MINING AND RECLAMATION PLAN
SUFCO MINE
AMENDMENT

OPERATED BY

CANYON FUEL COMPANY, LLC
Sufco Mine

SEDIMENTATION OVERFLOW POND
JUNE 2009

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Refer to Record No 0022 Date 6/22/2009
In C/0410002 2009 Incoming
For additional information

CHAPTER 1

GENERAL CONTENTS

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C/041/0002
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Canyon Fuel Company, LLC.
Sufco Mine
A Subsidiary of Arch Western Bituminous Group, LLC.

COPY

Ken May, General Manager
597 South SR 24
Salina, UT 84654
(435) 286-4400 - Office
(435) 286-4499- Fax

3341
BS

June 22, 2009

Mr. Daron Haddock
Permit Supervisor
Utah Coal Regulatory Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P. O. Box 145801
Salt Lake City, Utah 84114-5801

RE: New Sedimentation Overflow Pond Amendment to the Canyon Fuel Company, LLC, Sufco Mine, Permit Number C/041/0002

Dear Mr. Haddock:

Please find enclosed with this letter the Sufco Mine permit amendment to include a new Sedimentation Overflow Pond in the mine's M&RP. We have included four copies of the modified text in redline/strikethrough format along with completed C1 and C2 forms. One additional copy was sent to the Price Field Office. Clean copies of the pages with modifications will be forwarded to the Division once the modification is approved for inclusion in the permit.

The new Sedimentation Overflow Pond is being constructed about 800 feet downstream of the primary sedimentation pond north of the spring collection area. This new overflow pond has been designed to allow for flood control and sediment settling to retain sediment from the disturbed mine facilities and runoff from the 10-year, 24-hour storm event. This additional overflow pond will allow for increased pond volume, extra sediment settling time and will increase the mine discharge water quality. The new sedimentation pond and diversion culvert allows runoff to bypass the primary sedimentation pond, thereby allowing water to be drained from the primary sedimentation pond for sediment removal and maintenance.

The permit modification is being submitted as a minor modification since the additional disturbed permit area requested represents about 4.6% of the total existing disturbed permit acreage. Also the additional permit area is within the existing CHIA, is within the hydrologic basin in which the mine has a permit to operate, and does not involve a change to the liability insurance or operation after the cancellation thereof. The affected area has been included in the calculation of the disturbed area subject to reclamation bonding costs. A CD has been included with a copy of the entire Sufco Mine M&RP text chapters for additional reference to related areas if needed for this project in the M&RP plan.

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COPY

Sufco mine needs approval of this amendment for construction this summer. If you have any questions regarding the information contained in this letter or within the permit modification, please give Mike Davis a call at (435) 286-4421.

Sincerely,
CANYON FUEL COMPANY, LLC
Sufco Mine

Kenneth E. May
General Manager

Encl.

cc: DOGM - Price Field Office
DOGM Correspondence File

KEM/MLD:kb

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APPLICATION FOR COAL PERMIT PROCESSING

Permit Change ☒ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☐ Transfer ☐ COPY

Permittee: CANYON FUEL COMPANY, LLC
Mine: SUFCO MINE **Permit Number:** C/041/0002
Title: Sedimentation Overflow Pond
Description, Include reason for application and timing required to implement:
Sediment cleanout and increased retention time. July 31st approval required for construction this summer.

Instructions: If you answer yes to any of the first eight (gray) questions, this application may require Public Notice publication.

☒ Yes ☐ No 1. Change in the size of the Permit Area? Acres: _____ Disturbed Area: 2.126 ☒ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes ☒ No 6. Does the application require or include public notice publication?
☐ Yes ☒ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes ☒ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # _____
☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: _____
☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☒ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☐ Yes ☒ No 13. Does the application require or include collection and reporting of any baseline information?
☐ Yes ☒ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☒ Yes ☐ No 15. Does the application require or include soil removal, storage or placement?
☒ Yes ☐ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☒ Yes ☐ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☒ Yes ☐ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
☒ Yes ☐ No 21. Have reclamation costs for bonding been provided?
☒ Yes ☐ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☒ Yes ☐ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

Please attach four (4) review copies of the application. If the mine is on or adjacent to Forest Service land please submit five (5) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

KENNETH E. MAY, MINE MANAGER
Print Name

Kenneth E May 6/24/09
Sign Name, Position, Date

Subscribed and sworn to before me this 24th day of June, 20 09

Jill White
Notary Public

My commission Expires: _____, 20___)
Attest: State of _____)) ss:
County of _____

NOTARY PUBLIC
JILL WHITE
70 W 300 S
Gunnison, UT 84634
My Commission Expires
March 28, 2012
STATE OF UTAH

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Form DOGM- C1 (Revised March 12, 2002)

APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

COPY

Permittee: CANYON FUEL COMPANY, LLC
Mine: SUFCO MINE **Permit Number:** C/041/0002
Title: Sedimentation Overflow Pond

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Pages 1-10, 1-11 and 1-12 in Chapter 1, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Pages 2-17, 2-18 and 2-23 in Chapter 2, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Pages 5-2, 5-3, 5-14 and 5-56 to 5-59 in Chapter 5, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Pages 7-53 to 7-84, 7-90 and 7-91 in Chapter 7, Volume 2 of MRP.
☒ Add	☐ Replace	☐ Remove	Pages 7-84A and 7-84B in Chapter 7, Volume 2 of MRP.
☐ Add	☒ Replace	☐ Remove	Plates 5-2B and 5-6 in Chapter 5, Volume 1 of MRP.
☒ Add	☐ Replace	☐ Remove	Plates 7-4A, 7-5A, 7-5B and 7-5C in Chapter 7, Volume 2 of MRP.
☐ Add	☒ Replace	☐ Remove	Plates 7-6 and 7-7 in Chapter 7, Volume 2 of MRP.
☐ Add	☒ Replace	☐ Remove	Replace Bond Calculation pages: Total2068 page 1, DEMO2068 pages 1 and 12, Earth2068 pages 1 and 2, and Reveg2068 page 1 in Appendix 5-9 in Volume 6 of MRP.
☒ Add	☐ Replace	☐ Remove	Add new Appendix 7-23 in Volume 8 of MRP.
☐ Add	☐ Replace	☐ Remove	
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

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T. 21 S., R. 5 E., SLB&M
Sec. 4: Lots 1, 2, 3, 4, S1/2S1/2
Sec. 5: Lots 1, 2, 3, 4, S1/2S1/2
Sec. 7: Lots 2, 3, 4, S1/2NE1/4, SE1/4
Sec. 8: All
Sec. 9: All

Canyon Fuel Company, LLC acquired the right to entry on these properties in the merger described in Section 111 hereinabove.

In addition, the SUFCO Mine permit area includes certain fee lands owned by Canyon Fuel Company, LLC as follows:

T. 21 S., R. 5 E., SLB&M, Utah
Sec. 29, SW1/4, NW1/4, W1/2NE1/4, W1/2SE1/4
Sec. 30, S1/2NE1/4, E1/2SE1/4
containing 640.00 acres
T. 22 S., R. 4 E., SLB&M, Utah
Sec. 18, NW1/4NE1/4
containing 40 acres

The name of the owner of these fee lands changed from Coastal States Energy Company to Canyon Fuel Company, LLC as a result of the merger transaction described in Section 111 hereinabove.

The SUFCO Mine also uses certain Forest Service lands in its operation for a spring collection system, pumphouse, water transmission line, sanitary discharge line, sanitary drainfield, access road to the sediment pond, and 25 KV powerline. These USFS special use permit areas are shown on Plate 5-6 through portions of:

T. 22 S., R. 4 E., SLB&M, Utah
Sec. 12, S1/2
containing ~~13.03~~15.32 acres

The name of the permittee changed from Southern Utah Fuel Company to Canyon Fuel Company, LLC pursuant to the merger described in Section 111 hereinabove.

115 Status of Unsuitability Claims

To the best knowledge of Canyon Fuel Company, LLC, no portion of the area to be permitted is designated, or under study for being designated, unsuitable for mining.

Since the SUFCO Mine was in production before passage of the Surface Mining Control and Reclamation Act of 1977, the unsuitability criteria were not applied to the existing surface facilities.

Canyon Fuel Company, LLC does not propose to conduct coal mining or reclamation operations within 300 feet of any occupied dwelling. Coal mining and reclamation operations have been or will be conducted within 100 feet of a public road, see Section 5.2.1.1 for details. Forest Service approval to conduct coal mining and reclamation operations within 100 feet of the Link Canyon forest service road is located in Appendix 1-1 and the newspaper advertisement for public comment is located in Appendix 1-3.

116 Permit Term

The following information is presented to identify permit term requirements and stipulations. Canyon Fuel Company will be operating the SUFCO Mine with continuous miner and longwall mining methods. Although the Mining and Reclamation Permit Application covers the next five-year period of mining, information is presented below for the life of the mining operation.

1.	First coal produced	1941
2.	Termination of mining activity	December, 2016
3.	Horizontal extent of mine workings	~~25,290.14~~25,292.43 acres (Life of mine)
4.	Vertical extent of mine workings	Surface to 2,000 feet deep (Life of mine)

The anticipated total acreage to be affected during the five years of operation by underground mining activities is 1,500 acres. The estimated number of total surface acres to be affected over the entire mining operation is ~~46.306~~48.432 acres.

