stabilization: Cross drains may need to be lined with erosion resistant materials, such as rock riprap.

(7) Spacing: Refer to Table II-4.

4 . Broad-Based Dip

Description: A constructed dip or swale, across the road surface, sloped to the outslope for drainage of the road surface. See Figure II-2.

a. Design Criteria:

(1) Maximum road grade on which dips can be constructed is 10%.

(2) A 3% reverse grade should be constructed in the existing roadbed, by cutting upgrade of the dip location.

(3) Stone lining may be needed, but not required.

(4) Drainage outlet should be provided so as to prevent erosion, with appropriate sediment barrier, as previously discussed.

(5) Spacing : Refer to Table II-5.

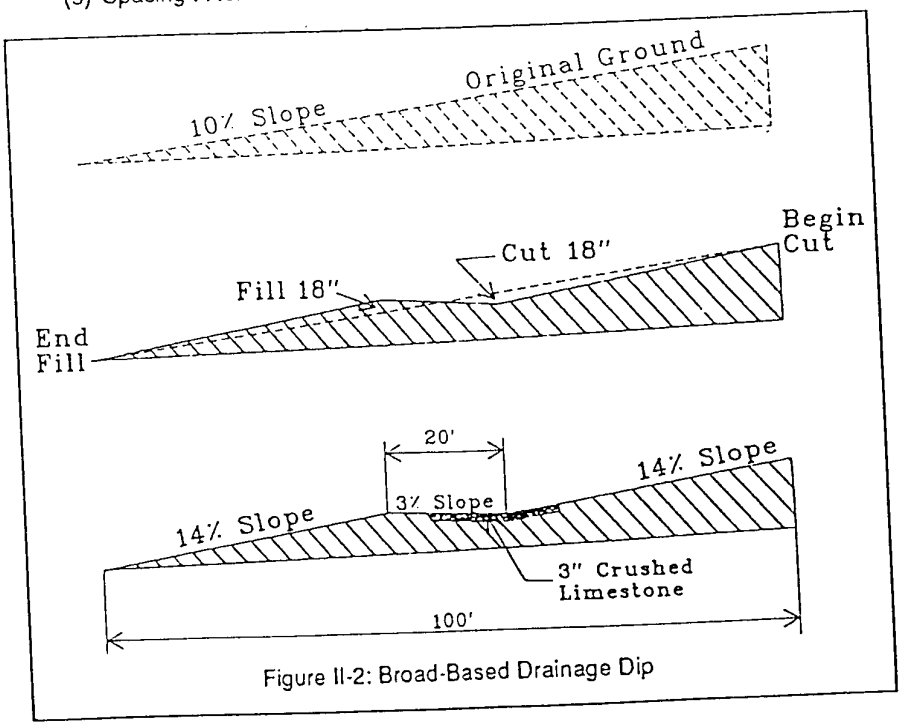


Figure II-2: Broad-Based Drainage Dip

5 . Diversion Ditch—Temporary

Description: A channel or ridge constructed across a slope for diverting surface runoff. See Figure II-3.

a. Purpose: To intercept surface water before it enters an erodible area and convey the runoff to a safe outlet.

b. Design Criteria:

(1) For drainage areas less than 10 acres (See Figure II-3)

(a) Minimum depth—18 inches

(b) Minimum top width—8 feet

(c) Maximum ditch grade—2 percent

(2) Drainage areas greater than 10 acres

(a) Capacity of ditch: will handle a 2-year frequency storm, 24-hour duration. For further design information, contact the local Soil Conservation Service Field Office.

(b) Velocity of water will not be greater than the permissible shown in Table II-2.

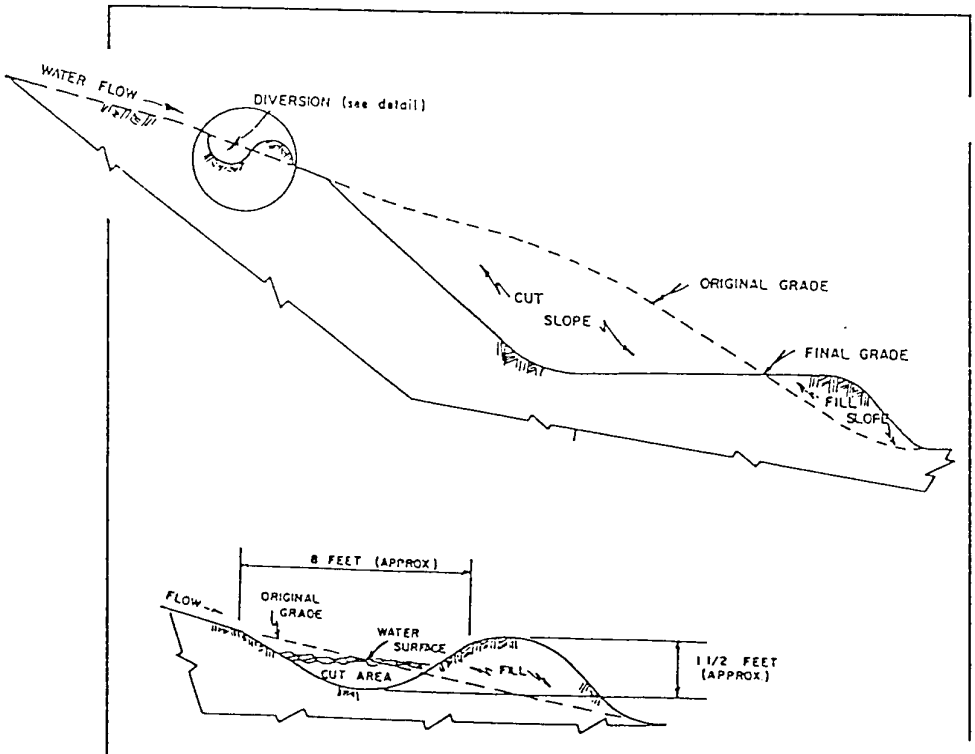


Figure II-3: Diversion Ditch–Temporary

6 . Culvert

Description: Buried pipe, under the roadway, to carry water from the ditches and natural drainageways. See Figure II-4.

a. Type Material
   (1) Steel
   (2) Aluminum
   (3) Concrete

b. Design Criteria:
   (1) Minimum size diameter will be 12"
   (2) For culvert sizes, based on drainage areas, refer to Table II-6.
   (3) Culverts will be located at approximately 30 degrees downgrade.
   (4) Culvert grade shall not be less than 1/2" per foot of length.
   (5) Culverts will have at least 12" of soil cover, or 1/2 pipe diameter, whichever is greater. Additional stabilization may be required.
   (6) Culverts will have adequate headwalls or drop inlets, at their inlet areas.
   (7) An adequate riprapped outlet will be provided, when needed, to prevent erosion from the culvert discharge, with adequate sediment control.
   (8) Situations may warrant the use of "open top culverts" in some areas.
   (9) Culvert Spacing : Refer to Table II-7

