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SEDIMENT CONTROL

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SECTION 25 SEDIMENT CONTROL PLAN

The primary control measure applied in the Pinabete Mine Plan permit area (permit area) to comply with the applicable effluent standards will be retaining the effluent or surface runoff from the disturbed areas in sedimentation ponds for evaporation. The evaporation rate of permit area is high, at 55 inches per year, as discussed in Section 12 (Climate). Sedimentation ponds are designed to retain the surface runoff and sediment from either the 100yr-6hr or 10yr-24hr storm event. BHP Navajo Coal Company (BNCC) will discharge from areas covered under the National Pollutant Discharge Elimination System (NPDES) Multi-Sector General Permit (MSGP) Subpart H areas. BNCC utilizes engineered structures or other best management practices (BMPs) to comply with the NPDES effluent limitations for point-source and storm-water discharges. In many areas BNCC will utilize ponds as BMP structures to contain run off from precipitation events up to and including the 10yr-24hr event. All discharges from the mine site will be covered under either an individual or NPDES MSGP permit where required. Discharges from reclamation areas off of the permit area will comply with 40 CFR Part 434 Subpart H.

25.1 Mining and Reclamation Practices and Methods to Control Erosion and Sediment

The sediment control methods described in Section 25.4 are applied to the mining and reclamation operations to prevent, to the extent possible, additional contribution of sediment to stream flow and to comply with applicable regulations. Refer to Section 18 (Water Resources) for the applicable water quality standards and regulations. The control of sediment and erosion from regraded spoils and reclaimed surfaces is discussed in Section 38 (Post-Reclamation Surface Stabilization and Sediment Control). Below is the description of the practices and methods applied to the affected areas to control drainage, erosion, and sediment.

25.1.1 Areas Subject to Effluent Limitations

25.1.1.1 Active Mining and Reclamation Areas

The active mining and reclamation areas consist of the following operational activities or areas: topdressing removal; overburden drilling, storage, and stripping; pits; spoil rows or piles; regraded spoils; and primary/final regrading of the last spoil row. Berms are utilized to convey surface flows from active mining and reclamation areas to a ramp or the mining pit, a depression in ungraded spoils, a depression or dugout sump along the berm, or a sediment pond. The retained water can be evaporated, used to suppress dust on haulroads, or discharged if the NPDES permit conditions are met. In many areas, BNCC will utilize ponds as BMP structures to contain surface flows from precipitation events up to and including the 10yr-24hr event. All discharges from disturbed areas will be covered under an NPDES permit where required.

The surface runoff and sediment from the disturbed areas will be retained in sediment ponds constructed downstream of the disturbance area or highwall. A diversion berm will be constructed along the edge of

topdressing removal disturbance to convey flows to topographic lows or existing drainages. At the low points or existing drainages the berm will be left open to allow flows to continue to the sediment ponds downstream. Typical layout of the diversion berm is presented on Exhibit 25.4-1. The sediment ponds located downstream of the pit are presented in the drainage control plan (Section 26, Drainage Control Plan) on Exhibit 26.1-1.

As part of reclamation, BNCC will remove temporary post-reclamation structures as described in its reclamation plans detailed in Section 35 (Hydrologic Reclamation Plan) and Section 38 (Post-Reclamation Surface Stabilization and Sediment Control). After erosion control measures sufficient to minimize the erosion rate to less than or equal to pre-mine levels have been installed, the reclamation areas will be reconnected to the native drainages that surround the permit area in accordance with 40 CFR Part 434 Subpart H. If the surface runoff from an active mining area has a potential to leave the permit area, or enter a reclaimed area downstream, a sediment pond will be constructed to retain the surface runoff and sediment. The pond will be located in either an existing drainage adjacent to the disturbed area or a reestablished drainage in the reclamation area. As reclamation progresses, watershed sizes can increase. It may be necessary to place additional ponds in series to retain the runoff and meet 40 CFR Part 434 standards until the area can be completely reclaimed. Berms can be used to prevent sediment and flows from leaving the disturbed area and to convey flows to sedimentation ponds.

The sequence in which reclamation area sediment controls are put into place is important to the functioning of the controls. The sequence is as follows:

1. Berms, ditches, and other drainage control structures are constructed to prevent surface runoff from the spoils from entering reclaimed areas, undisturbed lands, or leaving the permit area.
2. Spoils are regraded to the approximate original contours (AOC) topography with dozers and motor graders (see Section 34, Post-Reclamation Topography, for a complete description of the backfilling and grading operation). During this phase, additional berms and ditches can be constructed as required.
3. Topdressing is placed and spread onto the regraded spoils.
4. Berms and ditches that are no longer needed are removed.
5. The seedbed is prepared and the area is seeded.
6. Mulch is applied to the seeded area and crimped, and the remaining steps of the revegetation plan are carried out to establish a diverse, effective vegetation cover (Section 37, Post-Reclamation Vegetation).

As mining progresses, disturbed areas are reclaimed as described above. To prevent possible degradation of the downstream reclaimed or topdressed and seeded areas, berms and ditches will remain in place as long as practically possible during topdressing placement. Generally, berms are removed by blending the

material into the adjacent regraded spoils. In the process of removing the berms, positive drainage must be maintained in the drainage ways and on sloping surfaces. To achieve this, there must be sufficient area or distance adjacent to the berm to spread and blend in the material. Therefore, as topdressing placement approaches onto a berm, the berm must be removed while there is still sufficient distance remaining to spread and blend in the material.

If a large storm event occurs, excess water accumulated in the pit will be pumped to one or more sediment ponds. The design volume of the ponds will be maintained; the pumping will be only to ponds with sufficient capacity to accommodate additional water without jeopardizing the design volume. If there is no extra capacity in the ponds, the water or effluent can be pumped to an existing drainage for discharge if the standards of the appropriate NPDES permit are met.

25.1.1.2 Topdressing Stockpile Areas

Topdressing material will be removed in advance of mining and from the disturbed areas associated with the construction of mine support facilities. The topdressing will either be placed in stockpiles or direct hauled and spread onto available regraded areas.

Topdressing stockpiles are managed in a manner to minimize wind and water erosion, and to avoid sources of contamination. A perimeter berm and/or surface water-control structure will be constructed around the stockpiles to minimize loss and contamination from water erosion. To minimize loss from water and wind erosion, stockpile surfaces (i.e., sides and tops) will be stabilized by mulching and seeding. Topdressing stockpiles that will remain undisturbed for longer than six months will be mulched and those that will be undisturbed for one year or longer will be seeded and mulched during the next appropriate seeding period. After a stockpile is depleted, and if appropriate, the stockpile area will be left with adequate topdressing so that it can also be reclaimed. All stockpiles are clearly marked so that other mining activities do not inadvertently disturb or contaminate them. The berms and ditches are inspected on a routine basis and repaired as needed. Refer to Section 22 (Support Facilities) for more information on topdressing stockpiles.

The typical berm and ditch shown on Figure 22.9-1 will be used on stockpiles that have other surface drainage controls downstream, such as sediment ponds, impoundments, or the mining pit. They will not be used on the stockpiles where there would be potential for a discharge to occur onto an undisturbed area, reclaimed area, or off the permit area. If such is the case, a site-specific design certified by a professional engineer will be submitted for approval.

25.1.1.3 Field Coal Stockpile Area

Run-of-mine coal from the pit will be stockpiled at the field coal stockpile facility. The sediment and surface runoff from the disturbed area associated with the coal stockpile will be captured and retained in sedimentation ponds. The ponds will be located adjacent to the stockpile area in existing drainages or inside the stockpile area. Berms can be used to prevent sediment and flows from leaving the disturbed area and to convey flows to the sedimentation ponds. The water retained is usually evaporated but may be used to suppress dust on haulroads. There will be no discharge from this facility onto undisturbed areas or off the permit area from precipitation events up to and including the 10yr-24hr event. All discharges from the disturbed areas will be covered under an NPDES permit where required.

25.1.2 Areas Subject to Storm-water Permit Requirements

The affected areas and activities subject to storm-water permit requirements as stated in the NPDES MSGP Subpart H for coal mines and coal mining-related facilities include primary roads, ancillary roads, and temporary diversions (including material and topdressing stockpiles associated with the diversions). The methods applied to control drainage, erosion, and sediment from disturbed areas associated with primary and ancillary roads are discussed in Section 23 (Roads). Prior to commencing construction of any facility subject to MSGP 2008 Subpart H and construction general permits requirements, BNCC will acquire coverage via a notice of intent by submission of a Stormwater Pollution Prevention Plan (SWPPP) to the U.S. Environmental Protection Agency (USEPA).

25.1.3 Minimizing the Disturbed Area

Mine support facilities and infrastructure will be constructed per approved design plans. To minimize surface disturbance, excavation and placement of fill material will be limited to the catch lines and grades indicated on the approved plans.

In advance of mining, the maximum extent of allowable disturbance for topdressing removal will be 1,800 feet beyond the highwall. For a more detailed description of topdressing removal refer to Section 36 (Post-Reclamation Soil). Information regarding the mining sequence and area mined by years is presented in Section 20 (Mining Operations).

In the reclamation areas, backfilling and regrading to the final surface configuration (FSC) or AOC surface will be done contemporaneously to the extent practicable. For more details about the backfill and grading plan refer to Section 34 (Post-Reclamation Topography).

25.1.4 Diverting Runoff from Undisturbed Lands

The grading or drainage plans for the mine support facilities minimize, to the extent practicable, the co-mingling of flows from undisturbed and disturbed areas. If the topography is favorable, flows from the undisturbed areas are diverted either around or away from the area to be disturbed using berms, ditches, or channels. The design of the diversion structures is included in the designs for the support facilities (i.e., coal stockpile areas, blasting agents storage facility, topdressing stockpiles, etc.). Refer to Section 22 (Support Facilities) for description and design of mine support facilities.

Flows from undisturbed areas into a disturbed area will generally occur when the surface of an undisturbed area slopes toward an active reclamation or mining area. On the reclamation side, the flows from the undisturbed area and disturbed area (i.e., ungraded spoils, regraded spoils, and reclaimed areas) will co-mingle. Berms or ditches will be utilized to convey the flows to a depression in ungraded spoils, a ramp or the mining pit, or a sediment pond. On the highwall side or in the immediate mining area (IMA) (i.e., area of topsoil removal, truck/loader operation, blasting, and mining operations), the flows are usually retained in the mining pit, up against a safety berm at the crest of the highwall, or impounded. If the watershed of the undisturbed area is small, the flows can enter the pit or be retained against the safety berm at the crest of the highwall. However, if the watershed upstream of the IMA is large, it may be necessary to construct highwall impoundments to minimize inflows into the pit and IMA. The impoundments will be located upstream of the IMA on the highwall side of the pit. The primary intent is to retain all or a portion of the smaller intensity but more frequently occurring precipitation events, thereby enhancing the safety of the work areas in the IMA. Refer to Section 26 (Drainage Control Plan) for more information on highwall impoundments.