PERMITTED DISTURBED AREA BOUNDARY	ACTUAL AREA CURRENTLY DISTURBED TO BE RECLAIMED	SITE DESCRIPTION
~~28.084~~30.210	~~16.758~~17.405	Mine Site, East Spring Canyon
0.286	0.017	3 East Portals
1.774	0.70	4 East Portals
0.302	0.017	South Portals
0.396	0.017	Quitchupah Portals

0.967	0.39	Spring Collection Field, Convulsion Canyon
0.220	0.075	Pump House, Convulsion Canyon
0.784	0.40	Leach Field, Convulsion Canyon
1.595	0.193	Water Tank, East Spring Canyon
0.287	0.18	Substation, Link Canyon No. 1
0.245	0.12	Substation, Link Canyon No. 2
0.380	0.18	Link Canyon Portal
10.986	8.733	Waste Rock Disposal Site
~~46.306~~48.432	~~27.780~~28.427	Totals

The permit area, which is the same as the lease area legal descriptions in Section 114, includes 22,462.92 acres of Federal coal leases, 2,134.19 acres of State of Utah coal leases, 640 acres of fee coal leases, the 40 acres waste rock disposal site and ~~13.03~~15.32 acres under U.S. Forest Service special use permit for a total of ~~25,290.14~~25,292.43 acres.

117 Insurance and Proof of Publication

Certificates of Insurance issued to Canyon Fuel Company, LLC are located in the General Chapter 1 binder prepared for the Dugout Canyon Mine, Soldier Canyon Mine, SUFCO Mine, Skyline Mines and Banning Loadout operations and in Appendix 8-1.

The newspaper advertisement appears in Appendix 1-3. Verification of the advertisement appearing in the appropriate newspapers will be added to Appendix 1-3 and submitted to the Division no later than 4 weeks after publication.

118 Filing Fee

A photocopy of the receipt is presented in Appendix 1-4 as proof of payment of the permit filing fee.

120 Permit Application Format and Contents

The permit application contains clear, concise, current information, in the format required by the UDOGM.

CHAPTER 2

SOILS

5 of this permit. The A1 horizon in the area appeared to have a maximum thickness of 6-inches. As described previously in this section, where the topsoil is less than 6-inches thick, a lift of 6-inches of topsoil and subsoil will be taken and stockpiled as topsoil. The removal of the first 6-inches of soil will be observed and measured in the field by the site construction supervisor or a trained representative. The total area where soil salvage will be performed is approximately 0.07 acres (3,049 sq ft). Based on this area, the following volumes of salvaged soils have been calculated:

A1 or topsoil - maximum thickness 0.5 ft.
0.5 ft X 3,049 sq ft = 1,525 cu ft (~56 cu yds)*

AC and Cca horizon - average thickness of approximately 3 ft
3 ft X 3,049 sq ft = 9,147 cu ft (~339 cu yds)*

* Total volumes may vary from calculated since one large sandstone boulder is present in the cut area. Actual size of the boulder is unknown at this time.

The topsoil will be removed first and transported for storage at the waste rock storage site. It will be signed and stored separately from other piles located at the site. The subsoils will be removed to a depth of 42-inches or to the boundary with the weathered bedrock. Approximately 109 cu yds of subsoil and weathered bedrock will be used as fill material at the water tank site. The remaining subsoils will be transported to the waste rock site and stored with the subsoils removed previously from the minesite. Storage of the topsoil and subsoil piles will be done in accordance with Section 2.3.1.4 of this M&RP.

The topsoil removed from construction of the overflow pond and overflow pond access road will be stockpiled on a stable surface southwest of the overflow pond, see Plate 7-4A. According to Plate 2-1 the overflow pond site consists of type T soil. The A horizon is 0 to 2 inches in depth and the B horizon is 2-12 inches in depth. The topsoil stockpile will be segregated between A and B horizons. Much of the site of the overflow pond is on steep hill sides where topsoil is less then 6 inches deep. Assuming an average of 6 inches of removal the following quantities have been calculated:

0.167 ft X 49,950 sq ft = 8,342 cu ft (~309 cy) horizon A

0.333 ft X 49,950 sq ft = 16,633 cu ft (~616 cy) horizon B

Total 309 cy + 616 cy = 925 cy

During topsoil removal observations and measurements in the field will be conducted by the site construction supervisor or a trained representative.

2.3.1.2 Suitability of Topsoil Substitutes/Supplements

See Section 2.3.3.2

2.3.1.3 Testing of Topsoil Handling and Reclamation Procedures Regarding Revegetation

The Applicant will exercise care to guard against erosion during and after application of topsoil and will employ the necessary measures to ensure the stability of topsoil on graded slopes. Erosion control measures will include surface roughing and erosion mat placement on slope areas thought to be unstable. The Applicant will fill, regrade, or otherwise stabilize any rills or gullies deeper than nine (9) inches which form in areas which have been regraded and topsoiled. The areas adjacent to any rills or gullies which have been filled, regraded or otherwise stabilized, will be reseeded or stabilized accordingly.

Methods used to evaluate success of revegetation and stabilization appear in page 37 of Appendix 2-2. Erosion monitor pins will be placed on the slopes at the time of reseeding. Locations of the erosion pins will be obtained via a random number generator. The pin locations will be surveyed and revegetation analyses conducted annually following completion of reseeding, until the release of the bond.

2.3.1.4 Construction, Modification, Use, and Maintenance of Topsoil Storage Piles

The topsoil storage piles (Plate 2-1) at the SUFCO Mine in East Spring Canyon area consist of small amounts of topsoil, from the substation pad (27 cubic yards) and the area where the sediment pond (1,200 cubic yards) was constructed. The topsoil materials were segregated and stockpiled. The stockpiled materials were selectively placed in small area exemption areas within

The applicant will utilize the proposed topsoil subsequent to approval by the regulatory authorities.

Certification of Reclamation Topsoil Suitability. The suitability of the substitute topsoil shall be certified by an approved laboratory in accordance with at least one of the following: Soil Conservation Service (SCS) published data, SCS technical guides, state agricultural agency, Tennessee Valley Authority, BLM - USFS published data, physical and chemical analyses results, field-site trials, and greenhouse tests.

2.3.3.4 Testing of Substitute Topsoil

Only the substitute topsoil used in lieu of, or in conjunction with, on-site overburden and topsoil will be tested as described in Section 2.3.3.3.

2.3.4 Topsoil Storage

2.3.4.1 Topsoil Stockpiling

Topsoil removed will be stockpiled for later use in reclamation operations when it is impractical to promptly redistribute the topsoil on regraded areas.

Presently, the topsoil storage piles at the SUFCO Mine are of the small amounts of topsoil removed from the substation and sediment pond areas (Section 2.3.1.4).

2.3.4.2 Stockpiled Topsoil

Stable Stockpile Site. Stockpiled materials will be placed on a stable site within the permit area. The topsoil pile containing the topsoil removed from the sediment pond site was stockpiled in a small area exemption pile on a stable surface area (0.105 acres) below the sediment pond (Section 2.3.1.4). Topsoil removed for the construction of the overflow pond is stockpiled southwest of the overflow pond, see Plate 7-4A, in a small area exemption pile on a stable surface area (0.141 acres) The topsoil pile containing the soil removed from the substation area (0.02 acres) is located in a small area exemption pile on the south side of the substation. Topsoil removed from the Link Canyon Substation No. 1 will be located on the outslope below the pad as shown on Plate 5-2D.

CHAPTER 5

ENGINEERING

Locations of sedimentation ponds are noted on Plate 5-2A, 5-2B and in Volume 3 of this M&RP. No water treatment facilities exist at the site other than the sewage leach field, sediment basin, and sedimentation ponds.

The following facilities or activities do not exist or occur within the permit area:

- Coal preparation plant,
- Coal cleaning,
- Coal processing waste banks, dams, or embankments,
- Disposal of non-coal (non-waste rock) waste other than durable rock-type construction materials such as cinder block, and
- Air pollution control facilities.

Hence, certified maps or cross sections of these facilities are not provided in this plan. The durable rock-type construction materials are disposed of in the waste-rock disposal area together with the mine development waste.

Surface Configurations. Certified maps and cross sections showing the final (post-reclamation) surface configuration of the East Spring Canyon disturbed area are provided on Plates 5-3A&B and 5-4. Cut and fill volumes for final reclamation are contained in Appendix 2-5. Information regarding the final surface configuration of the waste-rock disposal areas is provided in Volume 3 of this M&RP.

Hydrology. Certified maps and cross sections associated with the hydrology of the SUFCO Mine area are provided in Chapter 7.

Geology. Certified maps and cross sections associated with the geology of the SUFCO Mine area are provided in Chapter 6.

5.1.2.2 Plans and Engineering Designs

All plans and engineering designs presented in this M&RP were prepared by or under the direction of and certified by a qualified registered professional engineer.

Excess Spoil. No excess spoil will be generated from the permit area.

Durable Rock Fills. No durable rock fills will exist in the permit area.

Coal Mine Waste. The design of the waste-rock facility has been certified by a qualified registered professional engineer.

Impoundments. The only impoundments constructed for the mining and reclamation operation consist of sedimentation ponds. Each of these ponds was designed by a professional engineer using current, prudent, engineering practices. These designs were certified by a qualified registered professional engineer.

The existing impoundments within the permit area consist of the ~~three~~four structures constructed for sediment control purposes. These structures are:

- The concrete sediment trap located near the southern end of the mine yard.
- The primary sedimentation pond located immediately below the fill on which the existing mine facilities are constructed.
- The overflow pond located 800 feet downstream from the primary sedimentation pond.
- The sedimentation pond located at the waste rock disposal site.

All pertinent information regarding these sedimentation ponds is presented in Sections 7.3.2.2 and 7.4.2.2.

Primary Roads. The design and construction of the primary road associated with the mine has been certified by a professional engineer as meeting the requirements of R645-301-534.200 and R645-301-742.420. This certification is presented in Appendix 5-1.

Plates 5-7 and 5-8 also shows the location and extent of underground workings in which planned-subsidence mining methods will be used as well as areas where measures will be taken to prevent, control, or minimize subsidence and subsidence-related damage. The location of the waste-rock disposal area in relation to the underground mine workings, is discussed in Volume 3 of this M&RP.

Land Surface Configuration. Slope measurements for undisturbed areas adjacent to disturbed areas associated with the mine are shown on Plate 5-2A&B. Surface facilities at the site have been in existence since 1941. Pre-mining topographic maps do not exist. Therefore, the slope measurements shown on Plate 5-2A&B are considered generally indicative of original land slopes in the vicinity of the mine.