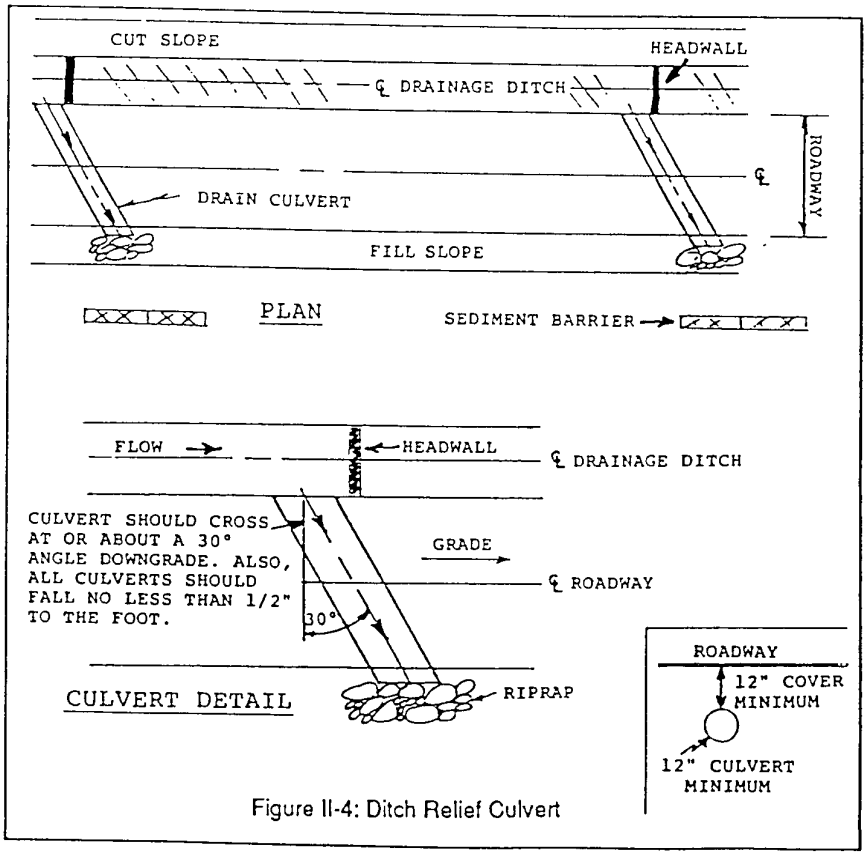


Figure II-4: Ditch Relief Culvert

c. Construction Specifications:

(1) Culverts will be installed to specified line and grade.

(2) Ditch will be excavated to a depth and grade to ensure proper cover for the culvert.

(3) Ditch bottom will have a firm foundation for the culvert. Gravel may be used to stabilize the ditch bottom.

(4) The culvert will be backfilled with material free of large rocks, which may cause damage to it.

(5) Stone may be needed for further surface stabilization.

(6) Recommended installation is with a backhoe rather than a dozer.

7 . Filter Strip

Description: A natural vegetative strip, left undisturbed, between the disturbed construction area and a water course. The filter strip acts as a buffer area to catch sediment, before it enters the water course.

a. Design Criteria:

Roads and other disturbed areas located above a stream will need a filter strip. The width of the filter strip depends on the slope of the land between the disturbed area and the stream. Refer to Table II-8. If this criteria cannot be followed, other type sediment barriers would be required. The filter strip area shall not be disturbed.

8 . Sediment Barriers

Description: A temporary restriction or barrier across a slope, at the toe of a slope, or at drainage outlets designed to trap sediment from a disturbed area by retarding and filtering water runoff. See Figures II-5, 6, and 7.

a. Types of Barriers

(1) Hay or straw bales

(2) Silt fences

(3) Brush piles

(4) Temporary earth or rock berms or dike

b. Construction Specifications:

(1) Hay or straw bales should be placed on the contour and tied with either wire or nylon string. Anchor each bale with two wood or metal stakes. Wooden stakes should be at least 2" x 2" and driven in the ground, a minimum of 1 1/2'. Bales should be keyed in the ground 4". Bales shall be placed in a row with the ends tightly abutting to the adjacent one.

(2) Silt fences should be placed on the contour. Fence posts shall not be spaced greater than 10' apart. If woven wire fence is used, it shall be fastened securely on the upstream side of the fence posts. Filter cloth, when used, shall be secured on the upstream side of the fence posts and anchored at the bottom. The filter cloth shall be embedded in the soil at least 4" and the soil compacted around it.

(3) Brush piles shall be a minimum of 3' in height and 5' in width at the base. They may be constructed as single pile units or windrowed, along the contour or at the base of a slope. The brush should be cut up so it can be compacted somewhat tightly together.

(4) Earth or rock barriers should not be more than 2' in height and have side slopes of 3:1 or flatter.

*Drainage Outlet Protection: All drainage outlets should have some type of protection; rock riprap, sediment barriers, or natural filter strip areas.