25.1.5 Stabilizing Exposed Surfaces and Backfilled Areas

To minimize loss from water and wind erosion, topdressing stockpile surfaces will be stabilized by mulching and seeding. Topdressing stockpiles that will remain undisturbed for longer than six months will be mulched and those that will be undisturbed for one year or longer will be seeded and mulched during the next appropriate seeding period, using the procedures outlined in Section 37 (Post-Reclamation Vegetation).

The backfilling and grading of spoil material to AOC topography will be done using fluvial geomorphic principles. This method of regrading will effectively stabilize graded spoil material and reclaimed surfaces to minimize erosion. Refer to Section 38 (Post-Reclamation Surface Stabilization and Sediment Control) for detailed discussion on using fluvial geomorphic principles to stabilize and control erosion from regraded spoils and reclaimed surfaces. The sequencing, timing, and schedule to regrade spoil material to AOC topography are provided in the backfill and grading plan provided in Section 34 (Post-Reclamation

Topography). The permanent vegetation to be established on reclaimed lands is discussed in Section 37 (Post-Reclamation Vegetation).

25.1.6 Retaining Sediment in the Disturbed Area

In the active mining and reclamation areas, storm-water flows containing sediment are retained within the disturbed area by using berms to convey surface flows to a ramp or the mining pit, a depression in ungraded spoils, a depression or dugout sump along the berm, or a sediment pond. Refer to Exhibit 25.4-1 for a typical drainage plan in active mining and reclamation areas.

The drainage or grading plan developed for each mine support facility (i.e., coal stockpiles, truck dump, topdressing stockpiles, etc.) was developed in a manner to retain surface flows and sediment from within the disturbed area. Berms, ditches, or channels are utilized to divert or convey flows.

25.2 Sediment Control Practices, Methods, Structures, and Facilities

The primary control measure used to comply with the applicable effluent standards is retaining the effluent or surface runoff from the disturbed areas in sedimentation ponds for evaporation. Sedimentation ponds are designed to retain the surface runoff and sediment from either the 100yr-6hr or 10yr-24hr storm event. There will be no discharge onto undisturbed areas or off the permit area from precipitation events up to and including the 10yr-24hr event. All discharges from the disturbed areas will be covered under an NPDES permit where required. BNCC will obtain an individual NPDES permit for discharges not authorized under the MSGP 2008 (see Section 25.1.2). The watersheds of the areas that will be covered under individual NPDES permit are detailed in this section. Refer to Section 26 (Drainage Control Plan) for description of design and operation of sedimentation ponds. Table 26.2-1 provides the references for locating supporting design data and design drawings.

25.2.1 Sediment Control Watersheds

The sediment control structure watersheds were delineated using aerial mapping on 10-feet contours. The watershed areas for the NPDES individual permit outfall points and sediment control structures are presented on Exhibit 25.2-1. Table 25.2-1 identifies the watershed associated with each NPDES individual permit outfall point and the type of control measure used.

25.2.1.1 Area 4 North Pond 415 Watershed for NPDES Outfall Point #1

Area 4 North Pond 415 is a sediment pond located at NPDES Outfall #1 that will retain the surface runoff and sediment from the disturbed area associated with mining and reclamation operations. Berms, v-ditches, or channels are used to divert flows from the disturbed areas into the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control

measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.2 Area 4 North Pond 416 Watershed for NPDES Outfall Point #2

Area 4 North Pond 416 is a sediment pond located at NPDES Outfall #2 that will retain the surface runoff and sediment from the disturbed area associated with the mining and reclamation operations. Berms, v-ditches, or channels are used to divert flows from the disturbed areas into the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.3 Area 4 North Pond 417 Watershed for NPDES Outfall Point #3

Area 4 North Pond 417 is a sediment pond located at NPDES Outfall #3 that will retain the surface runoff and sediment from the disturbed area associated with future mining and reclamation operations. Berms, v-ditches, or channels are used to divert flows from the disturbed areas into the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.4 Area North Pond 418 Watershed for NPDES Outfall Point #4

Area 4 North Pond 418 is a sediment pond located at NPDES Outfall #4 that will retain the surface runoff and sediment from the disturbed area associated with the future mining and reclamation area. Berms, v-ditches, or channels are used to divert flows from the disturbed areas into the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.5 Area 4 North Pond 419 Watershed for NPDES Outfall Point #5

Area 4 North Pond 419 is a sediment pond located at NPDES Outfall #5 that will retain the surface runoff and sediment from the disturbed area associated with future coal stockpile, mining and reclamation operations. Berms, v-ditches or channels are used to divert flows from the disturbed areas into the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on

sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.6 Area 4 North Pond 420 Watershed for NPDES Outfall Point #6

Area 4 North Pond 420 is a sediment pond located at NPDES Outfall #6 that will retain the surface runoff and sediment from the disturbed area associated with future mining and reclamation operations. The existing natural drainage ways will divert flows from the disturbed areas into the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.7 Area 4 North Pond 421 Watershed for NPDES Outfall Point #7

Area 4 North Pond 421 is a sediment pond located at NPDES Outfall #7 that will retain the surface runoff and sediment from the disturbed area associated with future mining and reclamation operations. Berms, v-ditches, or channels are used to divert flows from the disturbed areas to the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.8 Area 4 South Pond 422 Watershed for NPDES Outfall Point #8

Area 4 North Pond 422 is a sediment pond located at NPDES Outfall #8 that will retain the surface runoff and sediment from the disturbed area associated with future mining and reclamation operations. Berms, v-ditches, or channels are used to divert flows from the disturbed areas to the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.9 Area 4 South Pond 423 Watershed for NPDES Outfall Point #9

Area 4 North Pond 423 is a sediment pond located at NPDES Outfall #9 that will retain the surface runoff and sediment from the disturbed area associated with future mining and reclamation operations. Berms, v-ditches, or channels are used to divert flows from the disturbed areas to the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control

measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.10 Area 4 South Pond 424 Watershed for NPDES Outfall Point #10

Area 4 North Pond 424 is a sediment pond located at NPDES Outfall #10 that will retain the surface runoff and sediment from the disturbed area associated with future mining and reclamation operations. Berms, v-ditches, or channels are used to divert flows from the disturbed areas to the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.11 Area 4 South Pond 425 Watershed for NPDES Outfall Point #11

Area 4 North Pond 425 is a sediment pond located at NPDES Outfall #11 that will retain the surface runoff and sediment from the disturbed area associated with future mining and reclamation operations. Berms, v-ditches, or channels are used to divert flows from the disturbed areas to the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.12 Area 4 South Pond 426 Watershed for NPDES Outfall Point #12

Area 4 North Pond 426 is a sediment pond located at NPDES Outfall #12 that will retain the surface runoff and sediment from the disturbed area associated with future mining and reclamation operations. Berms, v-ditches, or channels are used to divert flows from the disturbed areas to the pond. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.12 TS-404 Pond 427 Watershed for NPDES Outfall Point #13

TS-404 Pond 426 is a sediment pond located at NPDES Outfall #12 that will retain the surface runoff and sediment from the disturbed area associated with future Topdressing Stockpile TS-404. A perimeter berm adjacent to the toe of the stockpile will divert flows from the stockpile area to the pond. Retaining the surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Refer to Section 22 (Support Facilities) for additional control measures and the operation of the

topdressing stockpiles. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.1.13 TS-406 Pond 428 Watershed for NPDES Outfall Point #14

TS-406 Pond 428 is a sediment pond located at NPDES Outfall #14 that will retain the surface runoff and sediment from the disturbed area associated with future Topdressing Stockpile TS-406. A perimeter berm adjacent to the toe of the stockpile will divert flows from the stockpile area to the pond. Retaining the surface runoff from the disturbed areas in the pond for evaporation ensures compliance with the applicable effluent standards. Refer to Section 25.4 for more information on sedimentation ponds and other control measures. Refer to Section 22 (Support Facilities) for additional control measures and the operation of the topdressing stockpiles. Pond design information is contained in Table 26.2-1 in Section 26 (Drainage Control Structures).

25.2.2 Reclaimed Area Watershed

Currently there are no reclaimed areas (i.e., areas where Phase II Bond Release has been granted; Section 51, Reclamation Schedule) within the permit area. As mining and reclamation progresses and reclaimed areas become available the required information will be incorporated into this section.

25.2.3 Small Area Exemption Watershed

Currently there are no small area exemptions, but if the need for them should arise in the future this section will be revised accordingly.

25.2.4 Alternate Sediment Control Measures

Fluvial geomorphic concepts will be utilized to regrade spoil material to AOC topography. This method of regrading will effectively stabilize the graded spoil material and reclaimed surfaces. Refer to Section 38 (Post-Reclamation Surface Stabilization and Sediment Control) for detailed discussion on using geomorphic concepts to stabilize and control erosion from regraded spoils and reclaimed surfaces.

25.3 Chemical Treatment

There is no need to chemically treat effluent to comply with effluent standards.

25.4 Use of Best Technology Currently Available

The best technology currently available will be utilized to control sediment from the disturbed areas. Structures will be designed, constructed, and maintained in a manner to prevent additional contributions of sediment to stream flow or to runoff outside the permit area to the extent possible. The following subsections detail sediment control structures to be used in the mining and reclamation operations.

25.4.1 Sedimentation Ponds

Sedimentation ponds or impoundments are used to retain and/or treat surface runoff or effluent from the disturbed areas (i.e., active mining areas, coal stockpile areas, reclamation areas, and support facility areas). Ponds will be designed to retain the runoff from either the 10yr-24hr or 100yr-6hr precipitation event. There will be no discharge from storm events less than and including the 10yr-24hr precipitation event. All discharges from the disturbed areas will be covered under an NPDES permit where required. Retained water will be evaporated or used for dust suppression purposes. Refer to Section 26 (Drainage Control Plan) for more details on sedimentation ponds.

25.4.2 Diversion Berms

V-ditches and berms are used to: 1) convey flows from disturbed areas to sediment ponds; 2) divert flows from undisturbed areas away from disturbed areas; 3) divert flows from disturbed areas into ramps, pits, depressions or dugout sumps, etc., thereby retaining the runoff within the disturbed areas; and 4) retain surface runoff from topdressing stockpiles, thus retaining the runoff within the disturbed area and preventing loss or contamination of topdressing material.

Diversion berms will be used to prevent runoff from active mining or regraded areas from leaving the permit area or entering reclamation and reclaimed areas. The berms function as a diversion structure to convey flows to a retaining structure (i.e., sediment pond, mining pit/ramp, depression, or dugout sumps). There are three situations where the berms are required:

1. In advance of topdressing removal where the general slope of the land will allow water to flow away from the advancing highwall and away from existing drainage control structures;
2. Following mining where the final grading is occurring and the general slope of the land allows water to flow toward reclaimed areas or off the permit area;
3. Areas at the end of the pits where drainage from topdressing-stripped areas, spoils, or regraded areas have potential to leave the permit area or enter reclaimed lands.

Berms are also utilized around mine support facility areas to prevent sediment and flows from leaving the disturbed area and to convey flows to sedimentation ponds.