Surface Facilities. Plates 5-2A,B,C,D,E,&F and Figure 5-0E shows the locations of the following surface facilities:

- Buildings, utility corridors, and facilities to be used,
- The area of disturbance at the mine mouth,
- Coal storage and loading facilities,
- Non-coal (non-waste rock) storage areas, and
- Explosive storage and handling facilities.
- Portal sites.

The remaining area of land to be affected by mining and reclamation operations is at the waste-rock site. The area of land to be affected at the waste-rock site is shown on maps provided in Volume 3 of this M&RP. The disturbed areas shown on Plates 5-2A,B,C,D,&E and the waste-rock area surface facility maps are the same as the land areas for which a performance bond or other guarantee has been posted.

Locations of topsoil stockpiles are shown on Plates 5-2A, 5-2B and in Volume 3 (Map 2). No coal processing waste banks, dams, or embankments exist in the permit area. Similarly, no spoil or coal preparation waste sites exist in the permit area. Sediment that is periodically removed from the sedimentation ponds will be disposed of at the waste-rock disposal site.

5.30 Operational Design Criteria and Plans

5.3.1 General

This application contains a general plan for each sedimentation pond within the permit area. No other water impoundments or coal processing waste banks, dams, or embankments exist in the permit area.

No minable coal exists beneath the sedimentation ponds. Thus, subsidence will not affect operation of the ponds.

5.3.2 Sediment Control

Sediment-control measures for the SUFCO Mine and Link Canyon facilities are described in detail in Section 7.3.2. The sedimentation structures at the portal facilities consist of a concrete sediment basin in the mine yard, ~~and~~ a primary sedimentation pond at the bottom of the fill slope upon which the mine yard is constructed and an overflow pond 800 feet below the primary sedimentation pond. At the waste-rock disposal site, a sedimentation pond and a decant pond have been constructed. Runoff-control structures at the mine yard and the waste-rock disposal site have been designed to convey runoff in a non-erosive manner. Sediment-control measures at the Link Canyon facilities consists of containment berms, gravel and silt fencing.

In addition to the use of sedimentation ponds and properly designed runoff-control facilities, sediment yields in the permit area are minimized by:

- Disturbing the smallest practicable area during the construction or modification of surface facilities and
- Contemporaneously reclaiming areas suitable for such reclamation.

5.3.3 Impoundments

5.3.3.1 Slope Stability

The only impoundments that are constructed, used, or maintained by SUFCO Mine are the sedimentation ponds at the portal facilities and the waste-rock disposal site. A slope-stability analysis for the ~~East Spring Canyon~~primary sedimentation pond is provided in Appendix 5-7. According to this analysis, the minimum safety factors for the ~~East Spring Canyon~~primary pond embankment are 2.2 under static conditions and 1.4 under seismic conditions. A slope-stability analysis for the overflow pond is provided in Appendix 7-23. These safety factors exceed the minimum requirements of R645-301-533.100.

A slope-stability analysis for the waste-rock disposal site sedimentation pond is presented in Appendix 5-7. According to this analysis, the minimum safety factors for the waste-rock area pond embankment are 2.8 under static conditions and 1.5 under seismic conditions. These safety factors exceed the minimum requirements of R645-301-533.100.

5.3.3.2 Foundation Considerations

No conditions were encountered during construction of the sedimentation ponds that suggested that the foundations upon which the ponds were constructed would be unstable. The slope-stability analyses presented in Appendix 5-7 indicate that the pond foundations will be stable under operating conditions.

Prior to construction of each sedimentation pond, all vegetative matter and topsoil was removed from the foundation area. Stability of the ponds has been enhanced through the installation of cutoff trenches and antiseep collars. Detailed cross sections of the sedimentation ponds are presented on Plates 7-5, 7-5A and in Volume 3.

5.3.3.3 Slope Protection

The outslopes and inslopes of the sedimentation ponds were revegetated following construction to minimize surface erosion and protect the embankments against sudden drawdown.

The ~~East Spring Canyon~~primary sediment pond has 2H:1V to 3H:1V inslopes (Plate 7-5). The overflow pond has 2H:1V to 3H:1V inslope (Plate 7-5A) The waste rock disposal site sedimentation

pond has a 3H:1V inslope (Volume 3 of this M&RP). Surface erosion ~~on both~~ would be minimized by the flatness of the inslopes.

In the event of a storm, rapid drawdown in the ~~East Spring Canyon~~primary sedimentation pond would be restricted to the vertical distance between the spillway and the peak water level, a distance of 0.20 ft (Plate 7-5). The maximum drawdown in the overflow pond during a storm event is 0.74 ft (Plate 7-5A). The maximum drawdown in the waste rock disposal site sedimentation pond during a storm event is 1.1 ft (Appendix II, Volume 3). Drawdown of this size is not significant and, given the flatness of the inslopes, is not of erosional concern.

During decant of the ~~East Spring Canyon~~ sedimentation ponds, flow is controlled and is unlikely to cause surface erosion.

5.3.3.4 Embankment Faces

Embankment inslopes and outslopes were revegetated following construction of the sedimentation ponds. Riprap was also placed on the upstream faces of the embankments near the discharge structures.

5.3.3.5 Highwalls

No highwalls are located below the water lines of the sedimentation ponds.

5.3.3.6 MSHA Criteria

No sedimentation ponds in the permit area meet the size criteria of 30 CFR 216(a).

5.3.3.7 Pond Operation and Maintenance Plans

Each sedimentation pond is designed in accordance with R645-301-740. Details of these designs are presented in Chapter 7 and in Volume 3.

The sedimentation ponds are operated as containment structures, with primary and emergency spillways to discharge water during a storm that exceeds the design capacity. Excess water

following a runoff event is held in the ponds until the suspended sediment settles. Water is decanted in accordance with the discharge permit and 40 CFR 434 effluent limitations.

The decant devices for the ~~two~~three sedimentation ponds consist of an inverted section of 12-inch diameter iron pipe ~~and 12-inch CMP culvert~~ connected to iron pipe at ~~East Spring Canyon~~ the primary sediment pond, an inverted section of 24-inch CMP pipe connected to an 18-inch pipe at the overflow pond and an inverted section of 12-inch CMP connected to 12-inch CMP pipe at the Waste Rock Disposal Site ~~respectively~~. Outflow from the decant devices is controlled by locked gate valves. Keys to the locks are maintained at the mine office. Details of the design of these decant devices are provided in Chapter 7.

Inspections of the sedimentation ponds are conducted on a quarterly basis (see Section 5.1.4.3). Maintenance that is required to keep the ponds in good working condition is performed as soon as practical following discovery of a maintenance need.

Sediment is removed from the ponds when it accumulates to 60 percent of the design sediment storage volume. This removed sediment is disposed of in the waste-rock disposal area.

5.3.4 Roads

5.3.4.1 Location, Design, Construction, Reconstruction, Use, Maintenance, and Reclamation

Control of Damage to Public or Private Property. All roads used by SUFCO Mine were designed in accordance with applicable county, UDOT, and U.S. Forest Service standards. By designing according to these standards, damage to public or private property has been minimized.

Road Surfacing. The surface of the mine access road consists of asphalt with a rock-chip wear surface (see Section 5.2.7.2). All ancillary roads are unimproved dirt roads. No acid- or toxic-forming materials have been used in the road surfaces.

CHAPTER 7

HYDROLOGY

7.3.1.6 Stream Buffer Zones

All perennial and intermittent streams in the mine area are protected by 100 foot stream buffer zones on either side of these streams. Coal mining and reclamation operations should not cause or contribute to the violation of applicable Utah or federal water standards and should not adversely effect the water quantity and quality or other environmental resources of the stream.

Stream Channel Diversions. Temporary or permanent stream channel diversions comply with R645-301-742.300.

Buffer Zone Designation. The areas surrounding the streams that are not to be disturbed are designated as buffer zones, and SUFCO has marked these as specified in R645-301-521.260.

7.3.1.7 Cross Sections and Maps

The locations of water rights for current users of surface water flowing into, out of, and within the permit and adjacent areas is provided on Plate 7-2. Discharges associated with the permit and adjacent areas are located as presented on Plate 7-3.

The locations of each water diversion, collection, conveyance, treatment, storage, and discharge facility to be used in the East Spring Canyon area are presented on Plate 7-6. Similar information for the waste-rock disposal site is presented in Volume 3 of this M&RP. Similar information for the Link Canyon Substation No. 1 and No. 2 facility areas is presented on Plates 5-2D and 5-2E. Similar information for the Link Canyon Portal facility area is presented on Plate 5-2F.

Locations and elevations of each station to be used for water monitoring during coal mining and reclamation operations are presented on Plate 7-3.

The construction details and cross sections for the concrete sediment trap are located in the "Alternate #1 Drainage Facilities and Sediment Control Plan" (Appendix 7-8). The existing topography and cross sections for the ~~main~~ primary sedimentation pond are located on Plates 7-4 and 7-5. The design topography and cross sections for the overflow pond are located on Plates 7-4A and 7-5A. The design topography and cross sections for the waste rock disposal site sedimentation pond are located in Volume 3 of this M&RP.

Other Cross Sections and Maps. Other relevant cross sections or maps are presented and discussed in Chapter 5 of this M&RP.

7.3.1.8 Water Rights and Replacement

Ground and surface water rights do exist within the Sufco Mine permit area. Mitigation has been performed at stock pond locations where claims have been made that the available surface water has been impacted by subsidence. Mitigation at these locations has been performed by the placement of bentonite in the bottom of stock ponds and by hauling replacement water to the ponds for livestock use during summer months.