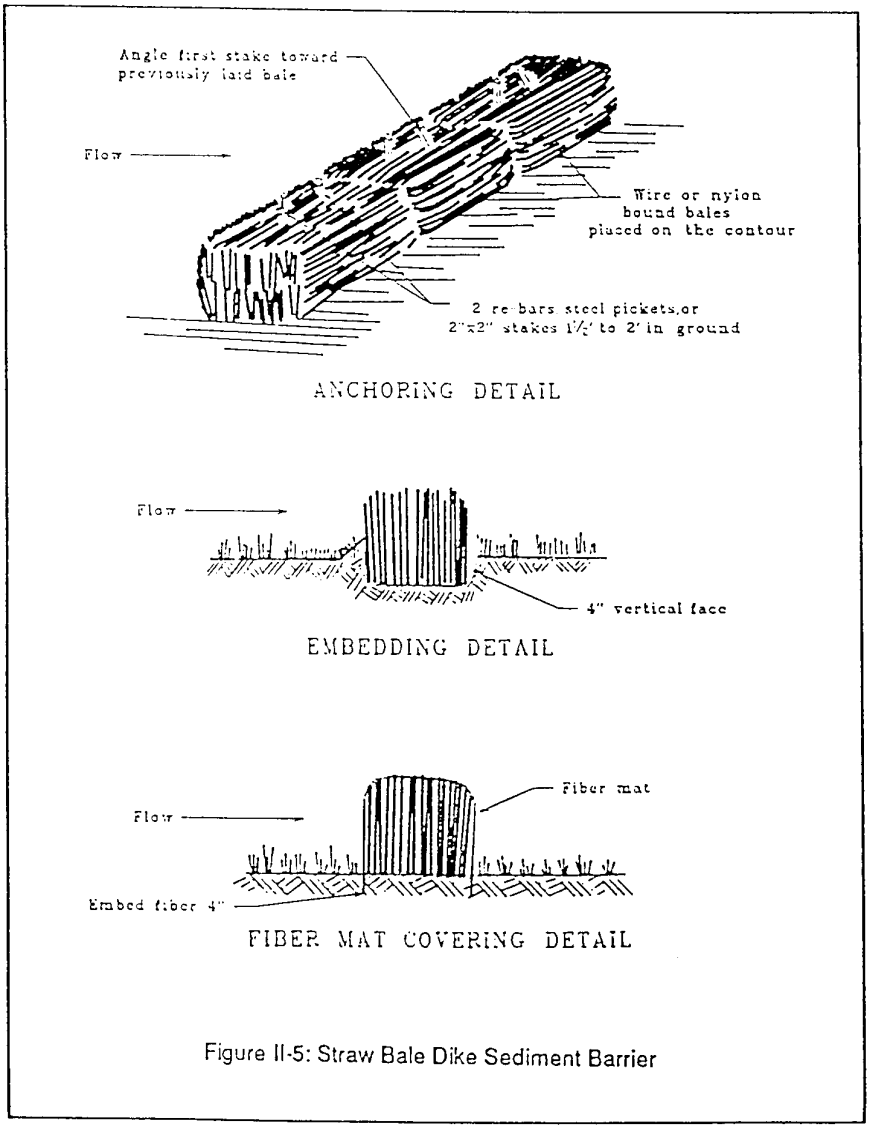


Figure II-5: Straw Bale Dike Sediment Barrier

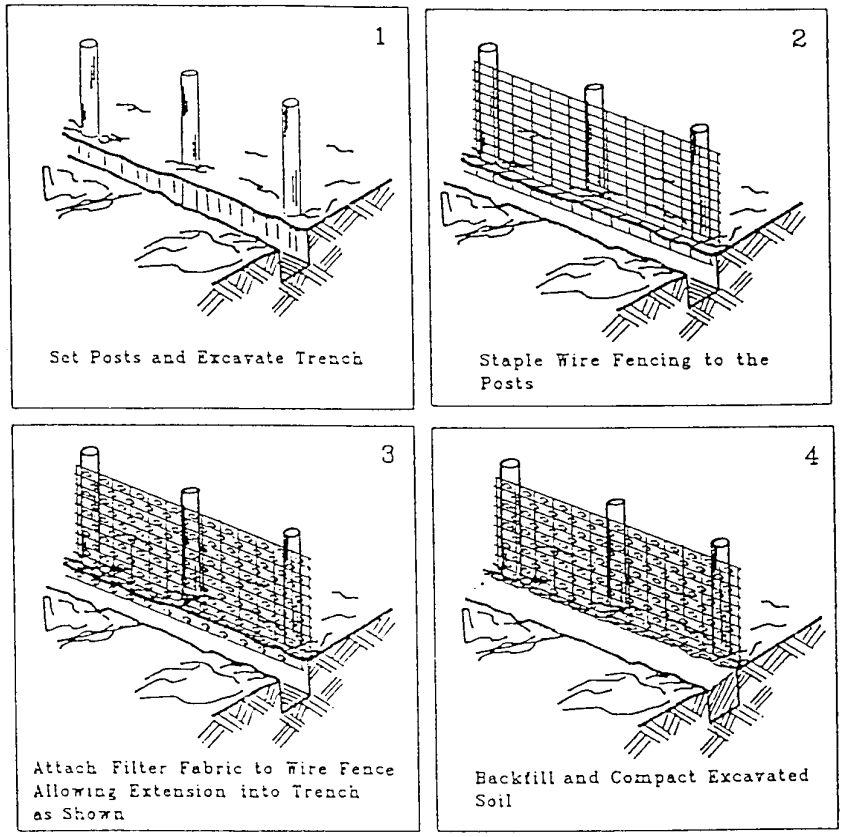


Figure II-6: Silt Fence Sediment Barrier

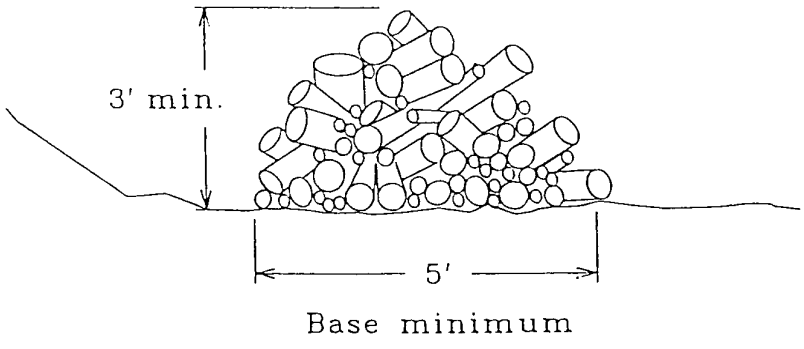


Figure II-7: Brush Pile Sediment Barrier

9. Stream Crossing - Temporary

Description: A temporary structural span installed across a flowing water-course, for use of construction traffic, drilling equipment, etc., so as to provide a means to cross the stream without damaging the stream and to prevent sediment from entering the stream. See Figures II-8 and II-9.

a. Types:
   (1) Culverts
   (2) Bridge
   (3) Stone base

b. Design Criteria:
   (1) The structure shall be large enough to handle a 1-year frequency storm, 24 hour duration.
   (2) If culverts are used, refer to Table II-6, for sizing. A minimum size diameter pipe that may be used is 18".
   (3) Depth of cover over the culverts shall be 1/2 the diameter of the culverts or 12", whichever is greater.

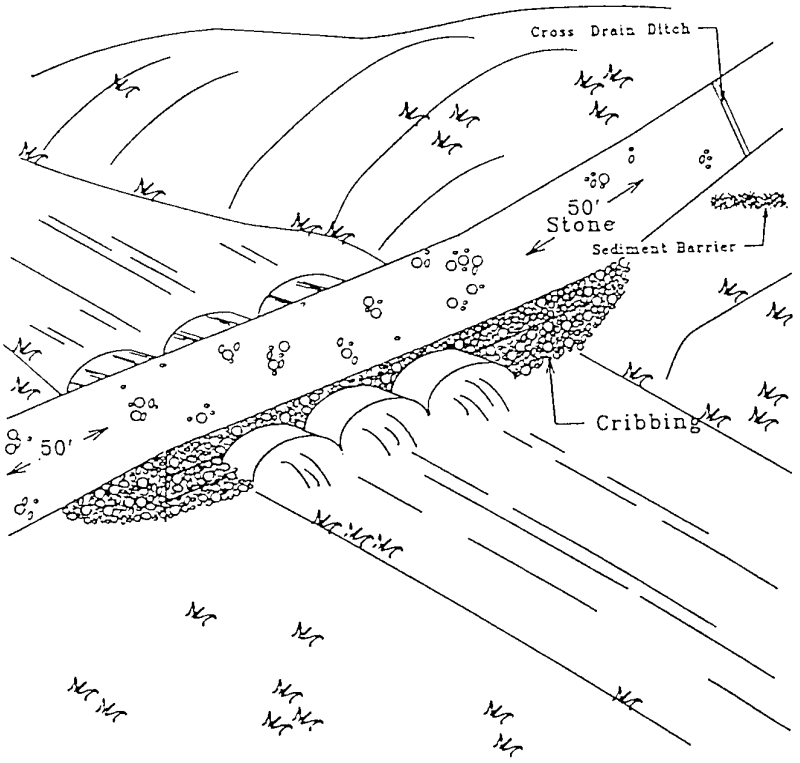


Figure II-8: Stream Crossing—Temporary, with Culvert

(4) Multi-culverts should be installed with spaces between them, equal to 1/2 the pipe diameter.

(5) Low water crossings may be used, if protected when overflowing occurs. This could be accomplished by using rock and concrete.

(6) Cross cribbing of the downstream side of culvert installations may be needed to aid in reducing structural damage during high velocity water overflow periods.

(7) Entrance and exit areas shall be stoned.

(8) If culverts or bridges are not used and stone base doesn't exist, stone shall be installed, with the entrance and exit being stoned for approximately 50'.

Permanent Stream Crossing Structures: Requires a "Stream Activity Permit" from the WV Public Lands Corp. of the WV Division of Natural Resources (304-348-2225).

*Temporary structures may also require the Permit.