Several factors are considered in the design criteria for diversion berms; the most important dimension of the immediate mining area diversion berm is the height. Two drainage conditions determine the height: water flowing along a berm (thus, the berm effectively functions as a diversion) and water contained by the berm in areas of relatively small depression. The maximum height of the diversion berm will be 4 feet, except in areas where the berm crosses topographical lows, in which case the berm can be 7.5 feet high. A diversion berm can impound water in low areas. The maximum depth of water behind a diversion berm

will be 6.5 feet (3.3 feet of running water and 3.2 feet of standing water). See Exhibit 25.4-1 for a typical design of a diversion berm.

The assumptions and design criteria used for diversion berms are as follows:

- A minimum of 1 foot of freeboard will be maintained at all times
- The 10yr-24hr design storm event (1.7 inches of rainfall) will be used
- Type II-70 storm type
- Maximum delta Z is 125 feet to calculate time of concentration (Tc)
- Areas have a Curve Number of 89
- Maximum area of concern is 300 acres
- Minimum area of concern is 25 acres
- Areas are approximated as squares (conservative for calculating Tc)
- Areas have a flow length equal to the square root of the area times 1.5
- Berm serves as an erodible channel
- Manning's number (n) assumed at 0.03
- Berm side grade = 2:1
- Regraded slope of 1% - 15% adjacent
- Flowline grade 1% - 15%
- Berm height can be calculated from the following reformatted Manning's equation:

$$b = \left(\frac{Qn\left(C_2^{\,2/3}\right)}{1.486\left(\frac{FS}{100}\right)^{1/2}\left(C_1^{\,5/3}\right)} \right)^{3/8}$$

where;

b	=	berm height
Q	=	peak flow (cfs) from drainage area
n	=	Manning's number
FS	=	flowline grade in percent
C_1	=	$1 + 50/IS$
IS	=	internal embankment grade
C_2	=	$(5)^{1/2} + ([IS^2 + 100^2]^{1/2}\ IS)$

From the above, the minimum calculated height for the berm is 1.3 feet and the maximum is 3.3 feet. From this equation it was also noted that some flows will exceed the erosive velocity of the soil; however, because the channels are generally in spoil, they will self-armor over time. Sediment will be retained within the disturbed areas not yet reclaimed and will not leave the permit area. For supporting data see Appendix 25.A.

25.4.3 Alternate Sediment Control Measures

If hydraulic analysis indicates that a protective lining is required to minimize erosion, riprap material will be used as a liner. Riprap will be utilized in channels or ditches with steep gradients, such as inlets into sediment ponds and some relief ditches along roads. The riprap specifications will be determined by the magnitude of the flow and channel gradient.

25.5 Certification of Designs and Exhibits

Certified design exhibits for Section 25 (Sediment Control Plan) are available for review upon request at either the mine office or the Office of Surface Mining Reclamation and Enforcement (OSM), Western Region, technical office in Denver, Colorado. Certified as-built exhibits for Section 25 (Sediment Control Plan) are available for review upon request at the mine office.

Personnel

Persons or organizations responsible for data collection, analysis, and preparation of this permit application package section:

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Table 25.2-1 NPDES Outfall Points and Sediment Control Measures

Watershed ID.	NPDES Outfall Point ID.	Watershed Area (ac)	Disturbed Area (ac)	Disturbance Type:	Type of Control Measure	Structure ID.
Area 4 North Pond 415	NPDES Outfall #1	5.6	5.6	Disturbed area surface drainage	Sedimentation Pond	Pond 415
Area 4 North Pond 416	NPDES Outfall #2	128.1	128.1	Disturbed area surface drainage	Sedimentation Pond	Pond 416
Area 4 North Pond 417	NPDES Outfall #3	261.8	261.8	Disturbed area surface drainage	Sedimentation Pond	Pond 417
Area 4 North Pond 418	NPDES Outfall #4	233.5	233.5	Disturbed area surface drainage	Sedimentation Pond	Pond 418
Area 4 North Pond 419	NPDES Outfall #5	199.3	199.3	Disturbed area surface drainage	Sedimentation Pond	Pond 419
Area 4 North Pond420	NPDES Outfall #6	387.4	387.4	Disturbed area surface drainage	Sedimentation Pond	Pond 420
Area 4 North Pond 421	NPDES Outfall #7	148.8	148.8	Disturbed area surface drainage	Sedimentation Pond	Pond 421
Area 4 South Pond 422	NPDES Outfall #8	476.7	464.3	Disturbed area surface drainage	Sedimentation Pond	Pond 422
Area 4 South Pond 423	NPDES Outfall #9	949.3	900.3	Disturbed area surface drainage	Sedimentation Pond	Pond 423
Area 4 South Pond 424	NPDES Outfall #10	45.0	45.0	Disturbed area surface drainage	Sedimentation Pond	Pond 424

Watershed ID.	NPDES Outfall Point ID.	Watershed Area (ac)	Disturbed Area (ac)	Disturbance Type:	Type of Control Measure	Structure ID.
Area 4 South Pond 425	NPDES Outfall #11	218.2	190.4	Disturbed area surface drainage	Sedimentation Pond	Pond 425
Area 4 South Pond 426	NPDES Outfall #12	81.5	70.0	Disturbed area surface drainage	Sedimentation Pond	Pond 426
Area 4 South Pond 427	NPDES Outfall #13	23.1	23.1	Disturbed area surface drainage	Sedimentation Pond	Pond 428
Area 4 North Pond 428	NPDES Outfall #14	5.4	5.4	Disturbed area surface drainage	Sedimentation Pond	Pond 428

AREA IV NORTH

AREA IV SOUTH

Pond 3
Pond 412
Pond 411
NM07
TS-403
Pond 406
West Haulroad (Future)
NPDES Outfall #6
Pond 420 (Future)
69 KV POWERLINE
NPDES Outfall #7
Pond 421 (Future)
NPDES Outfall #8
Pond 422 (Future)
69 KV POWERLINE
Pinabete Arroyo
NPDES Outfall #9
Pond 423 (Future)
NPDES Outfall #10
Pond 424 (Future)
NPDES Outfall #11
Pond 425 (Future)
NPDES Outfall #12
Pond 426 (Future)
WELL PA-1 ACCESS ROAD
NPDES Outfall #13
Pond 427 (Future)
WELL KPC-98-01 ACCESS ROAD
Pinabete Arroyo
TS-404
BURNHAM ROAD (B.I.A. 5082)
A4N MET 3 STA
Stub 23
Stub 23 AIR SW
S-21-69 AIR SW
S-28-69 AIR SW
NPDES Outfall #1
Pond 415 (Proposed)
NPDES Outfall #2
Pond 416 (Proposed)
NPDES Outfall #3
Pond 417 (Future)
NPDES Outfall #14
Pond 428 (Future)
TS-406
East Haulroad
Cottonwood Arroyo
69 kv Powerline
NPDES Outfall #4
Pond 418 (Future)
East haulroad
Cottonwood Arroyo
NPDES Outfall #5
Pond 419 (Future)
Burnham South Re-route
Coal Stockpile Area (Future)
East Haufroad
69 KV POWERLINE
Burnham South Re-route
VWP2007-01
Xpc98-01
Xpc2007-01
Xpc98-04

LEGEND

- PAVED ROAD
- DIRT ROAD
- HAUL ROAD
- TRAIL
- BUILDING
- FENCE
- IRRIGATION LINE
- CULVERT
- DAM
- DRAINAGE
- RAILROAD
- STEAM BUFFER ZONE
- POWERLINE
- × 5338.5 SPOT ELEVATION
- 5300 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- 218 5422.45 HORIZ. & VERT. CONTROL
- L-30 LEASE CORNER
- LEASE BOUNDARY
- POST-2016 PERMIT BOUNDARY
- MONITORING SITES
- WATERSHED BOUNDARY
- NPDES OUTFALL POINTS

500 0 500 1000

CONTOUR INTERVAL: 10'

Topo Revised by
Aero-Graphics, Inc.
2930 South West Temple
Salt Lake City, Utah 84115

Notes:
1.The design data for the mine support facilities are referenced on Tables 22.1-1, 23.2-1 and 26.2-1.

2.The hydrology and supporting design data for the drainage control structures are referenced on Table 26.2-1.

Original certified signed exhibits are maintained at the mine site and at OSM.

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	APPR BY	CHKD BY	DATE APPROVED
11-A	Feb 2012	RV	Inital Permit Submittal	RV	MD	RV

CERTIFICATION STATEMENT

I, Ron C. VAN VALKENBURG, hereby certify that this drawing was reviewed by me and that the information shown is complete and accurate to the best of my knowledge.

RON C. VAN VALKENBURG NEW MEXICO 9263 LICENSED PROFESSIONAL ENGINEER

EXHIBIT 25.2-1 SHEET-1

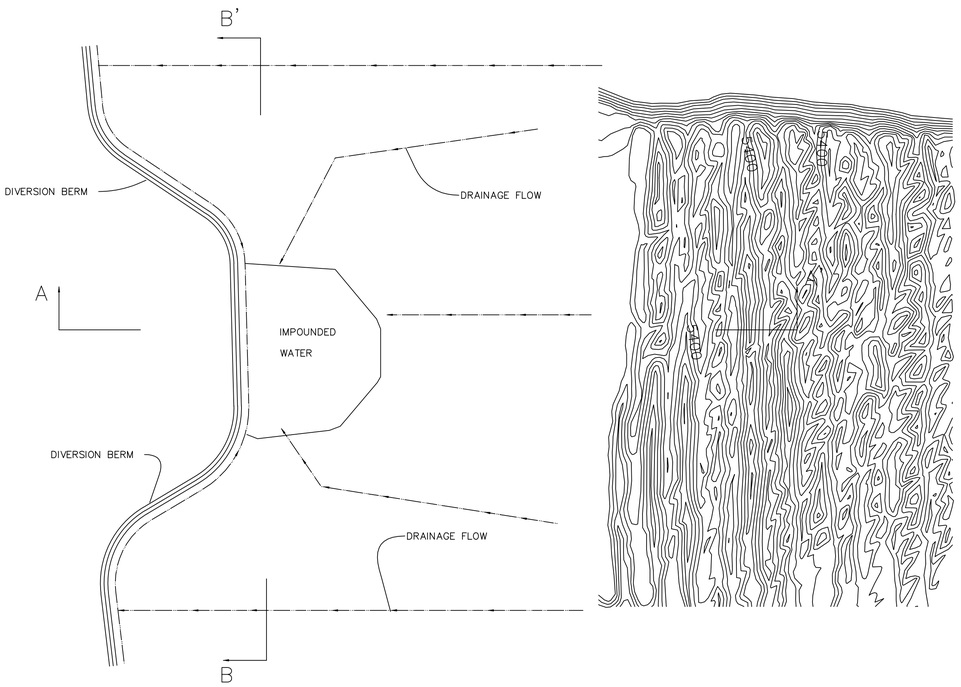
BHP NAVAJO COAL COMPANY

P.O. BOX 1717 FRUITLAND, NEW MEXICO 87416
PHONE (505)598-4200 Fax (505)598-4229

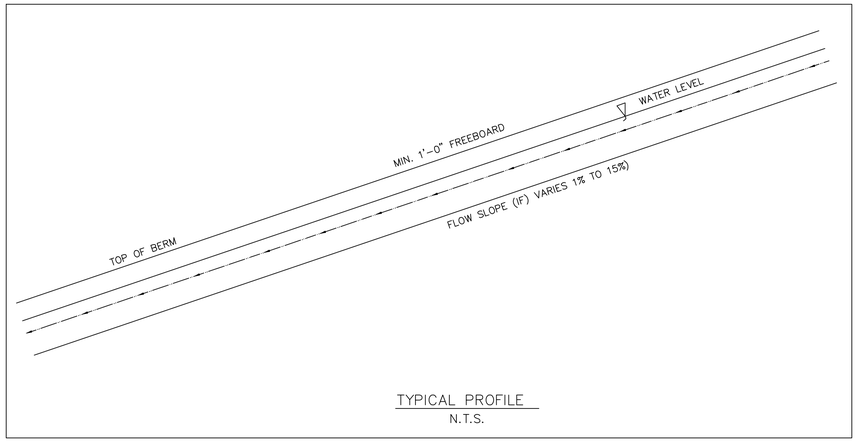
LOCATION MAP
Sediment Control Plan
NPDES Outfall Points