The Permittee will mitigate and replace the water supply of any land owner or adversely affected State appropriated water if such a water supply proves to be contaminated, diminished or interrupted as a result of mining operations. First, a determination will be made by the Division in accordance with R645-301-731.800 as to whether or not material damage has occurred. Then, in accordance with Regulation R645-301-525.510, the operator will correct any material damage resulting from subsidence caused to surface lands (which includes water rights), to the extent technologically and economically feasible. Negotiations will be held immediately with the impacted party to determine the appropriate mitigation activities. The restoration of water flows to impacted sources will be accomplished using the Best Technology Currently Available (BTCA). These activities may include, but not necessarily be limited to: piping or trucking water to the location of the loss; sealing surface fractures to prevent further losses (i.e., stream floors on bed rock or in shallow alluvium), and; construction of a ground water well and the installation of pumps to restore flows. If the above efforts are not successful, then the operator will explore the transferring of water rights to the injured party in flow equal to the determined loss and/or monetary reimbursement for proven material damages.

The water supply in the East Fork of Box Canyon is of special concern to Sufco and the regulatory authorities. In an effort to protect the minimal surface flows in this area, an intense monitoring and mitigation plan will be implemented prior to full extraction mining taking place under the East Fork. If changes in the quantity and quality of the water in the East Fork are noted, the Division will be immediately notified. A determination of the amount of water, if any, that is lost due to mining activities will be made using surface and ground water flow and climatic data. If a loss of flow is confirmed, the loss will be addressed as described in the proceeding text of this section.

7.3.2 Sediment Control Measures

The existing sediment control measures within the permit area have been designed, constructed, and maintained to prevent additional contributions of sediment to streamflow or to runoff outside the permit area. In addition, they have been designed to meet applicable effluent limitations, and minimize erosion to the extent possible.

The structures to be used for the runoff-control plan for the permit area include disturbed and undisturbed area diversion channels, sedimentation ponds, containment berms, silt fences, and road diversions and culverts.

7.3.2.1 Siltation Structures

The siltation structures within the permit area consist of the sedimentation ponds described in Section 7.3.2.2.

7.3.2.2 Sedimentation Ponds

There are ~~three~~ four sedimentation ponds operating at the mine facility. ~~Two~~ Three of them are located in the immediate vicinity of the existing facilities. A ~~third~~ fourth pond is located at the waste rock disposal site.

Concrete Sediment Trap. A sediment trap is located near the southern end of the mine yard which captures all disturbed area runoff from the mine yard area. This concrete sediment trap was designed to remove in excess of 65% of all solids from the disturbed area runoff before the water enters the main sedimentation pond below. The purpose of the concrete sediment trap is to reduce the required size of the main sedimentation pond and to decrease the amount of overall disturbance. A detailed design of the concrete sediment trap is contained in Appendix 7-8.

Operation of the sediment trap includes decanting the existing water and removing the sediment. Except during use, the telescoping decanting valve on the trap is locked to prevent unauthorized drainage of the concrete structure. On regular UPDES sampling days, the structure is inspected for sediment content. If a sediment delta is evident at the water level extending to or beyond the first of the mine discharge pipes, the structure will be decanted within one week of the observation. The decanting period shall not exceed four days. Sediment material from the structure will then be removed with a front-end loader and disposed of at the waste-rock disposal site.

~~Main~~ Primary Sedimentation Pond. The primary sedimentation pond is located in the area immediately below the fill on which the existing mine facilities are constructed. The existing sedimentation pond topography and cross sections are presented on Plates 7-4 and 7-5 of this M&RP.

The staff gauge in the pond has been marked to indicate the 60% clean-out elevation of 7408.1 feet as defined in Section 7.4.2. At least once each year following the spring runoff event, the pond will be drained with the decanting device to inspect the accumulated sediment level. The pond will be sampled for effluent quality immediately before the decanting operation.

If sediment has accumulated to the 60% clean-out elevation, the pond will be cleaned. The sediment will be transported and disposed of at the waste rock disposal site.

The southern-most extent of the sedimentation pond dam is located 180 feet south of the lease boundary across East Spring Canyon. The Fishlake National Forest Service issued a special use permit that approved the construction with the stipulation that the dam site be included in the disturbed mine permit area and subject to final reclamation. The area is included in the calculation of the disturbed area subject to bonding and in the calculation of final reclamation costs.

Overflow Pond. The overflow pond is located 800 feet downstream of the primary sedimentation pond. The overflow pond topography, cross sections and details are presented on Plate 7-4A and 7-5A of this M&RP.

The staff gauge in the overflow pond will be marked to indicate a clean-out elevation of 7243.62 feet as defined in Section 7.4.2. At least once each year, following the spring runoff event, the pond will be drained with the decanting device to inspect the accumulated sediment level. The pond will be sampled for effluent quality immediately before the decanting operation. When sediment has accumulated to the clean-out elevation, the pond will be cleaned. The sediment will be transported and disposed of at the waste rock disposal site.

Waste Rock Disposal Site Sedimentation Pond. The sedimentation pond located at the waste rock disposal site is presented on Figures 1 and 1A of Volume 3 of this M&RP. A discussion of the operation, maintenance, and reclamation of this pond is also contained therein.

Compliance Requirements. All sedimentation ponds will be maintained until removal in accordance with the reclamation plan (see Section 5.40 of this M&RP). When a pond is removed, the land will be revegetated in accordance with the reclamation plan defined in Section 5.40.

The Primary sedimentation pond and concrete sediment trap were designed together to contain the volume of sediment equal to 0.035 acre-foot per acre of disturbed area. The concrete sediment trap will provide for removal of 65% of this sediment volume, while the sedimentation pond will contain the remaining 35%. In addition, the sedimentation pond will fully contain the runoff from the 10-year, 24-hour storm event. The spillways for both the sedimentation pond and concrete sediment trap will adequately pass the peak flow from the 25-year, 6-hour precipitation event.

The overflow pond has been designed to retain sediment from the disturbed mine facilities and runoff from the 10-year, 24-hour storm event. The spillway for the overflow pond has been designed to safely pass the peak flow from the 25-year, 6-hour precipitation event. The affected area will be included in the calculation of the disturbed area subject to bonding and in the calculation of final reclamation costs.

The waste rock disposal site sedimentation pond was designed to contain a sediment volume equal to 0.1 acre-foot per acre of disturbed area. It will also fully contain the runoff from the 10-year, 24-hour storm event. The spillways for the pond were initially designed to pass the peak flows from the 25-year, 24-hour storm event. The revised design storm (25-year, 6-hour precipitation event) results in a smaller peak discharge and, thus, the spillways are adequately designed.

Additional design standards for all ponds are presented in Section 7.4.2.

MSHA Requirements. MSHA requirements defined in 30 CFR 77.216 are not applicable since the existing sedimentation ponds do not impound water or sediment to an elevation of 20 feet or more above the upstream toe of the structure. The ponds also store a volume less than 20 acre-feet.

7.3.2.3 Diversions

The objective of the run-off control plan is to isolate, to the maximum degree possible, run-off from disturbed areas from that of undisturbed areas. This is accomplished by:

- Allowing all upstream run-off to by-pass the disturbed area via a network of culverts.
- Routing run-off from the undisturbed east slope above the facilities down diversion ditches in the east side road to by-pass the disturbed area.
- Routing of any run-off from undisturbed areas which enters the disturbed area into the sediment control system.

The location of each diversion ditch or culvert for the main facility area is presented on Plate 7-6. The location of each diversion ditch for the Link Canyon Portal and Substation No. 1 and No. 2 facility areas is presented on Plates 5-2D, 5-2E, and 5-2F. A brief list of each diversion structure is as follows (refer to Plates 7-7, 5-2D, 5-2E, and 5-2F for the location of each sub-watershed boundary):

Diversion Ditches:

- Interception ditch along the East Side Road which drains watershed CBE-5.
- Interception ditch along the East Side Road which drains watersheds CBE-1 through CBE-5.
- Substation pad upper undisturbed interception ditch which drains watershed CBE-4.
- Substation pad lower undisturbed interception ditch which drains watershed CBE-3. This ditch is part of the alternate sediment control measures defined in Section 7.4.2.1.
- Riprap diversion channel for CBE continuance diversion. This diversion drains watersheds CBE-1 through CBE-5.
- Interception ditch which drains undisturbed watershed ESC-6 north of ATOF.
- Interception ditch which drains undisturbed watershed ESC-7 north of ATOF.
- Interception ditch which drains undisturbed watershed MSH-2 north of ATOF.
- Sedimentation Pond access road diversion ditch which drains disturbed watershed DIS-3.
- Main access road diversion ditch which drains undisturbed watershed DWN-1.

- Link Canyon Substation No. 1 ditch which drains watersheds LINK and ASCA-1.
- Link Canyon Substation No. 1 road swell which drains watersheds LINK, ASCA-1, and ASCA-3.
- Link Canyon Substation No. 2 ditch which drains watersheds LINK No.2, ASCA-4, and ASCA-7.
- Link Canyon Portal Access Road Channel No. 1 which diverts the access road disturbed drainage and undisturbed drainage above the access road to the Link Canyon drainage bypass culvert inlet.
- Link Canyon Portal Pad Channel No. 2 which diverts the pad area disturbed drainage and the undisturbed area above the pad to the Link Canyon drainage bypass culvert inlet.
- West Overflow Pond Undisturbed Area Diversion Channel which diverts and drains runoff from watershed DWN-3 around to Overflow Pond Access Road Channel.
- Overflow Pond Access Road Channel which diverts and drains runoff from watershed DWN-3 along the Overflow Pond Access Road.
- East Overflow Pond Undisturbed Area Diversion Channel (Shallow Section) which diverts and drains runoff from watershed DWN-5 around the Overflow Pond.
- East Overflow Pond Undisturbed Area Diversion Channel (Steep Section) which diverts and drains runoff from watershed DWN-5 down the overflow pond impoundment.