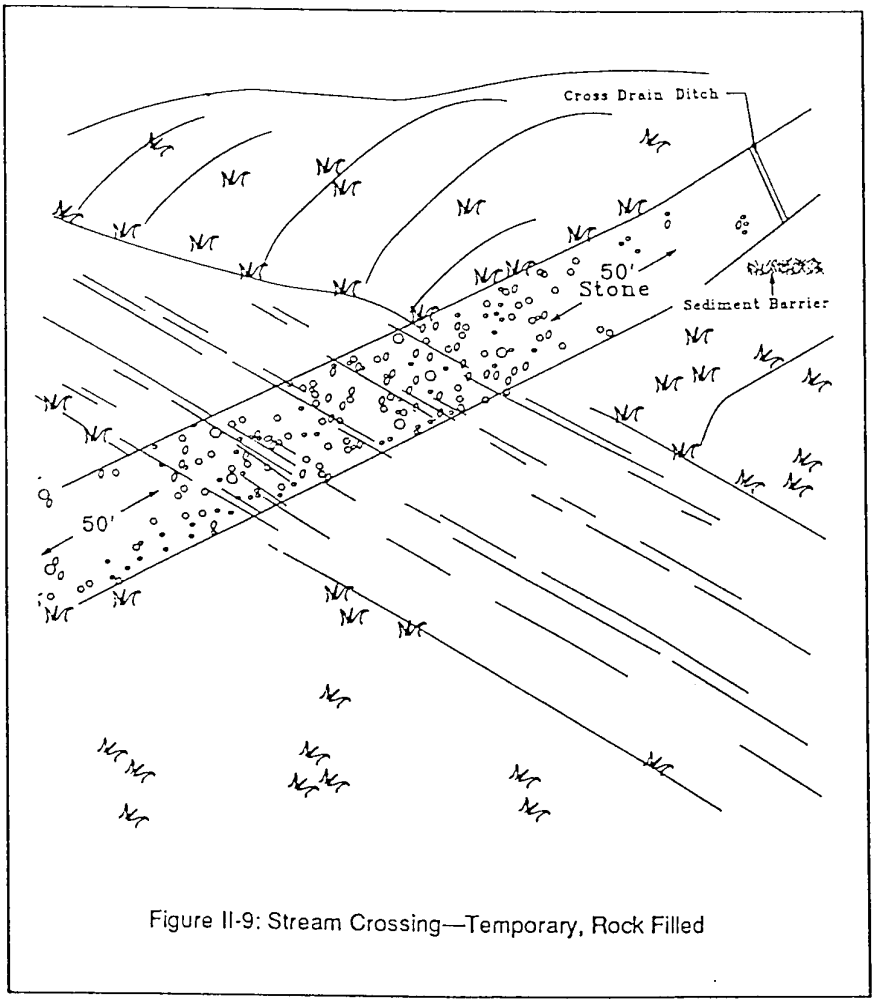


Figure II-9: Stream Crossing—Temporary, Rock Filled

10. Sediment Basin—Temporary

Description: A basin constructed to collect water runoff, with adequate retention time to allow sediment to settle.

a. Design Criteria:

(1) Water containing sediment from any disturbed area is diverted to the basin.

(2) The basin shall have adequate overflow pipes and/or spillways installed, with outlet protection.

(3) For actual design criteria, consult the Soil Conservation Service or the Division of Natural Resources - Dam Control Section.

(4) Maximum height shall be 15'.

Table II–1

Allowable Side Slopes

Material	Slope Horizontal–Vertical
Soil (clay-silt)	2:1
Sand (clean)	1:1
Shale	1:1
Rock	1/2:1

Table II–2

Permissible Velocities

Soil Texture	Maximum Velocity ft./sec.
Sand and sandy loam (noncolloidal)	2.5
Silt loam (also high lime clay)	3.0
Sandy clay loam	3.5
Clay loam	4.0
Stiff clay, fine gravel, graded loam to gravel	5.0
Graded silt to cobbles (colloidal)	5.5
Shale, hardpan and coarse gravel	6.0

Table II–3

V–Ditch

(2:1 side slopes) (N–.04)

Depth (ft)	Ditch Grade 0.2%		0.5%		1.0%		2.0%	
	V	Q	V	Q	V	Q	V	Q
1.0	1.0	2.0	1.5	3.0	2.2	4.4	3.0	6.0
1.5	1.3	5.9	2.1	9.5	2.9	13.0	4.1	18.5

Table II-4
Spacing of Cross Drains

Road Grade (%)	Distance Between Drains (Ft)
1	400
2	250
5	135
10	80
15	60
20	45

Based on US Forest Services requirement.

Table II-5
Spacing of Broad -Based Dips

Road Grade (%)	Distance Between Dips (Ft)
2	300
3	235
4	200
5	180
6	165
7	155
8	150
9	145
10	140

Table II-6
Pipe Sizes for Culverts Across Roads

Drainage Area (Ac)	Pipe Diameter (In)	Pipe Capacity (Cfs)
10	15	5
20	18	9
30	21	12
50	24	18
80	27	24
100	30	29
300	36	60
500	42	85

Table based on handling 2.5 inches of rainfall on steep slopes using a hydrologic curve number of 70. Pipe size is determined by using a headwater depth in diameters of 1.5.

Table II-7
Spacing of Culverts

Road Grade (%)	Distance (Ft)
2-5	500-300
6-10	300-200
11-15	200-100
16-20	100

Table II-8
Recommended Widths for Vegetation Strips between Earthmoving Activities and Streams

Slope of Land Between Earthmoving Activities		Width of Filtration Strip
Percent	Degree	Feet
0	0	25
10	6	45
20	12	65
30	17	85
40	22	105
50	27	125
60	31	145
70	35	165
70 Plus	35 Plus	165 Plus

B. Wellsite Construction

1. General

a. Clear any woody material, brush & trees, within the proposed site.

b. Trees should be cut and logs stacked. Smaller trees and brush should be cut and/or grubbed and piled in appropriate areas for use as sed-i ment barriers at water drainage outlets or windrowed below the wellsite, for wildlife purposes, burned (as per WV Forest Fire Laws), removed from site, or other methods as may be approved by DEP.

c. Topsoil should be removed and stockpiled in agricultural areas. In woodland areas tree stumps, large roots, large rocks, tree and leaf duff and debris, and ground vegetation should be removed, prior to actual site construction.

d. No brush or trees shall be placed in the fill areas.

e. Surface water diversion ditches should be constructed above the disturbed area to intercept water. If the situation warrants, a diversion ditch may be constructed below the disturbed area to aid in sediment control.

f. In areas of steep terrain, a terraced bench constructed at the base of the slope where fill is to be placed, may be desirable to create a toe foundation, to aid in holding the fill.

g. Drainage ditches should be constructed at the base of highwalls or as needed on location to aid in water control on the construc- tion site.

h. Sediment barriers should be installed at drainage outlets and below the construction site.

(1) Hay or straw bales

(2) Silt fences

(3) Brush piles

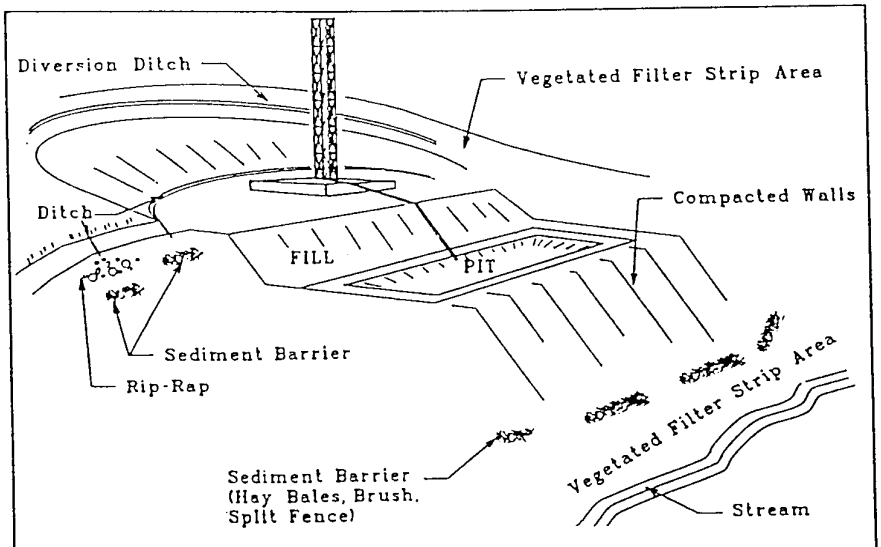


Figure II-10: Wellsite Construction View

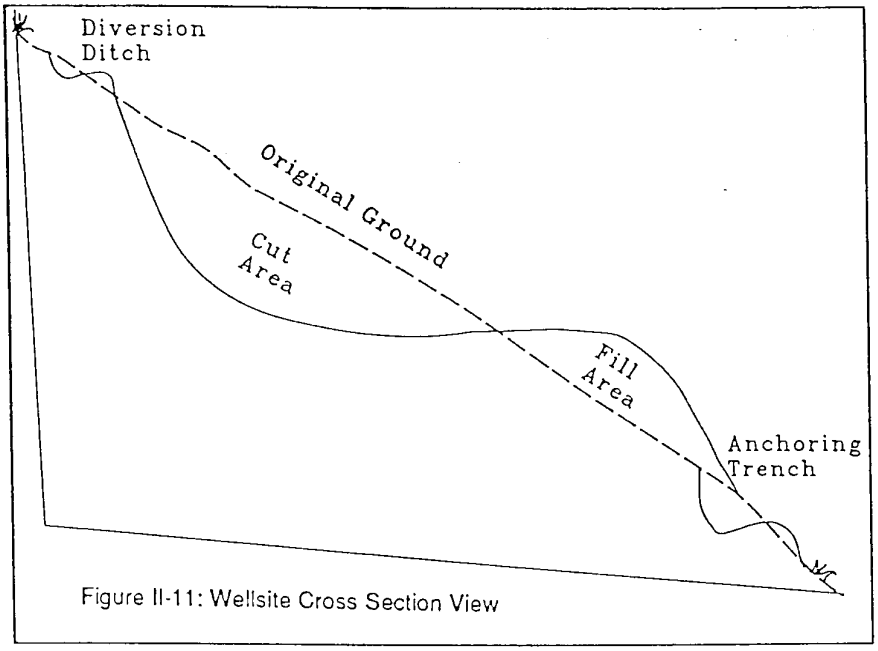


Figure II-11: Wellsite Cross Section View

(4) Earthen or rock berms

(5) Diversion ditches

(6) Filter Strips should be utilized where possible.