PREPARED BY RV	DRAWN BY RV	SCALE: 1"=500'
APPROVED BY	DATE Feb 2012	

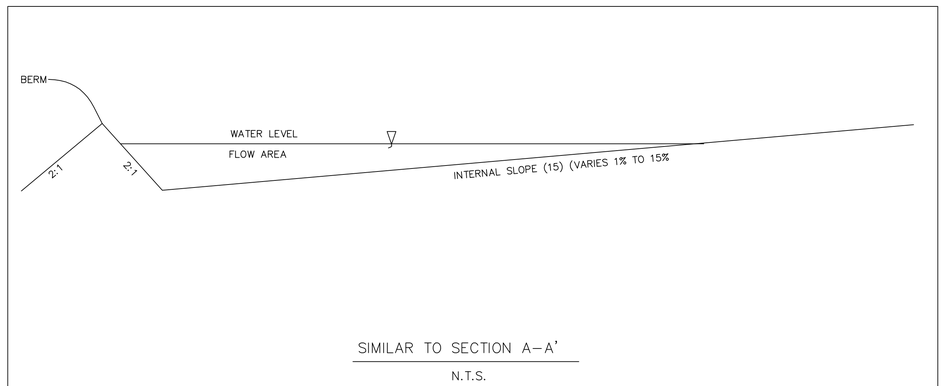
E 292,000 E 296,000 E 300,000 E 304,000 E 308,000 E 312,000



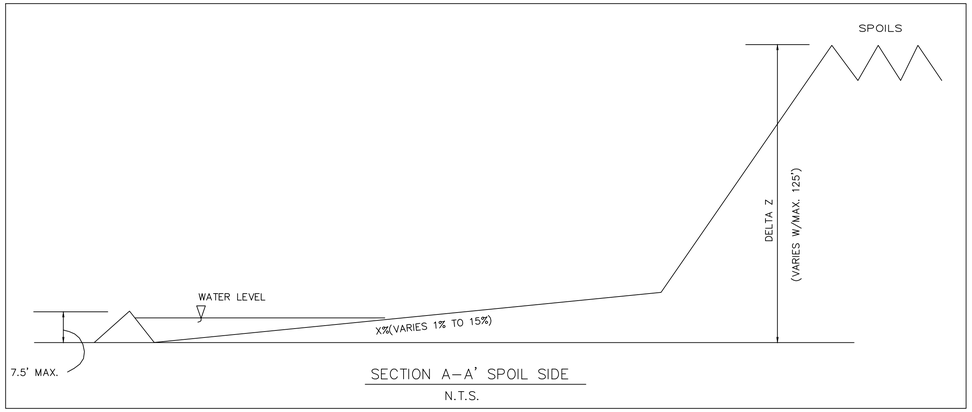
DIVERSION BERM
PARTIAL PLAN – SPOILS SIDE
N.T.S.



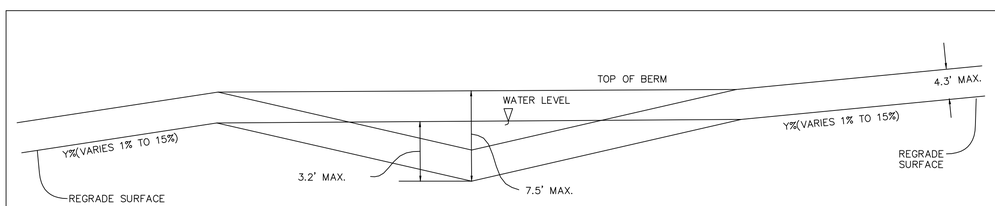
TYPICAL PROFILE
N.T.S.



SIMILAR TO SECTION A–A'
N.T.S.



SECTION A–A' SPOIL SIDE
N.T.S.



SECTION B–B' SPOIL SIDE
N.T.S.

LEGEND

- DRAINAGE
- ×5338.5 SPOT ELEVATION
- 5300 INDEX CONTOUR
- INTERMEDIATE CONTOUR

NOTES

1. The supporting design data is presented in Section 25.4 and Appendix 25.A

Original certified signed exhibits are maintained at the mine site and at OSM.

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
				APPROVALS		
11-A02-10-2012		PJF	SUBMITTED TO OSM FOR REVIEW AND APPROVAL	RV	MO	RV

CERTIFICATION STATEMENT

I, Ron C. Van Valkenburg, hereby certify that this drawing was reviewed by me and that the information shown is complete and accurate to the best of my knowledge.

RON C. VAN VALKENBURG NEW MEXICO 9263 LICENSED PROFESSIONAL ENGINEER

EXHIBIT 25.4-1

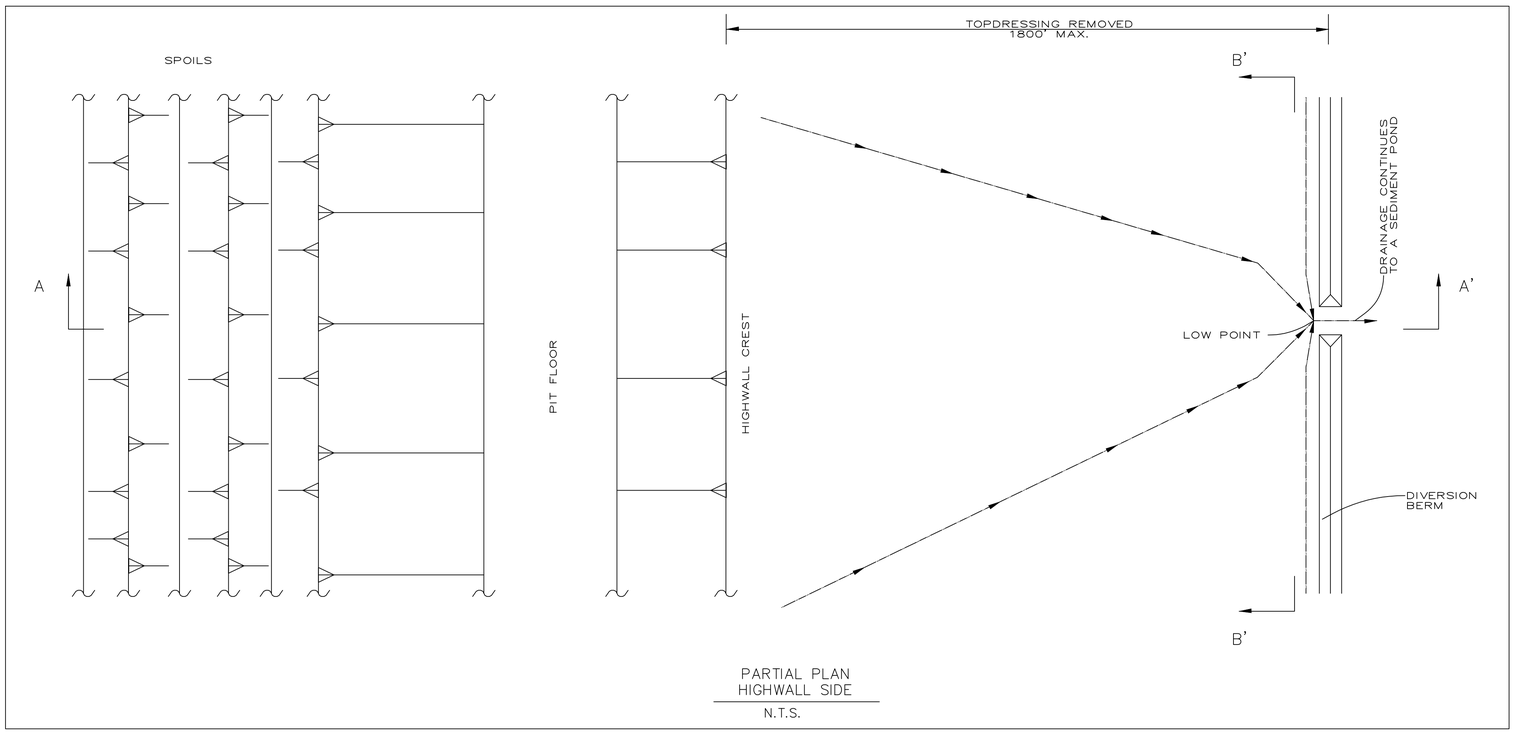
bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland,New Mexico,87416
Phone: 505-598-4200
Fax: 505-568-3361

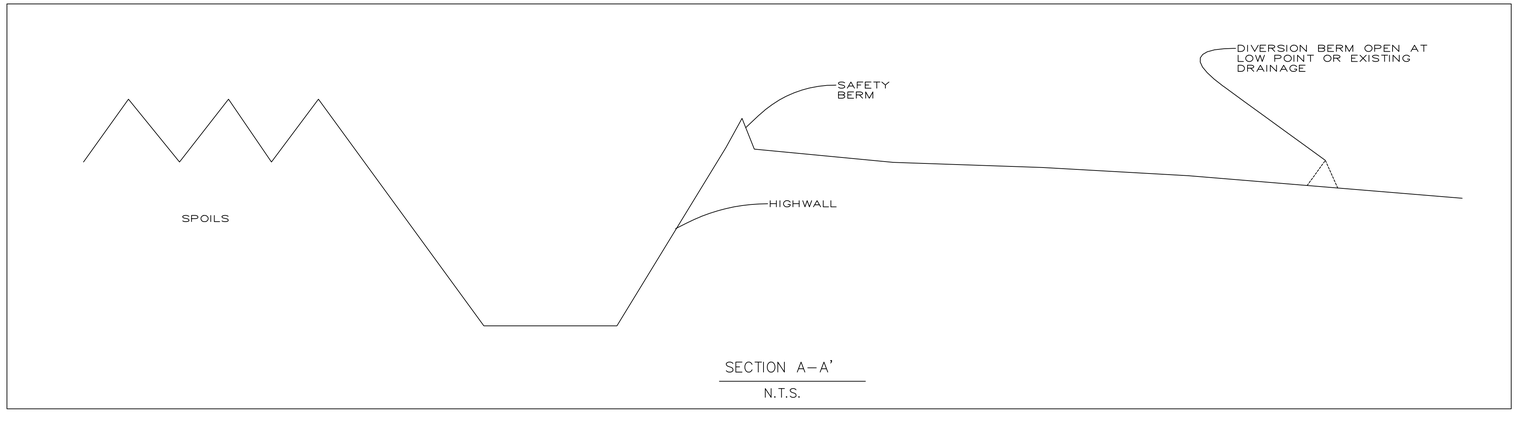
PINABETE PERMIT
Typical Diversion Berm
Plan, Profile and Section