Diversion Culverts:

- CBE bypass culvert at substation which drains watersheds CBE-2 through CBE-5.
- Pipe No. 5 diversion culvert which drains undisturbed watershed DWN-1.
- Mud Spring Hollow bypass culvert which drains undisturbed watersheds MSH-1 and MSH-2. This culvert discharges into the East Spring Canyon bypass culvert.
- East Spring Canyon bypass culvert which drains undisturbed watersheds ESC-1 through ESC-7. This bypass also receives flows from the Mud Spring Hollow bypass.
- East Spring Canyon bypass culvert emergency diversion at the main mine fan. This 3.5 foot square drop drain with oil skimmer cap connects into a 48-inch culvert directed into the East Spring Canyon bypass culvert. This serves as an overflow system when the trash rack at the inlet to East Spring Canyon becomes plugged with debris.

- 6-inch pipe diversion for undisturbed watershed ESC-7. This pipe discharges to the East Spring Canyon bypass culvert.

- Main Mine Fan Diversion. The main mine fan is located in a depression which is nine feet below the adjacent mine yard drainage system. A sump pump with automatic float controls in front of the main fan will pump the runoff from this area into the 10-inch mine yard drain line.

- 10-inch mine yard culvert drainage system. This system discharges to the concrete sediment trap.

- Link Canyon Portal bypass culvert which drains watersheds LCP-East and LCP-West.

- The primary sediment pond diversion culvert allows runoff from the disturbed area to bypass the primary sedimentation pond, thereby allowing water to be drained from the primary sedimentation pond for sediment removal. This culvert discharges to the overflow pond.

- The 66-inch overflow pond bypass culvert allows runoff from undisturbed watersheds DWN-1, DWN-2, DWN-3, MSH-1, MSH-2, and ESC-1 through ESC-7 to bypass the overflow pond. This culvert discharges immediately downstream of the overflow pond.

All diversion ditches are maintained with adequate rip-rap or alternative erosion protection in the ditch sections where flow velocities are great enough that a ditch lining is necessary. Adequate ditch capacities are maintained in all ditch sections. Culverts are kept free of debris and each outlet is lined with adequate riprap. Detailed diversion design is presented in Section 7.4.2.

Water bars in roadside ditches have been constructed of rocks to form low dams across the ditches. The rocks are large enough to resist movement during anticipated run-off events. They are arranged to channel water down the center of the ditch rather than around the water bar ends to prevent erosion of the ditch side walls. Accumulations of sediment behind the ditch water bars are permitted to rise to the lowest height of the bar.

Diversion ditch and culvert operation and maintenance for the diversions within the waste rock disposal site are presented in Volume 3 of this M&RP.

7.3.2.4 Road Drainage

Road drainage facilities include diversion ditches, culverts, containment berms, and/or water bars. The road drainage diversion ditches and culverts for the mine site and Link Canyon facility area are included in the list of diversions presented in Section 7.3.2.3 above. In addition, water bars have been constructed across dirt roads within the disturbed areas to channel water off the road onto downslopes or into roadside ditches. Riprap has been placed along these transitions to minimize the potential for erosion. Water bars have been constructed on the East Side road and along the access road to the sedimentation pond. Additional road drainage design information is presented in Section 7.4.2.

The operation of the road drainage diversions within the waste rock disposal site is presented in Volume 3 of this M&RP.

All road drainage diversions will be maintained and repaired to original condition following the occurrence of a large storm event. Culvert inlets and outlets will be kept clear of sediment and other debris.

7.3.3 Impoundments

7.3.3.1 General Plans

There are ~~three~~ four sedimentation ponds operating at the mine facility as described in Section 7.3.2.2. ~~Two~~ Three ponds are located at the East Spring Canyon surface facilities. A ~~third~~ fourth pond is located at the waste rock disposal site.

The concrete sediment trap is located near the southern end of the mine yard and captures all disturbed area runoff from the mine yard area. A detailed design of the sediment trap is contained in Appendix 7-8.

The ~~main~~ primary sedimentation pond is located in the area immediately below the fill on which the existing mine facilities are constructed. The existing sedimentation pond topography and cross sections are presented on Plates 7-4 and 7-5 of this M&RP.

The overflow pond is located 800 feet downstream from the primary sedimentation pond. The overflow pond is designed to allow for flood control and sediment settling while the primary

sediment pond is being drawn down for sediment removal. A series of canal boxes with valves will allow the primary sediment pond to be bypassed for draw down, sediment removal, and maintenance. Detailed design information regarding the overflow pond is provided in Appendix 7-23 and Plates 7-4A and 7-5A.

The waste rock disposal site sedimentation pond is located at the waste rock disposal site and is presented on Figures 1 and 1A of Volume 3 of this M&RP.

Certification. All maps and cross sections of the sedimentation ponds have been prepared by or under the direction of and certified by a qualified, registered, professional engineer.

Maps and Cross Sections. The construction details and cross sections for the concrete sediment trap are located in Appendix 7-8. The existing topography and cross sections for the main sedimentation pond are located on Plates 7-4 and 7-5 of this M&RP. The topography and cross sections for the overflow pond are located on Plates 7-4A and 7-5A of this M&RP. The design topography and cross sections for the waste rock disposal site sedimentation pond are located in Volume 3 of this M&RP.

Narrative. A description of each sedimentation pond is presented in Sections 7.3.2.2 and 7.4.2 of this M&RP.

Subsidence Survey Results. No underground coal mining occurs beneath the existing impoundments within the permit area and, therefore, there has been no effect from subsidence.

Hydrologic Impact. The preliminary hydrologic and geologic information required to assess the hydrologic impacts of the impoundments can be found in Section 7.2.4 and Chapter 6, respectively.

Design Plans and Construction Schedule. There are no additional structures proposed for the mining operation at this time. Designs of all existing structures have been described within this M&RP.

7.3.3.2 Permanent and Temporary Impoundments

Requirements. All impoundments have been designed and constructed using current, prudent, engineering practices. Specific foundation design and construction criteria are presented in Chapter 5 of this M&RP. Specific hydrologic design criteria for each impoundment are presented in Section 7.4.3. All impoundments will be inspected regularly based on the schedule contained in Section 5.1.4.3.

Permanent Impoundments. There are no permanent impoundment structures within the mine facilities at this time.

Temporary Impoundments. The UDOGM authorized the construction of the existing temporary impoundments at the mine as part of coal mining and reclamation operations.

Hazard Notifications. The sedimentation ponds will be examined for structural weakness and erosion at least four times per year. A report of these findings will be submitted to the UDOGM on a quarterly basis.

7.3.4 Discharge Structures

The discharge structures within the East Spring Canyon facilities area include the spillways on the concrete sediment trap, ~~and~~ primary sedimentation pond, and overflow pond. These discharge structures are defined in Section 7.4.4. The spillways constructed on the waste rock disposal site sedimentation pond are described in Volume 3 of this M&RP.

7.3.5 Disposal of Excess Spoil

There is no excess spoil generated at the mine.

7.3.6 Coal Mine Waste

Areas designated for the disposal of coal mine waste and coal mine waste structures are constructed and maintained as described in Volume 3 of this M&RP.

7.3.7 Noncoal Mine Waste

Noncoal mine waste is stored and disposed of as described in Chapter 5.

7.3.8 Temporary Casing and Sealing of Wells

Each groundwater monitoring well identified on Plate 7-3 will be operated and maintained as described in Section 7.4.8.

7.40 Design Criteria and Plans

7.4.1 General Requirements

This M&RP includes site-specific plans that incorporate minimum design criteria for the control of drainage from disturbed and undisturbed areas.

7.4.2 Sediment Control Measures

7.4.2.1 General Requirements

Design. Existing sediment control measures have been designed, constructed and maintained to provide the following:

- Prevent additional contributions of sediment to stream flow or to runoff outside the permit area.
- Meet the effluent limitations defined in Section 7.5.1.
- Minimize erosion to the extent possible.

Measures and Methods. The sediment control measures at the mine include practices carried out within and adjacent to the disturbed area. Sediment control methods include:

- Retention of sediment within the disturbed area;
- Diversion of runoff away from the disturbed area;
- Diversion of runoff using channels or culverts through disturbed areas to prevent additional erosion;
- Cut and fill slopes within the disturbed area will be revegetated with a quick growing vegetative cover (standard seed mix in section 3.4.1.2 minus the shrubs and trees) to provide interim reclamation and stability of the slopes during mining.
- Provide straw dikes, riprap, check dams, mulches, vegetative sediment filters, dugout ponds and other measures that reduce overland flow velocities, reduce runoff volumes or trap sediment;
- Treatment with chemicals; and
- Treatment of mine drainage in underground sumps. There are four portal sites in Quitchupah Canyon. The 4 East portal site is classified as an ASCA. South portals, 3 East portals, and Quitchupah portals have sediment control consisting of routing runoff from disturbed areas into the mine with berms and insloping. The runoff is then treated using in mine settling ponds prior to discharge through approved UPDES points. The disturbed area associated with the South portals

is 0.017 acre. The disturbed area associated with the 3 East portals is 0.017 acre. The disturbed area associated with the Quitchupah portals is 0.017 acre. A calculation demonstrating the insignificance of the inflow of surface water into the mine is included in Appendix 7-16.

Several alternate sediment control areas are defined within the mine site and are listed below (see Plates 5-2B,C,D,E,&F):

- The original substation pad area and fire water tank above the office building. The sediment controls include a graveled pad area and silt fences. The disturbed area is 0.324 acre.

- The topsoil stockpile near the mine site primary sedimentation pond. The sediment control consists of containment berms and silt fencing. The disturbed area is 0.105 acre.

- The topsoil stockpile near the mine site overflow pond. The sediment control consists of containment berms and silt fencing. The disturbed area of the overflow pond topsoil stockpile is 0.141 acres.

- The subsoil and sedimentation pond topsoil stockpiles at the waste rock disposal site. The sediment controls include containment berms and silt fencing. The disturbed area of the subsoil stockpile is 0.51 acre. The disturbed area of the pond topsoil pile is 0.293 acre.