(7) In situations of extended time lapse between construction and reclamation, temporary seeding and/or mulching of slopes may be needed to reduce erosion and stream sedimentation potential.

2. Pit Construction

a. Site Selection: The pit should be constructed in an area with adequate room, so it can handle the projected drilling & frac fluids, plus allowing for adequate freeboard during heavy rainfall. Avoid excessive steep areas, wet seepage areas, swamps, and excessive rocky areas, when possible.

b. The pit shall be constructed and maintained so as to prevent seepage, leakage, and overflows.

c. Pits should be constructed below surface ground level, when possible. Any aboveground pit walls, as is the case with pits constructed in the lower slope areas of the wellsite, shall be compacted, with a side slope being maintained that will preserve the structural integrity.

d. Avoid placing any brush, trees, tree limbs, roots, or large rocks in the pit walls.

e. Surface water must be diverted from the pit.

f. If existing soil is not suitable for the pit to be "impervious", suitable soil may be brought in or other impervious materials should be used, such as:

(1) Gel & pit sealant

(2) Plastic pit liners (hay or straw bedding may be needed)

(3) Clay

g. Pits constructed on location, should be constructed in solid ground, preferably on the cut or highwall side, not in the fill area. Adequate room should be allowed between the base of any highwalls and the pit, for the construction of a surface water drainage ditch.

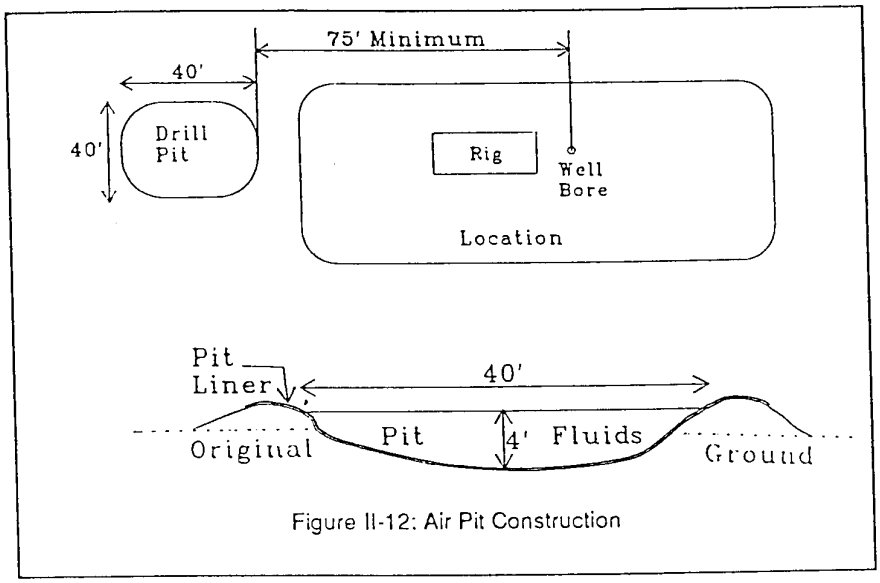


Figure II-12: Air Pit Construction

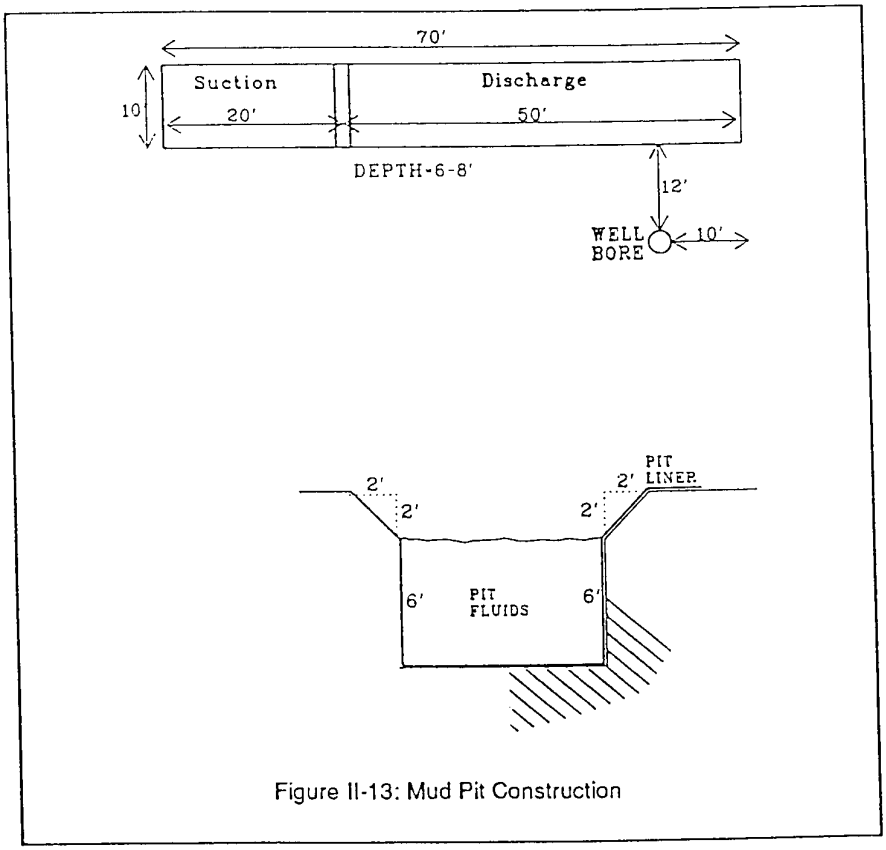


Figure II-13: Mud Pit Construction

RECLAMATION

Section III
Reclamation

All disturbed areas used in connection with the oil & gas operation shall be reclaimed, as per State Regulations. Reclamation shall include activities such as backfilling, installing permanent drainage structures, and revegetation.

Index

A. Wellsite Reclamation

1. Pit water treatment & disposal (as per ""General Water Pollution Control Permit")
2. Pit backfilling: Filling with dirt and recontouring. No brush, trees, tree tops, or stumps are to be buried in the pits.
3. The wellsite is to be backfilled, recontoured, or terraced.
4. Topsoil should be re-spread, used as top dressing, in areas where it has been stockpiled.
5. Installation of permanent water drainage and diversion ditches. In areas of long slopes, it may be desirable to install angled diversion ditches, to aid in controlling water runoff and erosion.
6. Bulldozer tracking, (up and down slopes), for compaction and seed bed preparation is desirable. See Figure III-1.
7. Maintaining sediment barriers is critical until vegetation is reestablished.

B. Access Road Reclamation

1. Road surfaces shall be regraded.
2. Permanent side ditches will be installed where needed and where the site will allow.
3. Permanent culverts, cross drains, and broad-based dips shall be installed where needed, based on criteria in Construction (Section II).
4. Side slopes of excavated cuts and outslopes shall be maintained, where the site allows, as per criteria in Section II.
5. Sediment barriers shall be maintained until vegetation is reestablished.