PREPARED BY PJF	DRAWN BY PJF	SCALE 1"= NTS
APPROVED BY RV	DATE 02-10-2012	(SHEET 1 OF 2)



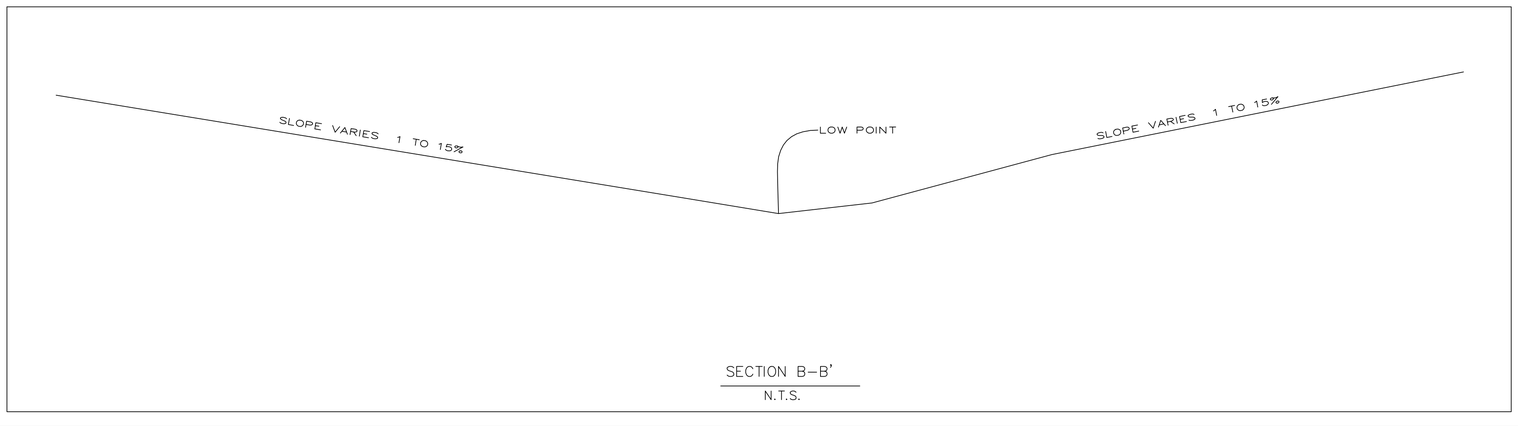
PARTIAL PLAN
HIGHWALL SIDE

N.T.S.



SECTION A–A'

N.T.S.



SECTION B–B'

N.T.S.

LEGEND

- DRAINAGE
- ×5338.5 SPOT ELEVATION
- 5300 INDEX CONTOUR
- INTERMEDIATE CONTOUR

NOTES

1. The supporting design data is presented in Section 25.4 and Appendix 25.A

Original certified signed exhibits are maintained at the mine site and at OSM.

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E. APPROVALS
11-A02-10-2012		PJF	SUBMITTED TO OSM FOR REVIEW AND APPROVAL	RV	MO	RV

CERTIFICATION STATEMENT

I, Ron C. Van Valkenburg, hereby certify that this drawing was reviewed by me and that the information shown is complete and accurate to the best of my knowledge.

RON C. VAN VALKENBURG NEW MEXICO 9263 LICENSED PROFESSIONAL ENGINEER

EXHIBIT 25.4-1

bhpbilliton

BHP Navajo Coal Company
P.O. Box 1717
Fruitland,New Mexico,87416
Phone: 505-598-4200
Fax: 505-568-3361

PINABETE PERMIT
Typical Diversion Berm
Plan, Profile and Section

PREPARED BY PJF	DRAWN BY PJF	SCALE 1"= NTS
APPROVED BY RV	DATE 02-10-2012	(SHEET 2 OF 2)

Appendix 25.A

Diversion Berm – Hydrology Analysis –

Worst Case Scenarios – 25 to 300 Acre Watersheds

NAVAJO MINE PINABETE PERMIT DIVERSION BERM

Worst case scenario for 25 acre watershed.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	25.000	25.000	23.18	1.33

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	25.000	0.154	0.000	0.000	89.000	M	23.18	1.329
	Σ	25.000						23.18	1.329

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	7.99	125.00	1,565.00	2.820	0.154
#1	1	Time of Concentration:					0.154

NAVAJO MINE PINABETE PERMIT DIVERSION BERM

Worst case scenario for 50 acre watershed.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	50.000	50.000	40.29	2.62

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	50.000	0.259	0.000	0.000	89.000	M	40.29	2.620
	Σ	50.000						40.29	2.620

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	5.65	125.00	2,214.03	2.370	0.259
#1	1	Time of Concentration:					0.259

NAVAJO MINE PINABETE PERMIT DIVERSION BERM

Worst case scenario for 75 acre watershed.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	75.000	75.000	53.74	3.92

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	75.000	0.351	0.000	0.000	89.000	M	53.74	3.925
	Σ	75.000						53.74	3.925

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	4.61	125.00	2,711.08	2.140	0.351
#1	1	Time of Concentration:					0.351

NAVAJO MINE PINABETE PERMIT DIVERSION BERM

Worst case scenario for 100 acre watershed.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	100.000	100.000	64.30	5.22

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	100.000	0.437	0.000	0.000	89.000	M	64.30	5.219
	Σ	100.000						64.30	5.219

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.99	125.00	3,131.02	1.990	0.437
#1	1	Time of Concentration:					0.437

NAVAJO MINE PINABETE PERMIT DIVERSION BERM

Worst case scenario for 200 acre watershed.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	200.000	200.000	93.34	10.42

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	200.000	0.731	0.000	0.000	89.000	M	93.34	10.423
	Σ	200.000						93.34	10.423

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	2.82	125.00	4,427.12	1.680	0.731
#1	1	Time of Concentration:					0.731

NAVAJO MINE PINABETE PERMIT DIVERSION BERM

Worst case scenario for 250 acre watershed.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	250.000	250.000	103.55	13.02

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	250.000	0.870	0.000	0.000	89.000	M	103.55	13.017
	Σ	250.000						103.55	13.017

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	2.53	125.00	4,950.29	1.580	0.870
#1	1	Time of Concentration:					0.870

NAVAJO MINE PINABETE PERMIT DIVERSION BERM

Worst case scenario for 300 acre watershed.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	300.000	300.000	112.87	15.63

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	300.000	0.997	0.000	0.000	89.000	M	112.87	15.628
	Σ	300.000						112.87	15.628

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	2.31	125.00	5,422.28	1.510	0.997
#1	1	Time of Concentration:					0.997

DIVERSION BERM

Berm Height Calculations

DIVERSION BERM HEIGHT CALCULATION									
Flow Slope (FS) (%)	Internal Slope (IS) (%)	Watershed Area (acres)	Peak Discharge (Q_{10}) (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Mannings Coefficient	Berm Height (B) (ft)	Berm + 1 Foot of Freeboard	Velocity (fps)
1	1	25	23.18	12.04	49.67	0.03	0.49	1.49	1.93
1	3	25	23.18	9.26	25.76	0.03	0.72	1.72	2.50
1	6	25	23.18	7.92	17.44	0.03	0.92	1.92	2.93
1	9	25	23.18	7.28	14.11	0.03	1.05	2.05	3.19
1	12	25	23.18	6.88	12.27	0.03	1.15	2.15	3.37
1	15	25	23.18	6.61	11.09	0.03	1.23	2.23	3.51
1	1	50	40.29	18.22	61.12	0.03	0.60	1.60	2.21
1	3	50	40.29	14.01	31.69	0.03	0.89	1.89	2.87
1	6	50	40.29	11.99	21.46	0.03	1.13	2.13	3.36
1	9	50	40.29	11.02	17.36	0.03	1.30	2.30	3.66
1	12	50	40.29	10.42	15.09	0.03	1.42	2.42	3.87
1	15	50	40.29	10.00	13.64	0.03	1.52	2.52	4.03
1	1	75	53.74	22.62	68.09	0.03	0.67	1.67	2.38
1	3	75	53.74	17.39	35.31	0.03	0.99	1.99	3.09
1	6	75	53.74	14.88	23.91	0.03	1.26	2.26	3.61
1	9	75	53.74	13.67	19.34	0.03	1.44	2.44	3.93
1	12	75	53.74	12.93	16.81	0.03	1.58	2.58	4.16
1	15	75	53.74	12.41	15.19	0.03	1.69	2.69	4.33
1	1	100	64.3	25.88	72.83	0.03	0.71	1.71	2.48
1	3	100	64.3	19.90	37.77	0.03	1.06	2.06	3.23
1	6	100	64.3	17.02	25.57	0.03	1.35	2.35	3.78
1	9	100	64.3	15.64	20.69	0.03	1.54	2.54	4.11
1	12	100	64.3	14.79	17.98	0.03	1.69	2.69	4.35
1	15	100	64.3	14.20	16.25	0.03	1.81	2.81	4.53
1	1	150	87.7	32.66	81.82	0.03	0.80	1.80	2.69
1	3	150	87.7	25.11	42.43	0.03	1.19	2.19	3.49
1	6	150	87.7	21.49	28.73	0.03	1.52	2.52	4.08
1	9	150	87.7	19.74	23.24	0.03	1.74	2.74	4.44
1	12	150	87.7	18.66	20.20	0.03	1.90	2.90	4.70
1	15	150	87.7	17.92	18.26	0.03	2.03	3.03	4.89
1	1	200	93.34	34.22	83.75	0.03	0.82	1.82	2.73
1	3	200	93.34	26.32	43.43	0.03	1.22	2.22	3.55
1	6	200	93.34	22.52	29.41	0.03	1.55	2.55	4.15
1	9	200	93.34	20.68	23.79	0.03	1.78	2.78	4.51
1	12	200	93.34	19.56	20.68	0.03	1.95	2.95	4.77
1	15	200	93.34	18.78	18.69	0.03	2.08	3.08	4.97
1	1	250	103.55	36.99	87.08	0.03	0.85	1.85	2.80
1	3	250	103.55	28.45	45.15	0.03	1.27	2.27	3.64
1	6	250	103.55	24.34	30.57	0.03	1.61	2.61	4.25
1	9	250	103.55	22.36	24.73	0.03	1.85	2.85	4.63
1	12	250	103.55	21.14	21.50	0.03	2.02	3.02	4.90
1	15	250	103.55	20.30	19.43	0.03	2.16	3.16	5.10
1	1	300	112.87	39.46	89.94	0.03	0.88	1.88	2.86
1	3	300	112.87	30.35	46.64	0.03	1.31	2.31	3.72
1	6	300	112.87	25.96	31.58	0.03	1.67	2.67	4.35
1	9	300	112.87	23.85	25.55	0.03	1.91	2.91	4.73
1	12	300	112.87	22.55	22.21	0.03	2.09	3.09	5.00
1	15	300	112.87	21.66	20.07	0.03	2.24	3.24	5.21
3	1	25	23.18	7.97	40.43	0.03	0.40	1.40	2.91