- The area above the mine fan in East Spring Canyon. The sediment control consists of silt fencing. The disturbed area is 0.122 acre.

- The pump house in Convulsion Canyon. The sediment control consists of containment berms and silt fencing. The disturbed area is 0.075 acre.

- The leach field in Convulsion Canyon. The sediment control consists of containment berms and silt fencing. The area is fenced to prevent grazing. The disturbed area is 0.40 acre.

- The new substation pad disturbed area is 0.287 acre. The sediment controls include gravel and silt fences.

- The 4 East portal site consists of a pad area where a mine fan has been built. The disturbed area associated with the two portal openings at this site is 0.70 acre. Alternate sediment control at this pad consists of a containment berm, gravel and silt fencing.

- The Link Canyon Substation No. 1 facility disturbed area is 0.18 acre. This substation pad area was reclaimed in 2000. The sediment control consists of containment berms, silt fencing, and vegetation.

- The Link Canyon Substation No. 2 facility disturbed area is 0.12 acre. The sediment control consists of containment berms, gravel and silt fencing.

- The Link Canyon Portal facility disturbed area is 0.18 acre. The sediment control consists of containment berms, gravel and silt fencing.

The total area for Alternate Sediment Control Areas (ASCA) is ~~3.296~~ 3.437 acres. This is approximately ~~11.9~~12.1 percent of ~~27.78~~ 28.427 acres of total disturbed area at the mine site, Link Canyon Portal and Substation No. 1 and No. 2 facility sites, and waste rock disposal site (including ASCA's and SAE's).

7.4.2.2 Siltation Structures

General Requirements. Additional contributions of suspended solids and sediment to stream flow or runoff outside the permit area are being prevented to the extent possible using various siltation structures.

The existing siltation structures for the main facilities area, the concrete sediment trap and ~~main~~ primary sedimentation pond, were not constructed before beginning coal mining operations. The structures were constructed upon implementation of applicable State and Federal Regulations. The overflow pond was constructed to allow for continued compliance with State and Federal Regulations. The sedimentation pond for the waste rock disposal site was constructed before the site was used. Each structure has been certified by a qualified registered professional engineer.

All siltation structures which impound water have been designed, constructed and maintained as described in Chapter 5 and Sections 7.3.3 and 7.4.3.

Siltation structures are also provided at the mine-water discharges points. Water is presently being discharged from the mine at UPDES discharge point 003 from the Quitchupah Canyon breakouts. UPDES discharge point 001 is approved as an alternative mine water discharge point. Design of the siltation structures for these discharge points is presented in Section 7.3.1.5.

Sedimentation Ponds. There are ~~three~~ four sedimentation ponds operating within the permit area. These ponds are described as follows:

- Concrete sediment trap located at the south end of the main facilities area.
- ~~Main~~ Primary sedimentation pond located in the area immediately below the fill on which the existing mine facilities are constructed.

- Overflow pond located approximately 800 feet downstream from the primary sedimentation pond.
- Waste rock disposal site sedimentation pond located at the waste rock disposal site.

Sedimentation Pond Use.

Individually or in Series. The concrete sediment trap and the primary sedimentation pond or overflow pond are designed to work in series to manage the design sediment volume and pass the peak discharge rate. The overflow pond is designed to allow runoff from the concrete sediment trap to bypass the primary sediment pond to allow for draw down, sediment removal, and maintenance. The sedimentation pond at the waste rock disposal site functions individually.

Location. All sedimentation ponds are located as near as possible to the disturbed areas. The location of the concrete sediment trap, ~~and~~ primary sedimentation pond, and overflow pond ~~is~~ are indicated on Plate 7-6. Location of the waste rock disposal site sedimentation pond is presented in Volume 3 of this M&RP. ~~None of the existing ponds are located within a perennial stream channel.~~ The concrete sediment trap, primary sediment pond, and waste rock disposal site sediment pond are not located within a perennial stream channel. The overflow pond is located within a perennial stream channel.

Design, Construction and Maintenance.

Sediment Storage Volume. The concrete sediment trap, ~~and~~ primary sedimentation pond or overflow pond were designed to, in series, control a sediment volume of 0.035 acre-feet per acre of disturbed area. The disturbed area, contributing sediment to the concrete sediment trap and primary sedimentation pond, contains 15.88 acres from contributing watersheds DIS-1 through DIS-5. The disturbed areas, contributing sediment to the overflow pond, contains 16.49 acres from contributing watersheds DIS-1 through DIS-6. Refer to Plate 7-7 for a location of the watersheds. Although it contributes runoff to the ponds, a sediment storage volume from the watershed CBW-1 is not included in the calculations because it is an undisturbed area.

The sediment trap was constructed to provide easy access for the removal of 65% of all solids before runoff from the disturbed area enters the primary sedimentation pond. Although the

concrete basin does not have 65% of the total sediment volume it permits reduction of the ~~main~~ primary pond size by that amount because it provides a sediment control measure for the removal of sediment equal to the reduced volume.

The concrete sediment trap was constructed after consultation with representatives from the Office of Surface Mining, the Division of Oil, Gas and Mining and the U.S. Forest Service during the spring of 1980 and was built subsequent to approval of the various regulatory authorities. The design was selected in preference to other designs employing a full size pond due to environmental considerations. Among these considerations was that a full size pond would have required the disturbance of at least twelve additional acres of presently undisturbed area. In addition, the resulting pond would have been exceedingly difficult to maintain with respect to regular and frequent sediment recovery and disposal.

The primary sedimentation pond was designed to fully contain the remaining 35% of the design sediment volume. Based on calculations presented in Appendix 7-14, the disturbed area totals 15.88 acres. Therefore, the primary sedimentation pond will contain a maximum of 24,211 cubic feet (0.556 acre-feet) of sediment. The elevation of the maximum sediment level is 7410.4 feet. The 60% sediment clean-out volume of 14,527 cubic feet (0.333 acre-feet) has an elevation of 7408.1 feet.

The overflow pond is designed to work in series with the concrete sediment trap, and/or the primary sedimentation pond. A review of sedimentation pond discharge records for the period of 11/06/99 to 07/09/08 indicates that normal dust suppression activities at the facility, and wash down of transport vehicles contributes a constant flow of approximately 0.046 cfs from the disturbed area to the concrete sediment trap and primary sedimentation pond. The sediment trap and the primary sedimentation pond were designed to create a quiescent sediment settling area capable of containing runoff from a 10-year, 24-hour storm with a spillway capable of safely discharging the peak flow resulting from a 25-year, 6-hour storm. Dust suppression and washdown water flows almost constantly into these two basins, the overflow pond is sized to more efficiently manage runoff from the 10-year, 24-hour storm from the disturbed and adjacent areas.

The overflow pond was designed to fully contain the design sediment volume for the disturbed area. As indicated in Appendix 7-23, the disturbed area associated with this pond totals 16.49 acres. This disturbed area includes 15.88 acres treated and detained by the concrete sediment

trap and primary sediment pond and 0.61acres of the overflow pond. The 0.61 acres of disturbed area for the overflow pond includes only the pond area itself no additional sediment will be created. Based on a sediment storage volume of 0.035 acre-feet per acre of disturbed area, the overflow pond will contain 24,211 cubic feet (0.556 acre-feet) of sediment. The elevation of the maximum sediment level is 7,245.41 feet. The 60% sediment clean-out volume of 14,526 cubic feet (0.33 acre-feet) has an elevation of 7,243.62 feet.

The design sediment storage volume and 60% clean-out level for the waste rock disposal site sedimentation pond is presented in Volume 3 of this M&RP.

Detention Time. An adequate detention time will be provided in each pond to allow the effluent to meet UPDES and 40 CFR Part 434 limitations. The decant water will be sampled and discharged from the pond in accordance with the above referenced effluent limitations.

Design Event. The sedimentation ponds are designed to fully contain the 10-year, 24-hour precipitation event.

Overflow Pond, Primary Sedimentation Pond and Concrete Sediment Trap. The calculations contained in Appendix 7-14 were based on the assumption that the primary sedimentation pond will fully contain the runoff from the main facility disturbed areas. The concrete sediment trap will pass the water to the sedimentation pond, but will not provide significant runoff storage. The concrete sediment trap is used primarily for the removal of sediment.

Several drainage areas, identified on Plate 7-6, contribute runoff to the overflow pond. The disturbed drainage area contributing directly to the overflow pond are DIS-1 through DIS-6. The undisturbed drainage area contributing to the overflow pond is CBW-1.

The curve numbers used to determine the design runoff volume were based on information presented in Appendix 7-11 and Appendix 7-23. The curve number assumed for the disturbed watershed DIS-1 through DIS-4 is 80 and for DIS-5 and DIS-6 is 100, see Appendix 7-11 and 7-23. The curve number for undisturbed watersheds CBW-1 is 72, see Appendix 7-11. Refer to Table 7-6 for a list of all disturbed and undisturbed subwatershed areas and curve numbers within the facilities area. Based on the curve numbers presented above, the storm runoff volume from the 10-year, 24-hour storm event to the overflow pond is 57,898 cubic feet (1.33 acre-feet). The

maintenance runoff rate of 0.046 cfs adds 3,975 cubic feet (0.0913 acre-feet) to this volume during a 24-hour period, resulting in a combined required runoff storage volume of 61,873 cubic feet (1.42 acre-feet) without sediment storage. The calculations, presented in Appendix 7-23, are based on hydrologic design methods described in Appendix 7-10. As presented above, the maximum sediment storage volume is 24,211 cubic feet. In order to fully contain the runoff from the 10-year, 24-hour storm event and the maximum sediment storage, the primary spillway elevation for the overflow pond is 7252.5 (2.14 acre-feet), from the stage-capacity table contained in Table 7-8A. The required minimum elevation for the primary spillway with a volume of 24,211 cubic feet is 7,252.26, for ease of construction the primary spillway elevation will be 7,252.50 feet.