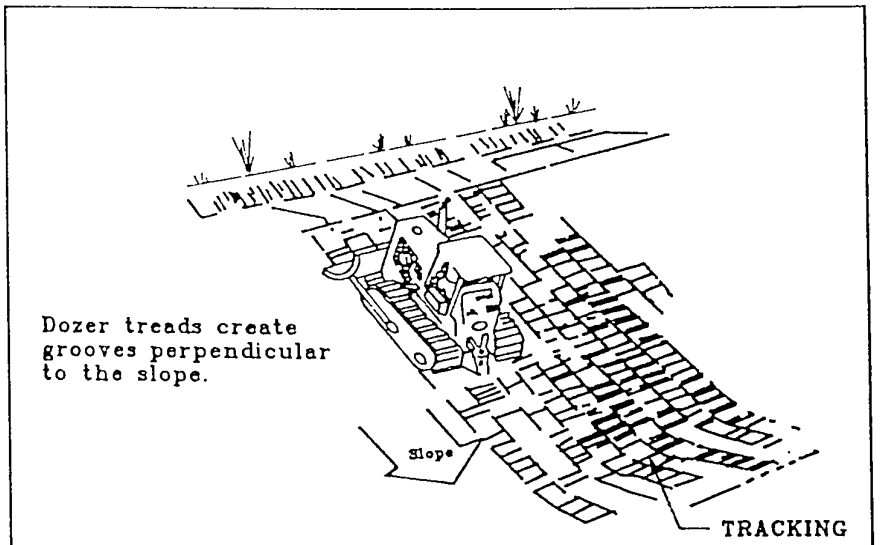


Figure III-1: Bulldozer Tracking Procedure

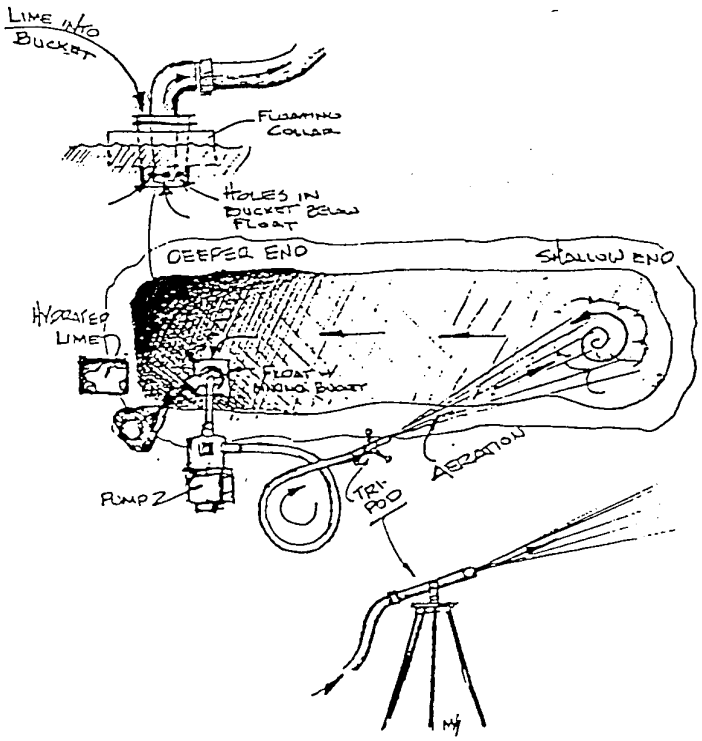


Figure III-2: Pit Treatment/Circulation

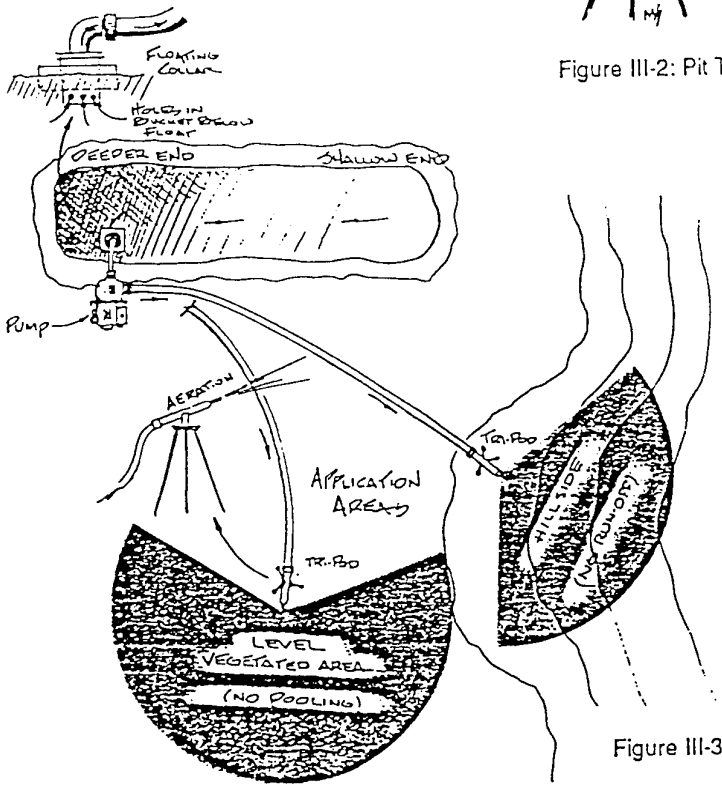


Figure III-3: Pit Fluid Discharge

C. General Notes

1. Pipelines: Pipeline installation shall be in accordance with State Regulations. Any disturbed areas created by pipeline installation shall be reclaimed.
2. Tank Batteries, Power lines: Any disturbed areas created by the installation of tank batteries or powerlines, even if out of the immediate construction site, shall be reclaimed in accordance with State Regulations, as these operations are in connection with the "Permitted" operation.
3. Well Maintenance: Disturbed areas created due to well maintenance, workover, etc. shall be reclaimed so as to aid in reduced erosion and sedimentation.
4. API Numbers: API Identification Numbers shall be displayed at the well, in a manner designated by DEP.

D. Tank Dike Construction

Tank dike construction or secondary containment structures, shall be in accordance with Federal & State S.P.C.C. Regulations. See Figures III-4 and III-5.

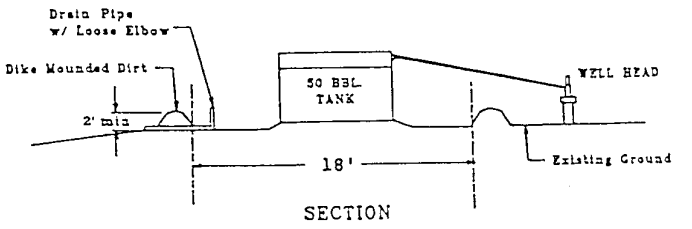
1. Secondary containment area shall be large enough to contain the contents of the single largest tank, per battery, plus 10%.
2. Containment area shall be impervious and be compatible with the potential spill material.
3. Dike walls can be constructed with earthen material, concrete, or other impervious material.
4. Earthen dike walls should be compacted and sloped.
5. It is recommended that secondary containment structures be constructed above ground for ease in maintenance. Accumulations of fresh water can be disposed of more readily from these structures, thus keeping the area available for emergency containment.
6. Below ground containment areas, moat type, are acceptable but not recommended, due to greater maintenance required to keep free of fresh water accumulations.
7. Sealed fresh water drains with outside valves may be installed, for the removal of uncontaminated fresh water.
8. Refer to Exhibits, minimum standards shown.

* For further information and specifications, refer to "WV Miscellaneous Water Pollution Control Regulations" and Federal "Oil Pollution Prevention Regulations" Title 40, Part. 112 concerning S.P.C.C.

Table III-1
Dike Design Data

Tank Size	110% of Tank Vol. (Cubic Feet)	Minimum Allowable L x W x D*
50 Bbl. (Skid Mount)	308	18′ x 18′ x 2′ = 81 Bbl.
100 Bbl.	616	22′ x 20′ x 2′ = 122 Bbl.
210 Bbl.	1176	26′ x 30′ x 2′ = 237 Bbl.
250 Bbl.	1400	30′ x 30′ x 2′ = 280 Bbl.