DIVERSION BERM HEIGHT CALCULATION									
Flow Slope (FS) (%)	Internal Slope (IS) (%)	Watershed Area (acres)	Peak Discharge (Q_{10}) (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Mannings Coefficient	Berm Height (B) (ft)	Berm + 1 Foot of Freeboard	Velocity (fps)
1	1	25	23.18	12.04	49.67	0.03	0.49	1.49	1.93
1	3	25	23.18	9.26	25.76	0.03	0.72	1.72	2.50
3	3	25	23.18	6.13	20.96	0.03	0.59	1.59	3.78
3	6	25	23.18	5.25	14.19	0.03	0.75	1.75	4.42
3	9	25	23.18	4.82	11.48	0.03	0.86	1.86	4.81
3	12	25	23.18	4.56	9.98	0.03	0.94	1.94	5.09
3	15	25	23.18	4.38	9.02	0.03	1.00	2.00	5.30
3	1	50	40.29	12.07	49.74	0.03	0.49	1.49	3.34
3	3	50	40.29	9.28	25.79	0.03	0.72	1.72	4.34
3	6	50	40.29	7.94	17.46	0.03	0.92	1.92	5.07
3	9	50	40.29	7.30	14.13	0.03	1.05	2.05	5.52
3	12	50	40.29	6.90	12.28	0.03	1.16	2.16	5.84
3	15	50	40.29	6.62	11.10	0.03	1.24	2.24	6.08
3	1	75	53.74	14.98	55.41	0.03	0.54	1.54	3.59
3	3	75	53.74	11.52	28.74	0.03	0.81	1.81	4.66
3	6	75	53.74	9.86	19.46	0.03	1.03	2.03	5.45
3	9	75	53.74	9.06	15.74	0.03	1.18	2.18	5.93
3	12	75	53.74	8.56	13.68	0.03	1.29	2.29	6.28
3	15	75	53.74	8.22	12.37	0.03	1.38	2.38	6.54
3	1	100	64.3	17.14	59.27	0.03	0.58	1.58	3.75
3	3	100	64.3	13.18	30.74	0.03	0.86	1.86	4.88
3	6	100	64.3	11.28	20.81	0.03	1.10	2.10	5.70
3	9	100	64.3	10.36	16.83	0.03	1.26	2.26	6.21
3	12	100	64.3	9.80	14.64	0.03	1.38	2.38	6.56
3	15	100	64.3	9.41	13.23	0.03	1.47	2.47	6.84
3	1	150	87.7	21.63	66.59	0.03	0.65	1.65	4.05
3	3	150	87.7	16.63	34.53	0.03	0.97	1.97	5.27
3	6	150	87.7	14.23	23.38	0.03	1.23	2.23	6.16
3	9	150	87.7	13.07	18.91	0.03	1.41	2.41	6.71
3	12	150	87.7	12.36	16.44	0.03	1.55	2.55	7.09
3	15	150	87.7	11.87	14.86	0.03	1.66	2.66	7.39
3	1	200	93.34	22.67	68.16	0.03	0.67	1.67	4.12
3	3	200	93.34	17.43	35.35	0.03	0.99	1.99	5.36
3	6	200	93.34	14.91	23.93	0.03	1.26	2.26	6.26
3	9	200	93.34	13.70	19.36	0.03	1.45	2.45	6.81
3	12	200	93.34	12.95	16.83	0.03	1.58	2.58	7.21
3	15	200	93.34	12.44	15.21	0.03	1.69	2.69	7.50
3	1	250	103.55	24.50	70.87	0.03	0.69	1.69	4.23
3	3	250	103.55	18.84	36.75	0.03	1.03	2.03	5.50
3	6	250	103.55	16.12	24.88	0.03	1.31	2.31	6.42
3	9	250	103.55	14.81	20.13	0.03	1.50	2.50	6.99
3	12	250	103.55	14.00	17.50	0.03	1.65	2.65	7.39
3	15	250	103.55	13.45	15.81	0.03	1.76	2.76	7.70
3	1	300	112.87	26.14	73.19	0.03	0.72	1.72	4.32
3	3	300	112.87	20.10	37.96	0.03	1.07	2.07	5.62
3	6	300	112.87	17.20	25.70	0.03	1.36	2.36	6.56
3	9	300	112.87	15.80	20.79	0.03	1.55	2.55	7.14
3	12	300	112.87	14.94	18.07	0.03	1.70	2.70	7.56
3	15	300	112.87	14.35	16.33	0.03	1.82	2.82	7.87

DIVERSION BERM HEIGHT CALCULATION									
Flow Slope (FS) (%)	Internal Slope (IS) (%)	Watershed Area (acres)	Peak Discharge (Q_{10}) (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Mannings Coefficient	Berm Height (B) (ft)	Berm + 1 Foot of Freeboard	Velocity (fps)
1	1	25	23.18	12.04	49.67	0.03	0.49	1.49	1.93
1	3	25	23.18	9.26	25.76	0.03	0.72	1.72	2.50
5	1	25	23.18	6.58	36.73	0.03	0.36	1.36	3.52
5	3	25	23.18	5.06	19.05	0.03	0.54	1.54	4.58
5	6	25	23.18	4.33	12.90	0.03	0.68	1.68	5.35
5	9	25	23.18	3.98	10.43	0.03	0.78	1.78	5.82
5	12	25	23.18	3.76	9.07	0.03	0.85	1.85	6.16
5	15	25	23.18	3.61	8.20	0.03	0.91	1.91	6.42
5	1	50	40.29	9.97	45.20	0.03	0.44	1.44	4.04
5	3	50	40.29	7.66	23.44	0.03	0.66	1.66	5.26
5	6	50	40.29	6.56	15.87	0.03	0.84	1.84	6.14
5	9	50	40.29	6.02	12.84	0.03	0.96	1.96	6.69
5	12	50	40.29	5.70	11.16	0.03	1.05	2.05	7.07
5	15	50	40.29	5.47	10.09	0.03	1.12	2.12	7.37
5	1	75	53.74	12.37	50.35	0.03	0.49	1.49	4.34
5	3	75	53.74	9.51	26.11	0.03	0.73	1.73	5.65
5	6	75	53.74	8.14	17.68	0.03	0.93	1.93	6.60
5	9	75	53.74	7.48	14.30	0.03	1.07	2.07	7.19
5	12	75	53.74	7.07	12.43	0.03	1.17	2.17	7.60
5	15	75	53.74	6.79	11.24	0.03	1.25	2.25	7.92
5	1	100	64.3	14.15	53.86	0.03	0.53	1.53	4.54
5	3	100	64.3	10.88	27.93	0.03	0.78	1.78	5.91
5	6	100	64.3	9.31	18.91	0.03	1.00	2.00	6.91
5	9	100	64.3	8.55	15.30	0.03	1.14	2.14	7.52
5	12	100	64.3	8.09	13.30	0.03	1.25	2.25	7.95
5	15	100	64.3	7.77	12.02	0.03	1.34	2.34	8.28
5	1	150	87.7	17.86	60.50	0.03	0.59	1.59	4.91
5	3	150	87.7	13.73	31.38	0.03	0.88	1.88	6.39
5	6	150	87.7	11.75	21.24	0.03	1.12	2.12	7.46
5	9	150	87.7	10.80	17.19	0.03	1.28	2.28	8.12
5	12	150	87.7	10.21	14.94	0.03	1.41	2.41	8.59
5	15	150	87.7	9.80	13.50	0.03	1.50	2.50	8.95
5	1	200	93.34	18.71	61.93	0.03	0.61	1.61	4.99
5	3	200	93.34	14.39	32.12	0.03	0.90	1.90	6.49
5	6	200	93.34	12.31	21.75	0.03	1.15	2.15	7.58
5	9	200	93.34	11.31	17.59	0.03	1.31	2.31	8.25
5	12	200	93.34	10.70	15.29	0.03	1.44	2.44	8.73
5	15	200	93.34	10.27	13.82	0.03	1.54	2.54	9.09
5	1	250	103.55	20.23	64.39	0.03	0.63	1.63	5.12
5	3	250	103.55	15.56	33.39	0.03	0.94	1.94	6.66
5	6	250	103.55	13.31	22.61	0.03	1.19	2.19	7.78
5	9	250	103.55	12.23	18.29	0.03	1.37	2.37	8.47
5	12	250	103.55	11.56	15.90	0.03	1.50	2.50	8.96
5	15	250	103.55	11.10	14.37	0.03	1.60	2.60	9.33
5	1	300	112.87	21.58	66.51	0.03	0.65	1.65	5.23
5	3	300	112.87	16.60	34.49	0.03	0.97	1.97	6.80
5	6	300	112.87	14.20	23.35	0.03	1.23	2.23	7.95
5	9	300	112.87	13.04	18.89	0.03	1.41	2.41	8.65
5	12	300	112.87	12.33	16.42	0.03	1.55	2.55	9.15