Several drainage areas, identified on Plate 7-7, contribute runoff to the primary sedimentation pond. The disturbed drainage areas contributing to the pond are DIS-1, DIS-2, DIS-3, DIS-4, and DIS-5. The undisturbed drainage area contributing to the pond is CBW-1. The undisturbed drainage CBW-1 is discharged to the pond because it was determined that construction of a diversion ditch along the top of the cut slope from the trash pit north to Mud Spring Hollow may cause some stability problems with the cut slope.

The curve numbers used to determine the runoff volumes were based on information presented in Appendix 7-9. The average curve number for the disturbed area is 80. The curve number assumed for the undisturbed watershed CBW-1 is 72. The curve number for the pond area (watershed DIS-5) was assumed to be 100. Refer to Table 7-6 for a list of all disturbed and undisturbed subwatershed areas and curve numbers within the facilities area.

Based on the curve numbers presented above, the storm runoff volume from the 10-year, 24-hour storm event is 57,898 cubic feet (1.329 acre-feet). The calculations, presented in Appendix 7-14, are based on hydrologic design methods described in Appendix 7-10. As presented above, the maximum sediment storage volume is 24,211 cubic feet. Thus, the minimum capacity of the pond at the elevation of the primary spillway must be 82,109 cubic feet (1.885 acre-feet), assuming the spillway does not spill during the 10-year, 24-hour storm.

In order to fully contain the runoff from the 10-year, 24-hour storm event and the maximum sediment storage, the primary spillway on the sedimentation pond will need to be raised. From the stage-capacity curve for the existing pond structure contained in Appendix 7-14, the required elevation of the primary spillway is 7418.15 feet.

Waste Rock Disposal Site Sedimentation Pond. The design storm runoff volume for the waste rock disposal site sedimentation pond is presented in Volume 3 of this M&RP. The sedimentation pond adequately contains the runoff from the 10-year, 24-hour storm event with maximum sediment storage.

Dewatering Device. The concrete sediment trap contains a telescoping dewatering device which can decant water from any elevation in the basin. It will be locked to prevent unauthorized drainage of the concrete structure.

The existing dewatering device on the primary sedimentation pond will be modified so the flowline will be at the elevation of the maximum sediment level, elevation 7410.4 feet. Water will be discharged from the pond in accordance with UPDES guidelines.

The overflow pond dewatering device is designed to decant at the 60% sediment level, 7,243.62 feet. Water will be discharged from the pond in accordance with UPDES guidelines.

The dewatering device for the waste rock site sedimentation pond is identified in Volume 3 of this M&RP.

TABLE 7-6

Summary of Watershed Data

Watershed	Curve Number	Area (acres)	Time of Concentration (hours)
DIS-1	80	2.46	0.021
DIS-2	80	9.27	0.226
DIS-3	80	1.40	0.066
DIS-4	80	2.23	0.022
DIS-5	100	0.34	0.008
CBW-1	72	29.8	0.183
DWN-1	79	7.23	0.110
CBE-1	72	12.4	0.187
CBE-2	90	0.30	0.017
CBE-3	90	0.05	0.011
CBE-4	72	3.05	0.119
CBE-5	72	3.88	0.107
ESC-1	72	882	1.36
ESC-2	72	1010	0.875
ESC-3	72	211	0.453
ESC-4	72	468	1.18
ESC-5	72	487	0.776
ESC-6	79	0.92	0.042
ESC-7	79	0.57	0.053
MSH-1	72	1956	1.89
MSH-2	79	0.55	0.046
ESC-1 through ESC-5	72	3058	1.89
DWN-2	79	6.02	0.033
DWN-3	79	2.25	0.028
DWN-4	79	36.74	0.217
DWN-5	79	12.65	0.175
DIS-6	100	0.61	0.015

Short Circuiting. Short circuiting is minimized in the primary sedimentation pond and the waste rock disposal site sedimentation pond because both ponds will fully contain the runoff from the 10-year, 24-hour precipitation event.

Sediment Removal. Sediment removal from the concrete sediment trap will be performed frequently such that the basin will operate efficiently. On regular UPDES sampling days, the structure will be inspected for sediment content. If a sediment delta is evident at the water level extending to or beyond the first of the mine discharge pipes. Sediment material from the structure will then be removed with a front-end loader and mixed with coal in the adjacent coal storage pile.

Sediment removal from the primary sedimentation pond will be conducted when the sediment level reaches the 60% clean-out level. From the stage-capacity curve presented in Appendix 7-14, the 60% clean-out elevation is 7408.1 feet. The sediment will be transported and disposed of at the waste rock disposal site.

Sediment removal from the overflow pond will be conducted when the sediment level reaches an elevation of 7,243.62 feet or 60% of sediment capacity. The sediment will be transported and disposed of at the waste rock disposal site.

Sediment removal procedures for the waste rock disposal site sedimentation pond are defined in Volume 3 of this M&RP.

Excessive Settlement. Existing sedimentation ponds within the permit area have been operating for a period long enough to ensure that any settlement which may have occurred is now complete. Excessive settlement has not been observed at either the primary sedimentation pond or the waste rock disposal site sedimentation pond. During construction, the embankment of the overflow pond will be compacted to an average of 95% of maximum dry density, to minimize the chance of excessive settling.

Embankment Material. During construction of the primary sedimentation pond, overflow pond and the waste rock disposal site sedimentation pond the embankment materials were free of sod, large roots, frozen soil, and acid- or toxic forming coal-processing waste.

Compaction. During construction the primary sedimentation pond was compacted to an average of 95% of maximum dry density. The sedimentation pond at the waste rock disposal site was compacted to a maximum dry density of 90% as determined by ASTM D1557. During construction of the overflow pond, the embankment of the pond will be compacted to an average of 95% of maximum dry density.

MSHA Sedimentation Ponds. MSHA requirements defined in 30 CFR 77.216 are not applicable at this mine since the existing sedimentation ponds do not impound water or sediment to an elevation of 20 feet or more above the upstream toe of the structure. The ponds also store a volume less than 20 acre-feet.

Other Sedimentation Ponds. All sedimentation ponds within the permit area have primary and emergency spillways that will, in combination, safely discharge a 25-year, 6-hour precipitation event.

Concrete Sediment Trap, ~~and~~ Primary Sedimentation Pond and Overflow Pond. The 25-year, 6-hour storm event was routed through the concrete sediment trap and primary sedimentation pond to determine the adequacy of the existing spillways. The concrete sediment trap and sedimentation pond are hydraulically connected since overflow from the basin is discharged to the pond. The computer software SEDIMOT II, as described in Appendix 7-10, was used for the routing. SEDIMOT II assumes that the ponds are full of water up to the spillway elevation at the beginning of the storm event. The overflow pond was designed using HydroCAD version 8.50 software to safely convey the 25-year, 6-hour storm event. HydroCAD assumes that the sediment trap and primary sedimentation pond are full of water up to the spillway at the beginning of the storm.

The stage-capacity data for the sediment trap, ~~and~~ primary sedimentation pond, and overflow pond are presented in Tables 7-7, ~~and~~ 7-8, and 7-8A. The spillway analysis for the primary sedimentation pond assumes that the primary spillway flowline is raised, per discussions above, to an elevation of 7418.15 feet. Stage-discharge data were computed for both the concrete sediment trap and the sedimentation pond and input directly into SEDIMOT II. The purpose of calculating the stage-discharge relationship in the sediment trap was that the spillway is not a

typical design, and SEDIMOT II would not accommodate it directly. A stage-discharge curve was computed for the primary sedimentation pond to incorporate the discharge from both the primary and emergency spillways. The SEDIMOT II input and output for the sediment trap and primary sedimentation pond is contained in Appendix 7-14. The spillway analysis for the overflow pond utilized both HydroCAD version 8.50 and FlowMaster I. HydroCAD was used to calculate the flow rate. FlowMaster was used to calculate the flow velocity. For full calculations see Appendix 7-23.

TABLE 7-7

Stage-Capacity Curve for the Concrete Sediment Trap

ELEVATION (FT)	AREA (FT^2)	INCREMENTAL VOLUME (FT^3)	CUMULATIVE VOLUME (FT^3)
7436.1	360.0		0
		1469.0	
7438.7	770.0		1469.0
		756.0	
7439.6	911.0		2225.0
		377.0	
7440.0	974.0		2602.0
		613.0	
7440.6	1069.0		3215.0
		1069.0	
7441.6	1069.0		4284.0

TABLE 7-8

Stage-Capacity Data for the Primary Sedimentation Pond

ELEVATION (FT)	AREA (FT^2)	INCREMENTAL VOLUME (FT^3)	CUMULATIVE VOLUME (FT^3)
7401.0	188.3		0
		534.9	
7402.0	881.4		534.9
		1122.6	
7403.0	1363.8		1657.5
		1567.1	
7404.0	1770.3		3224.5
		1971.6	
7405.0	2172.8		5196.1
		2390.2	
7406.0	2607.6		7586.3
		2857.8	
7407.0	3108.0		10,444.1
		3387.6	
7408.0	3667.1		13,831.6
		3941.7	
7409.0	4216.3		17,773.3
		4487.6	
7410.0	4758.8		22,260.9
		5030.7	
7411.0	5302.6		27,291.6

TABLE 7-8 (Continued)

Stage-Capacity Data for the Primary Sedimentation Pond

ELEVATION (FT)	AREA (FT^2)	INCREMENTAL VOLUME (FT^3)	CUMULATIVE VOLUME (FT^3)
		5587.8	
7412.0	5873.0		32,879.4
		6172.5	
7413.0	6471.9		39,051.8
		6877.2	
7414.0	7282.4		45,929.0
		7667.6	
7415.0	8052.8		53,596.6
		8405.6	
7416.0	8758.4		62,002.2
		9105.2	
7417.0	9452.0		71,107.4
		6786.2	
7418.0	9937.1		77,893.5
		4541.1	
7418.15	10,245.7		82,434.6
		1544.4	
7418.3	10,346.3		83,979.3
		7406.7	
7419.0	10,815.8		91,386.0
		11,147.2	
7420.0	11,478.6		102,533.2