*Length x Width x Depth—All measurements at inside of base of dike. Other dike dimensions are acceptable provided the area contained is at least equal to that indicated above



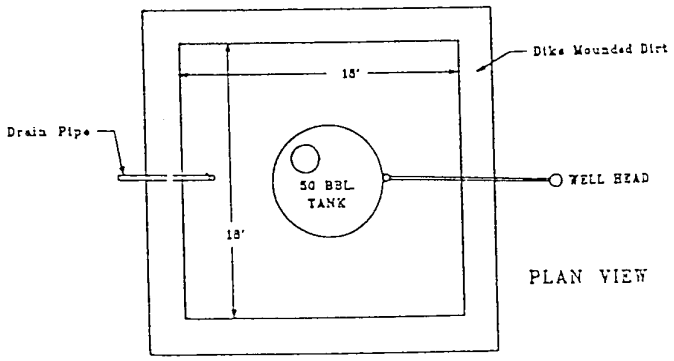
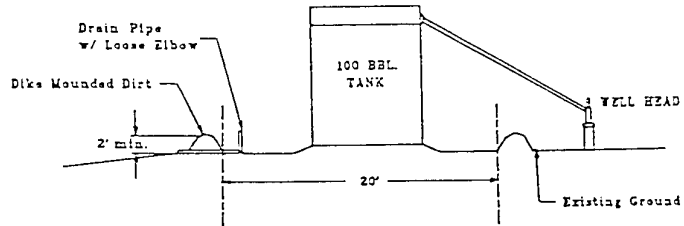


Figure III-4: Dike Design Data, 50 Bbl. Tank



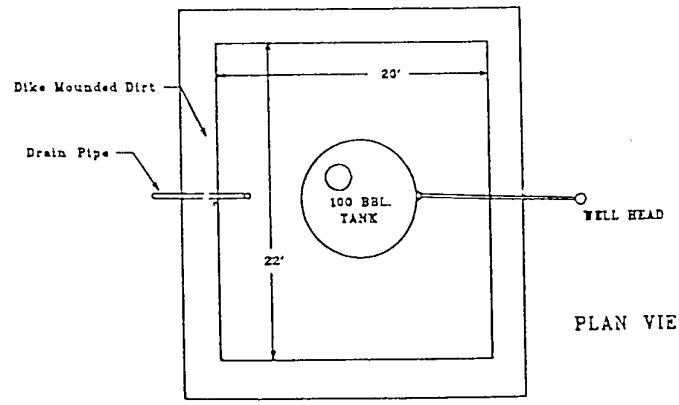


Figure III-5: Dike Design Data, 100 Bbl. Tank

REVEGETATION

SECTION IV
REVEGETATION

A. General

1. Objectives

This section provides planning and establishment of temporary and permanent vegetative cover on all disturbed areas. The objective is to provide sufficient vegetation to control erosion and sedimentation on and off the site. Considerations for the improvement of water quality and wildlife habitat are incorporated into this section. With prior and documented approval, these standards may be adjusted and modified to meet individual site requirements.

2. Acreage Calculation:

Application rates listed in this section are on a "per acre" basis. To calculate acreage, the planner must measure the average length and width (in feet) of each area to be treated. Acreage is determined by multiplying the length by the width, then dividing the total by 43,560.

Example: 230 feet long x 210 feet wide=48,300 sq.ft.

Then: 48,300÷43,560 = 1.1 acres.

B. Site Preparation

1. Water Control:

Install needed surface water control measures. See Section II, Construction, for guidance.

2. Seedbed Preparation:

The seedbed must be loose at the time of seeding. Applications of seed on hard ground will result in a poor stand of vegetation. The seedbed must be loosened by disking on the contour, or by bulldozer tracking up and down the slope. Backblading is acceptable on gentle slopes such as the bench or road bed.

C. Seeding

1. Temporary Seeding:

a. General

Temporary vegetative cover must be established where runoff will go directly into a stream immediately upon construction of the site (site includes road and location), and must be established on road bank and location slopes when reclamation cannot be completed within the prescribed 6 months as allowed.

b. Seed Mixtures

Table 1 gives recommended types of temporary vegetation, corresponding rates of application, and planting seasons. In situations where another cover is desired, contact the local soil conservation district for seeding recommendations. Approval of the oil and gas inspector is needed.

c. Establishment

Apply seed by broadcasting, drilling, or hydraulic applications according to the rate indicated in Table IV-1. Perform all planting operations at right angles to the slopes.

2. Permanent Seeding:

a. General

Planting of permanent vegetative covers shall be performed on all disturbed areas. After proper grading and seedbed preparation, the vegetation will reestablish ground cover for the control of surface water runoff and erosion.

b. Lime and Fertilizer

(1) Lime shall be applied to all permanent seedings. The pH of the soil is to be determined and shown on the construction and reclamation plan. Once the pH is known, select the amount of lime to be applied fromTable IV-3.

(2) Fertilizer shall be applied in all permanent seedings. Apply the equivalent of 500 lbs. of 10-20-20 fertilizer per acre.

(3) Application: For best results and maximum benefits the lime and fertilizer are to be applied at the time of seedbed preparation.

c. Seed Mixtures

Selection: From Table IV-2, select seed mixtures that are best suited for conditions at the site.

d. Seeding for Wildlife Habitat

When developing construction and reclamation plans for sites, planners are encouraged to consider the needs of wildlife. The publication "Managing Gas and Oil Well Sites For Wildlife" provides detailed planning guidelines. This publication is available from the oil and gas section of the Department of Environmental Protection of the WV Division of Natural Resources.

D. Mulching

1. General:

Mulch can be used alone for temporary erosion control or in conjunction with other structural or vegetative control measures. Mulch must be applied to all temporary and permanent seedings on all disturbed areas. Mulch helps to conserve moisture, and to prevent sun scald and freezing of the new growth of seedlings.

2. Specifications:

From Table IV-4 select the type of mulch and rate of application that will best suit the conditions at the site.

3. Anchoring

Depending on the field situation, mulch may not stay in place because of wind action or rapid water runoff. In such cases, mulch is to be anchored mechanically or with mulch netting.

a. Mechanical Anchoring

Apply mulch and pull a mulch anchoring tool over the mulch. When a disk is used, set the disk straight and pull across the slope. Mulch material should be tucked into the soil about three inches.

b. Mulch Netting

Follow manufacturer's recommendations when positioning and stapling the mulch netting to the soil surface.

E. Fencing

Newly seeded areas must be protected from livestock for one full year. Where livestock are to be present, planners should consult the affected landowner to coordinate the fence type and layout.

Table IV-1

Temporary Seedings for Critical Areas

Seed	Rates in lbs. Per Acre	Recommended Date
Annual Ryegrass	40	Mar.1 to June 1 Aug. 15 to Sept. 15
Spring Oats	96	Mar. 1 to June 15
Rye Grain	140	Aug. 15 to Oct. 15
Annual Ryegrass	26	Mar. 1 to June 15
Spring Oats	64	Mar. 1 to June 15

Table IV-2

Permanent Seedings for All Disturbed Areas

Seed	Rate in Lbs. per Acre	Notes
Tall Fescue Ladino Clover	40 5	Best Used in Wooded Area or Pasture
Tall Fescue Birdsfoot Trefoil	30 10	Wooded or Pasture over 1500 elev.
Tall Fescue Crownvetch	30 10	Wooded areas, steep banks low maintenance
Orchardgrass Birdsfoort Trefoil	12 10	Meadow elev. over 1500
Orchardgrass Ladino	12 3	Meadow
Kentucky Bluegrass Redtop White Clover	20 5 2	Pasture
Kentucky Bluegrass Redtop Birdsfoot Trefoil	20 5 10	Pasture Elev. over 1500

Seeding is not recommended during the month of November
Use only Endophyte-Free variety of tall fescue
Inoculate all legume seeds
Use 4 times the inoculant when hydroseeding

Table IV-3

Lime and Fertilizer Application Table

pH of Soil	Lime in Tons Per Acre	Fertilizer, lbs. per Acre 10-20-20- or Equivalent
Above 6.0	2	500
5.0 to 6.0	3	500
Below 5.0	4	500

The pH can be determined with a portable pH testing kit or by sending the soil samples to a soil testing laboratory.