DIVERSION BERM HEIGHT CALCULATION									
Flow Slope (FS) (%)	Internal Slope (IS) (%)	Watershed Area (acres)	Peak Discharge (Q_{10}) (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Mannings Coefficient	Berm Height (B) (ft)	Berm + 1 Foot of Freeboard	Velocity (fps)
1	1	25	23.18	12.04	49.67	0.03	0.49	1.49	1.93
1	3	25	23.18	9.26	25.76	0.03	0.72	1.72	2.50
5	15	300	112.87	11.84	14.84	0.03	1.65	2.65	9.53
7	1	25	23.18	5.80	34.49	0.03	0.34	1.34	3.99
7	3	25	23.18	4.46	17.88	0.03	0.50	1.50	5.19
7	6	25	23.18	3.82	12.11	0.03	0.64	1.64	6.07
7	9	25	23.18	3.51	9.80	0.03	0.73	1.73	6.61
7	12	25	23.18	3.32	8.52	0.03	0.80	1.80	6.99
7	15	25	23.18	3.19	7.70	0.03	0.86	1.86	7.28
7	1	50	40.29	8.78	42.43	0.03	0.42	1.42	4.59
7	3	50	40.29	6.76	22.00	0.03	0.62	1.62	5.96
7	6	50	40.29	5.78	14.90	0.03	0.79	1.79	6.97
7	9	50	40.29	5.31	12.05	0.03	0.90	1.90	7.59
7	12	50	40.29	5.02	10.48	0.03	0.99	1.99	8.02
7	15	50	40.29	4.82	9.47	0.03	1.05	2.05	8.36
7	1	75	53.74	10.90	47.27	0.03	0.46	1.46	4.93
7	3	75	53.74	8.38	24.51	0.03	0.69	1.69	6.41
7	6	75	53.74	7.17	16.60	0.03	0.88	1.88	7.49
7	9	75	53.74	6.59	13.43	0.03	1.00	2.00	8.15
7	12	75	53.74	6.23	11.67	0.03	1.10	2.10	8.62
7	15	75	53.74	5.98	10.55	0.03	1.18	2.18	8.98
7	1	100	64.3	12.47	50.56	0.03	0.49	1.49	5.15
7	3	100	64.3	9.59	26.22	0.03	0.74	1.74	6.70
7	6	100	64.3	8.21	17.75	0.03	0.94	1.94	7.84
7	9	100	64.3	7.54	14.36	0.03	1.07	2.07	8.53
7	12	100	64.3	7.13	12.49	0.03	1.17	2.17	9.02
7	15	100	64.3	6.85	11.28	0.03	1.26	2.26	9.39
7	1	150	87.7	15.74	56.80	0.03	0.56	1.56	5.57
7	3	150	87.7	12.11	29.46	0.03	0.83	1.83	7.24
7	6	150	87.7	10.36	19.94	0.03	1.05	2.05	8.47
7	9	150	87.7	9.52	16.13	0.03	1.20	2.20	9.22
7	12	150	87.7	9.00	14.03	0.03	1.32	2.32	9.75
7	15	150	87.7	8.64	12.68	0.03	1.41	2.41	10.15
7	1	200	93.34	16.50	58.15	0.03	0.57	1.57	5.66
7	3	200	93.34	12.69	30.15	0.03	0.85	1.85	7.36
7	6	200	93.34	10.85	20.42	0.03	1.08	2.08	8.60
7	9	200	93.34	9.97	16.52	0.03	1.23	2.23	9.36
7	12	200	93.34	9.43	14.36	0.03	1.35	2.35	9.90
7	15	200	93.34	9.05	12.98	0.03	1.45	2.45	10.31
7	1	250	103.55	17.83	60.46	0.03	0.59	1.59	5.81
7	3	250	103.55	13.71	31.35	0.03	0.88	1.88	7.55
7	6	250	103.55	11.73	21.23	0.03	1.12	2.12	8.83
7	9	250	103.55	10.78	17.17	0.03	1.28	2.28	9.61
7	12	250	103.55	10.19	14.93	0.03	1.40	2.40	10.16
7	15	250	103.55	9.79	13.49	0.03	1.50	2.50	10.58
7	1	300	112.87	19.02	62.44	0.03	0.61	1.61	5.93
7	3	300	112.87	14.63	32.38	0.03	0.91	1.91	7.72
7	6	300	112.87	12.52	21.92	0.03	1.16	2.16	9.02
7	9	300	112.87	11.50	17.74	0.03	1.32	2.32	9.82

DIVERSION BERM HEIGHT CALCULATION									
Flow Slope (FS) (%)	Internal Slope (IS) (%)	Watershed Area (acres)	Peak Discharge (Q_{10}) (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Mannings Coefficient	Berm Height (B) (ft)	Berm + 1 Foot of Freeboard	Velocity (fps)
1	1	25	23.18	12.04	49.67	0.03	0.49	1.49	1.93
1	3	25	23.18	9.26	25.76	0.03	0.72	1.72	2.50
7	12	300	112.87	10.87	15.42	0.03	1.45	2.45	10.38
7	15	300	112.87	10.44	13.93	0.03	1.55	2.55	10.81
9	1	25	23.18	5.28	32.90	0.03	0.32	1.32	4.39
9	3	25	23.18	4.06	17.06	0.03	0.48	1.48	5.71
9	6	25	23.18	3.47	11.55	0.03	0.61	1.61	6.67
9	9	25	23.18	3.19	9.35	0.03	0.70	1.70	7.26
9	12	25	23.18	3.02	8.12	0.03	0.76	1.76	7.68
9	15	25	23.18	2.90	7.34	0.03	0.82	1.82	8.00
9	1	50	40.29	7.99	40.48	0.03	0.40	1.40	5.04
9	3	50	40.29	6.15	20.99	0.03	0.59	1.59	6.55
9	6	50	40.29	5.26	14.21	0.03	0.75	1.75	7.66
9	9	50	40.29	4.83	11.50	0.03	0.86	1.86	8.34
9	12	50	40.29	4.57	10.00	0.03	0.94	1.94	8.82
9	15	50	40.29	4.39	9.03	0.03	1.01	2.01	9.18
9	1	75	53.74	9.92	45.10	0.03	0.44	1.44	5.42
9	3	75	53.74	7.63	23.39	0.03	0.66	1.66	7.04
9	6	75	53.74	6.53	15.83	0.03	0.84	1.84	8.23
9	9	75	53.74	6.00	12.81	0.03	0.96	1.96	8.96
9	12	75	53.74	5.67	11.14	0.03	1.05	2.05	9.48
9	15	75	53.74	5.45	10.06	0.03	1.12	2.12	9.87
9	1	100	64.3	11.35	48.24	0.03	0.47	1.47	5.66
9	3	100	64.3	8.73	25.01	0.03	0.70	1.70	7.37
9	6	100	64.3	7.47	16.94	0.03	0.89	1.89	8.61
9	9	100	64.3	6.86	13.70	0.03	1.02	2.02	9.37
9	12	100	64.3	6.49	11.91	0.03	1.12	2.12	9.91
9	15	100	64.3	6.23	10.76	0.03	1.20	2.20	10.32
9	1	150	87.7	14.33	54.19	0.03	0.53	1.53	6.12
9	3	150	87.7	11.02	28.10	0.03	0.79	1.79	7.96
9	6	150	87.7	9.43	19.03	0.03	1.00	2.00	9.30
9	9	150	87.7	8.66	15.39	0.03	1.15	2.15	10.13
9	12	150	87.7	8.19	13.38	0.03	1.26	2.26	10.71
9	15	150	87.7	7.86	12.09	0.03	1.35	2.35	11.15
9	1	200	93.34	15.01	55.47	0.03	0.54	1.54	6.22
9	3	200	93.34	11.54	28.77	0.03	0.81	1.81	8.09
9	6	200	93.34	9.88	19.48	0.03	1.03	2.03	9.45
9	9	200	93.34	9.07	15.76	0.03	1.18	2.18	10.29
9	12	200	93.34	8.58	13.70	0.03	1.29	2.29	10.88
9	15	200	93.34	8.24	12.38	0.03	1.38	2.38	11.33
9	1	250	103.55	16.23	57.67	0.03	0.56	1.56	6.38
9	3	250	103.55	12.48	29.91	0.03	0.84	1.84	8.30
9	6	250	103.55	10.68	20.25	0.03	1.07	2.07	9.70
9	9	250	103.55	9.81	16.38	0.03	1.22	2.22	10.56
9	12	250	103.55	9.27	14.24	0.03	1.34	2.34	11.16
9	15	250	103.55	8.91	12.87	0.03	1.43	2.43	11.63
9	1	300	112.87	17.31	59.57	0.03	0.58	1.58	6.52
9	3	300	112.87	13.31	30.89	0.03	0.87	1.87	8.48
9	6	300	112.87	11.39	20.91	0.03	1.10	2.10	9.91

DIVERSION BERM HEIGHT CALCULATION									
Flow Slope (FS) (%)	Internal Slope (IS) (%)	Watershed Area (acres)	Peak Discharge (Q_{10}) (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Mannings Coefficient	Berm Height (B) (ft)	Berm + 1 Foot of Freeboard	Velocity (fps)
1	1	25	23.18	12.04	49.67	0.03	0.49	1.49	1.93
1	3	25	23.18	9.26	25.76	0.03	0.72	1.72	2.50
9	9	300	112.87	10.46	16.92	0.03	1.26	2.26	10.79
9	12	300	112.87	9.89	14.71	0.03	1.38	2.38	11.41
9	15	300	112.87	9.50	13.29	0.03	1.48	2.48	11.88
11	1	25	23.18	4.90	31.69	0.03	0.31	1.31	4.73
11	3	25	23.18	3.77	16.43	0.03	0.46	1.46	6.15
11	6	25	23.18	3.22	11.13	0.03	0.59	1.59	7.19
11	9	25	23.18	2.96	9.00	0.03	0.67	1.67	7.83
11	12	25	23.18	2.80	7.82	0.03	0.74	1.74	8.28
11	15	25	23.18	2.69	7.07	0.03	0.79	1.79	8.62
11	1	50	40.29	7.42	38.99	0.03	0.38	1.38	5.43
11	3	50	40.29	5.70	20.22	0.03	0.57	1.57	7.07
11	6	50	40.29	4.88	13.69	0.03	0.72	1.72	8.26
11	9	50	40.29	4.48	11.07	0.03	0.83	1.83	8.99
11	12	50	40.29	4.24	9.63	0.03	0.91	1.91	9.51
11	15	50	40.29	4.07	8.70	0.03	0.97	1.97	9.90
11	1	75	53.74	9.20	43.43	0.03	0.42	1.42	5.84
11	3	75	53.74	7.08	22.52	0.03	0.63	1.63	7.59
11	6	75	53.74	6.06	15.25	0.03	0.81	1.81	8.88
11	9	75	53.74	5.56	12.34	0.03	0.92	1.92	9.66
11	12	75	53.74	5.26	10.72	0.03	1.01	2.01	10.22
11	15	75	53.74	5.05	9.69	0.03	1.08	2.08	10.64
11	1	100	64.3	10.53	46.45	0.03	0.45	1.45	6.11
11	3	100	64.3	8.10	24.09	0.03	0.68	1.68	7.94
11	6	100	64.3	6.93	16.31	0.03	0.86	1.86	9.28
11	9	100	64.3	6.36	13.20	0.03	0.99	1.99	10.10
11	12	100	64.3	6.02	11.47	0.03	1.08	2.08	10.69
11	15	100	64.3	5.78	10.37	0.03	1.15	2.15	11.13
11	1	150	87.7	13.29	52.19	0.03	0.51	1.51	6.60
11	3	150	87.7	10.22	27.06	0.03	0.76	1.76	8.58
11	6	150	87.7	8.74	18.32	0.03	0.97	1.97	10.03
11	9	150	87.7	8.03	14.82	0.03	1.11	2.11	10.92
11	12	150	87.7	7.59	12.89	0.03	1.21	2.21	11.55
11	15	150	87.7	7.29	11.65	0.03	1.30	2.30	12.02
11	1	200	93.34	13.92	53.42	0.03	0.52	1.52	6.70
11	3	200	93.34	10.71	27.70	0.03	0.78	1.78	8.72
11	6	200	93.34	9.16	18.76	0.03	0.99	1.99	10.19
11	9	200	93.34	8.42	15.17	0.03	1.13	2.13	11.09
11	12	200	93.34	7.96	13.19	0.03	1.24	2.24	11.73
11	15	200	93.34	7.64	11.92	0.03	1.33	2.33	12.21
11	1	250	103.55	15.05	55.54	0.03	0.54	1.54	6.88
11	3	250	103.55	11.57	28.80	0.03	0.81	1.81	8.95
11	6	250	103.55	9.90	19.50	0.03	1.03	2.03	10.46
11	9	250	103.55	9.10	15.78	0.03	1.18	2.18	11.38
11	12	250	103.55	8.60	13.72	0.03	1.29	2.29	12.04
11	15	250	103.55	8.26	12.40	0.03	1.38	2.38	12.53
11	1	300	112.87	16.06	57.37	0.03	0.56	1.56	7.03
11	3	300	112.87	12.35	29.75	0.03	0.84	1.84	9.14

DIVERSION BERM HEIGHT CALCULATION									
Flow Slope (FS) (%)	Internal Slope (IS) (%)	Watershed Area (acres)	Peak Discharge (Q_{10}) (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Mannings Coefficient	Berm Height (B) (ft)	Berm + 1 Foot of Freeboard	Velocity (fps)
1	1	25	23.18	12.04	49.67	0.03	0.49	1.49	1.93
1	3	25	23.18	9.26	25.76	0.03	0.72	1.72	2.50
11	6	300	112.87	10.56	20.14	0.03	1.06	2.06	10.68
11	9	300	112.87	9.71	16.29	0.03	1.22	2.22	11.63
11	12	300	112.87	9.18	14.17	0.03	1.33	2.33	12.30
11	15	300	112.87	8.81	12.80	0.03	1.43	2.43	12.81
13	1	25	23.18	4.60	30.71	0.03	0.30	1.30	5.04
13	3	25	23.18	3.54	15.92	0.03	0.45	1.45	6.55
13	6	25	23.18	3.03	10.78	0.03	0.57	1.57	7.66
13	9	25	23.18	2.78	8.72	0.03	0.65	1.65	8.34
13	12	25	23.18	2.63	7.58	0.03	0.71	1.71	8.82
13	15	25	23.18	2.53	6.85	0.03	0.76	1.76	9.18
13	1	50	40.29	6.96	37.78	0.03	0.37	1.37	5.78
13	3	50	40.29	5.36	19.59	0.03	0.55	1.55	7.52
13	6	50	40.29	4.58	13.27	0.03	0.70	1.70	8.79
13	9	50	40.29	4.21	10.73	0.03	0.80	1.80	9.57
13	12	50	40.29	3.98	9.33	0.03	0.88	1.88	10.12
13	15	50	40.29	3.82	8.43	0.03	0.94	1.94	10.54
13	1	75	53.74	8.64	42.09	0.03	0.41	1.41	6.22
13	3	75	53.74	6.65	21.83	0.03	0.61	1.61	8.08
13	6	75	53.74	5.69	14.78	0.03	0.78	1.78	9.45
13	9	75	53.74	5.23	11.96	0.03	0.89	1.89	10.29
13	12	75	53.74	4.94	10.39	0.03	0.98	1.98	10.88
13	15	75	53.74	4.74	9.39	0.03	1.05	2.05	11.33
13	1	100	64.3	9.89	45.02	0.03	0.44	1.44	6.50
13	3	100	64.3	7.60	23.35	0.03	0.66	1.66	8.45
13	6	100	64.3	6.51	15.81	0.03	0.83	1.83	9.88
13	9	100	64.3	5.98	12.79	0.03	0.95	1.95	10.76
13	12	100	64.3	5.65	11.12	0.03	1.05	2.05	11.38
13	15	100	64.3	5.43	10.05	0.03	1.12	2.12	11.85
13	1	150	87.7	12.48	50.58	0.03	0.49	1.49	7.03
13	3	150	87.7	9.60	26.23	0.03	0.74	1.74	9.14
13	6	150	87.7	8.21	17.76	0.03	0.94	1.94	10.68
13	9	150	87.7	7.54	14.37	0.03	1.07	2.07	11.62
13	12	150	87.7	7.13	12.49	0.03	1.18	2.18	12.29
13	15	150	87.7	6.85	11.29	0.03	1.26	2.26	12.80
13	1	200	93.34	13.08	51.78	0.03	0.51	1.51	7.14
13	3	200	93.34	10.06	26.85	0.03	0.75	1.75	9.28
13	6	200	93.34	8.60	18.18	0.03	0.96	1.96	10.85
13	9	200	93.34	7.91	14.71	0.03	1.10	2.10	11.81
13	12	200	93.34	7.47	12.78	0.03	1.20	2.20	12.49
13	15	200	93.34	7.18	11.55	0.03	1.29	2.29	13.00
13	1	250	103.55	14.14	53.83	0.03	0.53	1.53	7.32
13	3	250	103.55	10.87	27.91	0.03	0.78	1.78	9.52
13	6	250	103.55	9.30	18.90	0.03	1.00	2.00	11.13
13	9	250	103.55	8.55	15.29	0.03	1.14	2.14	12.12
13	12	250	103.55	8.08	13.29	0.03	1.25	2.25	12.82
13	15	250	103.55	7.76	12.01	0.03	1.34	2.34	13.35
13	1	300	112.87	15.08	55.60	0.03	0.54	1.54	7.48

DIVERSION BERM HEIGHT CALCULATION									
Flow Slope (FS) (%)	Internal Slope (IS) (%)	Watershed Area (acres)	Peak Discharge (Q_{10}) (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Mannings Coefficient	Berm Height (B) (ft)	Berm + 1 Foot of Freeboard	Velocity (fps)
1	1	25	23.18	12.04	49.67	0.03	0.49	1.49	1.93
1	3	25	23.18	9.26	25.76	0.03	0.72	1.72	2.50
13	3	300	112.87	11.60	28.83	0.03	0.81	1.81	9.73
13	6	300	112.87	9.92	19.52	0.03	1.03	2.03	11.37
13	9	300	112.87	9.12	15.79	0.03	1.18	2.18	12.38
13	12	300	112.87	8.62	13.73	0.03	1.29	2.29	13.09
13	15	300	112.87	8.28	12.41	0.03	1.38	2.38	13.64
15	1	25	23.18	4.36	29.90	0.03	0.29	1.29	5.32
15	3	25	23.18	3.35	15.50	0.03	0.44	1.44	6.91
15	6	25	23.18	2.87	10.50	0.03	0.55	1.55	8.08
15	9	25	23.18	2.64	8.49	0.03	0.63	1.63	8.79
15	12	25	23.18	2.49	7.38	0.03	0.69	1.69	9.30
15	15	25	23.18	2.39	6.67	0.03	0.74	1.74	9.69
15	1	50	40.29	6.60	36.78	0.03	0.36	1.36	6.10
15	3	50	40.29	5.08	19.07	0.03	0.54	1.54	7.94
15	6	50	40.29	4.34	12.91	0.03	0.68	1.68	9.28
15	9	50	40.29	3.99	10.45	0.03	0.78	1.78	10.10
15	12	50	40.29	3.77	9.08	0.03	0.85	1.85	10.68
15	15	50	40.29	3.62	8.21	0.03	0.91	1.91	11.12
15	1	75	53.74	8.19	40.98	0.03	0.40	1.40	6.56
15	3	75	53.74	6.30	21.25	0.03	0.60	1.60	8.53
15	6	75	53.74	5.39	14.39	0.03	0.76	1.76	9.97
15	9	75	53.74	4.95	11.64	0.03	0.87	1.87	10.85
15	12	75	53.74	4.68	10.12	0.03	0.95	1.95	11.48
15	15	75	53.74	4.50	9.14	0.03	1.02	2.02	11.95
15	1	100	64.3	9.37	43.83	0.03	0.43	1.43	6.86
15	3	100	64.3	7.21	22.73	0.03	0.64	1.64	8.92
15	6	100	64.3	6.17	15.39	0.03	0.81	1.81	10.43
15	9	100	64.3	5.67	12.45	0.03	0.93	1.93	11.35
15	12	100	64.3	5.36	10.82	0.03	1.02	2.02	12.00
15	15	100	64.3	5.14	9.78	0.03	1.09	2.09	12.50
15	1	150	87.7	11.83	49.24	0.03	0.48	1.48	7.41
15	3	150	87.7	9.10	25.53	0.03	0.72	1.72	9.64
15	6	150	87.7	7.78	17.29	0.03	0.91	1.91	11.27
15	9	150	87.7	7.15	13.99	0.03	1.04	2.04	12.27
15	12	150	87.7	6.76	12.16	0.03	1.14	2.14	12.97
15	15	150	87.7	6.49	10.99	0.03	1.22	2.22	13.51
15	1	200	93.34	12.40	50.40	0.03	0.49	1.49	7.53
15	3	200	93.34	9.53	26.14	0.03	0.73	1.73	9.79
15	6	200	93.34	8.16	17.70	0.03	0.93	1.93	11.45
15	9	200	93.34	7.49	14.32	0.03	1.07	2.07	12.46
15	12	200	93.34	7.08	12.45	0.03	1.17	2.17	13.18
15	15	200	93.34	6.80	11.25	0.03	1.25	2.25	13.72
15	1	250	103.55	13.40	52.41	0.03	0.51	1.51	7.73
15	3	250	103.55	10.30	27.18	0.03	0.76	1.76	10.05
15	6	250	103.55	8.82	18.40	0.03	0.97	1.97	11.75
15	9	250	103.55	8.10	14.89	0.03	1.11	2.11	12.79
15	12	250	103.55	7.66	12.94	0.03	1.22	2.22	13.52
15	15	250	103.55	7.35	11.69	0.03	1.30	2.30	14.08

DIVERSION BERM HEIGHT CALCULATION									
Flow Slope (FS) (%)	Internal Slope (IS) (%)	Watershed Area (acres)	Peak Discharge (Q_{10}) (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Mannings Coefficient	Berm Height (B) (ft)	Berm + 1 Foot of Freeboard	Velocity (fps)
1	1	25	23.18	12.04	49.67	0.03	0.49	1.49	1.93
1	3	25	23.18	9.26	25.76	0.03	0.72	1.72	2.50
15	1	300	112.87	14.29	54.13	0.03	0.53	1.53	7.90
15	3	300	112.87	10.99	28.07	0.03	0.79	1.79	10.27
15	6	300	112.87	9.40	19.00	0.03	1.00	2.00	12.00
15	9	300	112.87	8.64	15.37	0.03	1.15	2.15	13.06
15	12	300	112.87	8.17	13.37	0.03	1.26	2.26	13.82
15	15	300	112.87	7.85	12.08	0.03	1.35	2.35	14.39