When 4 tons of lime per acre are applied it must be incorporated into the soil by disking, backblading or tracking up and down the slope.

Table IV-4

Mulch Materials Rates and Uses

Material	Minimum Rates Per Acre	Coverage	Remarks
Hay or Straw	2 to 3 Tons 100 to 150 Bales	Cover 75 To 90% of Surface	Subject to Wind blowing or washing unless tied down
Wood Fiber Pulp Fiber Wood-Cellulose Recirculated Paper	1000 to 1500 lbs.	Cover all Disturbed Areas	For Hydroseeding

MAINTENANCE

Section V
Maintenance

Index

A. Long-Term Maintenance

1. General

All revegetated access roads and well sites are to be maintained throughout the life of the well. Culverts, road ditches, broad-based dips, and diversion ditches must be maintained in proper working order. Whenever the soil is disturbed on any well or road by well-related activity, it will be revegetated according to this manual.

B. Description of Grasses and Legumes for use in Revegetation

1. Temporary Seeding—Annual Grasses

a. Oats (Avena sativa): A cool season annual grass primarily grown for animal feed and human consumption, but also used for soil stabilization. Oats are usually seeded in early spring. Seeding rates are 3 bushels (100 lbs.) per acre or 2 lbs. per 1,000 square feet.

b. Annual Ryegrass (Lolium multiflorum): An annual bunch-grass that grows from one to two feet tall. Rye grasses cross-pollinate, so "common ryegrass" may be a mixture of annual and perennial species. Annual Ryegrass is adaptable throughout West Virginia. It grows best on dark, rich soils in mild climates. A firm, mellow surface over compact subsoil gives good results. It does not withstand dry, hot weather or severe winters. It will tolerate wet soils with good surface drainage. Annual Ryegrass germinates rapidly, which makes it particularly suited to disturbed-area stabilization and temporary seeding. However, it should not be used where volunteers will cause problems later. Seeding rates are 60 lbs. per acre or 1 1/2 lbs. per 1,000 square feet; lesser amounts are suitable in mixtures, depending on the characteristics of the companion species.

2. Permanent Seeding—Perennial Grasses and Legumes

a. Kentucky Bluegrass (Poa pretense): A long-lived, cool-season perennial which forms a dense sod; it may be used to stabilize waterways, slopes, cuts and fills, as well as lawns, athletic fields, golf courses and playgrounds. It is well adapted to well-drained, fertile soils and the climate throughout West Virginia. The optimum soil pH ranges from 6.0 to 7.0. Bluegrass is essentially

dormant during dry or hot weather, but it will survive severe drought. It requires a firm, weed-free seedbed, and adequate fertilizer (liberal phosphorous) and lime are important. The minimum mowing height is 1 1/2 inches; critical erosion areas may be mowed only once a year. Several varieties of bluegrass may be used together to ensure good stand survival.

b. Tall Fescue (Festuca arundinacea): A cool-season perennial that is commonly used for pastures, hay, recreational areas and low maintenance lawns as well as for stabilization of waterways, banks, slopes, cuts, fills and spoils. Tall/Fescue is currently the most widely used grass for stabilizing large disturbed areas. It is a robust, long-lived, deep-rooted bunchy grass which may have short rhizomes (underground stems). It is adaptable throughout West Virginia to a wide range of climate conditions. The optimum soil pH is from 6.0 to 7.0, but it will tolerate ph from 3.0 to 8.0. This grass will grow on shallow and claypan soils if they are moist. Growth is limited more by moisture than by temperature extremes, but it will tolerate drought, infertile soils and moderate shade. Tall fescue requires a firm seedbed. Hydroseeding can be used successfully. Legumes are difficult to maintain in fescue stands due to the aggressive growth habits of this grass. Mowing is desirable on critical erosion areas, at least once every two years; lack of periodic mowing will encourage clumpiness. Some varieties of tall fescue are host to an endophyte fungus damaging to livestock, so a fungus-resistant variety should be used when seeding near pasture areas.

c. Redtop (Agrostis alba): A coarse, cool-season, short-lived perennial grass with rhizomes; used for pasture, companion grass in turf seedings, and stabilization of ditch and channel banks, grassed waterways and other disturbed areas. It will grow from 30 to 60 inches high. No improved varieties have been developed. Redtop is adaptable throughout West Virginia, but it grows best in the cool, humid parts of the state. It will grow under a wide variety of soil and moisture conditions. It grows on very acid soils (pH 4.0 to 7.5) and poor clayey soils of low fertility. It is drought resistant, but it is also a useful wetland grass. Redtop has very small seeds and requires a compact seedbed. It is not recommended for seeding alone. Adequate fertilization is essential on critical erosion areas to obtain good cover rapidly. Redtop will disappear from a stand under frequent low mowing.

d. Orchardgrass (Dactylis glomerata): A long-lived, cool-season bunch-type grass commonly grown for hay or pasture. It is an early maturing grass, adapted well to conditions throughout the Northeast. Orchardgrass performs best on soils that are adequately supported with lime and a complete fertilizer. It is not well adapted to tight, poorly drained soils.

e. Crown Vetch (Coronilla varia): A cool-season perennial herbaceous legume with a reclining growth habit. It reaches 2 to 3 feet in height, and it does not climb or twine. Crown Vetch is used primarily for erosion control of critical areas such as steep roadbanks, surface mine spoil, and industrial waste areas. It is also useful as a residential ground cover. It is deep-rooted, winter-hardy, and drought tolerant. It also tolerates moderate shade. It grows best on well-drained soils with a ph range of from 5.5 to 8.3. It will persist on more acid soils for a prolonged period once established. It is not adapted to soils with poor drainage. The varieties Chemung, Penngift and Emerald are commonly used in West Virginia. Only inoculated seed should be used. Crown Vetch requires at least 500 lbs. per acre of 5-10-10 fertilizer, or the area should be fertilized according to soil test results. Soil acidity must be raised above a pH of 5.5 . Crown Vetch will not persist under frequent mowing.

f. White Clover & Ladino Clover (Trifolium repens): A cool-season perennial legume. There are two types of White Cover. One is Ladino White Clover, which is the large-growing type commonly used for hay and silage in mixture

with a grass. The other is the Common White Clover used mostly for pasture, whose thick growing and spreading characteristics makes it ideal for erosion control. The common type has a prostrate type of growth, while the Ladino is more upright. Both spread by stolons and by roots at the nodes. Representative common varieties used in West Virginia are Tillman, Common and White Dutch. Ladino is the only cultivar for the large type. White Clover thrives in cool climates and on moist, rich soils with full sun. It will not tolerate extremes of cold or drought. Where soil is not adequate, Ladino is short lived. Optimum soil pH is 6.5, but is will grow in a pH range of from 5.0 to 7.5. Common White Clover volunteers readily in bluegrass mixtures where moderate to high fertility is maintained. Stands are persistent. Ladino Clover requires inoculation, fertilizing and liming for successful growth. Phosphorous and potash are the key fertilizer elements required. Ladino makes a good companion crop with grasses such as orchardgrass, broomgrass, tall fescue and timothy. These grasses will normally crowd out the Ladino after 2 to 3 years. Seed should be planted (drilled or broadcast) at shallow depths, and firm seedbed is desirable.

g. Birdsfoot Trefoil (Lotus corniculatus): A perennial legume used for pasture, hay, erosion control, wildlife food and cover. It has a well developed tap-like root with many roots near the surface. It is best adapted to higher elevations on a variety of soil conditions. It grows poorly on poorly drained soils. The best pH range is 6.0 to 6.5. Will not survive in continually pastured areas.