TABLE 7-8A

Stage-Capacity Data for the Overflow Pond

ELEVATION (FT)	AREA (FT^2)	INCREMENTAL VOLUME (FT^3)	CUMULATIVE VOLUME (FT^3)
7238.0	928		0
		1,170	
7239.0	1,413		1,170
		1,655	
7240.0	1,897		2,825
		2,253	
7241.0	2,609		5,078
		2,965	
7242.0	3,320		8,043
		3,728	
7243.0	4,135		11,771
		4,542	
7244.0	4,949		16,313
		5,397	
7245.0	5,844		21,710
		6,292	
7246.0	6,739		28,002
		7,217	
7247.0	7,695		35,219
		8,173	
7248.0	8,651		43,392
		9,178	

TABLE 7-8A (Continued)

Stage-Capacity Data for the Overflow Pond

ELEVATION (FT)	AREA (FT^2)	INCREMENTAL VOLUME (FT^3)	CUMULATIVE VOLUME (FT^3)
7249.0	9,705		52,570
		10,232	
7250.0	10,759		62,802
		11,348	
7251.0	11,937		74,150
		12,526	
7252.0	13,114		86,676
		13,750	
7253.0	14,386		100,441
		15,022	
7254.0	15,658		115,463
		16,359	
7255.0	17,060		131,822

From the final analysis of the 25-year, 6-hour storm event, the maximum inflow rate to the sediment trap from storm runoff is 2.0 cubic feet per second (cfs) and the maximum outflow rate from the basin is 2.1 cfs. The corresponding high water level in the sediment trap is 7440.0 feet, 1.6 feet below the top of the concrete structure.

The maximum inflow rate to the primary sedimentation pond is 2.65 cfs and the maximum outflow rate is 2.2 cfs. The corresponding high water level is 7418.35 feet, 0.2 feet above the primary spillway flowline, and 1.65 feet below the minimum embankment elevation of 7420.0.

The maximum design inflow rate to the overflow pond is 6.31 cfs and the maximum design outflow rate is 6.31 cfs. The corresponding high water level is 7253.24, 0.74 feet above the primary spillway flowline, and 1.76 feet below the minimum embankment elevation of 7255.0.

Details for the concrete sediment trap spillway are presented in Appendix 7-8. Details for the primary and emergency spillways on the primary sedimentation pond can be found on Plate 7-5. Details for the overflow pond primary and emergency spillway can be found in Appendix 7-23 and on Plate 7-5A.

Waste Rock Disposal Site Sedimentation Pond. The sedimentation pond at the waste rock disposal site will adequately pass the 25-year, 6-hour precipitation event through the primary and emergency spillways. Details regarding the spillway design are located in Volume 3 of this M&RP.

Other Treatment Facilities. There are no other treatment facilities within the mine permit area.

Exemptions. Exemption areas are listed below (see Plate 5-2B):

- The south side of the original substation pad area above the office building. This area is classified as an "Exempt Area". The demonstration for this area is a SEDCAD computer program and is located in Appendix 7-16. The disturbed area is 0.040 acre.
- The spring collection field in Convulsion Canyon. This area is classified as an "Exempt Area". The demonstration for this area is a SEDCAD computer program and is located in Appendix 7-16. The area is fenced to prevent grazing. The disturbed area is 0.39 acre.

- The water tank area northeast of the mine site. This area is classified as an "Exempt Area". The demonstration for this area is a SEDCAD computer program and is located in Appendix 7-16. The disturbed area is 0.193 acre.

The total disturbed area contributing to the ~~East Spring Canyon~~ primary sedimentation pond is 15.88 acres. The total disturbed area contributing to the overflow pond is 16.49 acres. The total disturbed area contributing to the waste rock disposal site sedimentation pond is 7.93 acres. The total area for Small Area Exemption (SAE) is 0.623 acres. This is 2.2 percent of ~~27.78~~ 28.427 acres of total disturbed area at the mine site, Link Canyon Portal and Substation No. 1 and No. 2 facility sites, and waste rock disposal site (including ASCA's and SAE's).

7.4.2.3 Diversions

General Requirements. The diversions within the permit area consist of drainage ditches and culverts. All diversions within the permit area have been designed to minimize adverse impacts to the hydrologic balance, to prevent material damage outside the permit area and to assure the safety of the public.

All diversions and diversion structures have been designed, located, constructed, maintained and used to:

- Be stable
- Provide protection against flooding and resultant damage to life and property
- Prevent, to the extent possible, additional contributions of suspended solids to stream flow outside the permit area
- Comply with all applicable local, state, and federal laws and regulations

All diversions within the permit area are temporary and will be removed when no longer needed. The diversions will be reclaimed in accordance with the reclamation plan defined in Chapter 5.

Peak discharge rates from the undisturbed and disturbed area drainages within the permit area were calculated for use in determining the adequacy of the existing diversion ditches and culverts. The storm runoff calculations for the temporary diversion structures were based on the 10-year, 6-hour precipitation event of 1.3 inches. Curve numbers were based on those defined in Appendix 7-9 and professional judgement. A description of the methods used to determine the peak discharge rates is presented in Appendix 7-10. The overflow pond bypass culvert was designed to safely convey the 100-year, 6-hour precipitation event of 2.06 inches. For more information of designs and calculations see Plates 7-5A, 7-5B, and 7-5C and Appendix 7-23. The

sediment trap outfall culvert, primary sediment pond bypass, and overflow pond inlet swale were designed to safely convey the 24-year, 6-hour precipitation event of 1.55 inches. The remaining overflow pond diversion; overflow pond access road channel, west and east overflow pond undisturbed area diversion channels were designed to safely convey the 10-year, 6-hour event.

The disturbed and undisturbed drainage areas for the facilities area are presented on Plate 7-7. Those drainage areas too large to fit on Plate 7-7 can be found on Plate 7-8. A summary of watershed characteristics is presented in Table 7-6. The disturbed and undisturbed drainage areas for the Link Canyon facilities area are presented on Plate 5-2D,E,&F. Link Canyon diversion calculations and designs are presented in Appendix 7-12.

The size and location of each existing diversion ditch and culvert were verified in the field. All diversions are located on Plates 7-6 and 5-2D,E,&F. The minimum capacity and freeboard of each diversion ditch was determined based on the minimum ditch slope, while the maximum velocity and minimum riprap protection was calculated based on the maximum ditch slope. The capacity of each culvert was determined using the minimum culvert slope, and the outlet velocity and riprap protection was verified using the culvert outlet slope. Slopes were measured either in the field or from a contour map with the scale of 1" = 50'. A description of the methods used to determine diversion capacities, flow velocities, and riprap sizes is presented in Appendix 7-10 and 7-23. All diversion calculations are presented in Appendices 7-12, ~~and~~ 7-13, and 7-23.

Diversion of Perennial and Intermittent Streams. Flows from the two tributary streams are diverted under the fill area by two large corrugated metal pipes. Both diversions are temporary, and can adequately pass the peak flows from the 10-year, 6-hour precipitation event.

Mud Spring Hollow flows into a 42-inch diameter CMP. The mitered inlet structure is constructed of concrete and has a headwall of approximately 4 feet. It discharges directly into the 72-inch East Spring Bypass culvert. Based on the calculations presented in Appendix 7-11, the peak flow rate from watershed MSH-1 is 38.06 cfs. The minimum culvert slope is 1.8% which results in a maximum flow depth of 1.79 feet. The existing culvert is adequate in size.

The flows in East Spring Canyon are diverted by a 72-inch diameter CMP. This pipe is large enough to handle the flows from East Spring Canyon and Mud Spring Hollow. This CMP extends

under the fill area and discharges downstream below the primary sedimentation pond. The size of the bypass narrows to a 48-inch diameter CMP down the steep fill slope.

The peak flow from East Spring Canyon is 59.6 cfs. The concrete inlet structure was evaluated according to methods described in Appendix 7-10. The inlet structure is adequate to pass the design storm event.

An emergency diversion was constructed at the main mine fan for the East Spring Canyon bypass culvert. This 3.5 foot square drop drain with oil skimmer cap connects into a 48-inch culvert directed into the East Spring Canyon bypass culvert. This serves as an overflow system when the trash rack at the inlet to East Spring Canyon becomes plugged with debris.

The combined peak flow from East Spring Canyon and Mud Spring Hollow for the 10-year, 6-hour precipitation event is 97.9 cfs. The capacity of the culvert was evaluated based on this flow rate and a minimum culvert slope of 1.2%. The resulting maximum flow depth of 2.6 feet indicates that the existing culvert is adequate. The capacity of the 48-inch culvert was also verified. The resulting maximum flow depth, corresponding to the minimum slope of 10%, is 1.75 feet. The 48-inch culvert is adequate to pass the design storm.

The discharge velocity from the 48-inch culvert was determined to verify the adequacy of the existing riprap (D_{50} = 15 inches). The calculated outlet velocity, based on a culvert outlet slope of 10%, is 18.5 feet per second. Using methods defined in Appendix 7-10, the required average riprap size at the outlet is 15 inches. The existing riprap is acceptable.

Outfall from the 48-inch East Spring Canyon and Mud Spring Hollow culvert described above flow approximately 800 feet through the natural stream at the canyon bottom into a 66-inch smooth wall CMP culvert whose inlet will be installed immediately upstream from the overflow pond. The 66-inch smooth wall CMP culvert is designed to safely convey the peak flow from a 100-yr, 6-hr storm for East Spring Canyon, Mud Spring Hollow, overflow from the primary sedimentation pond, and undisturbed areas upstream from the overflow pond (DWN-2 and DWN-4). This culvert will discharge immediately below the overflow pond within the natural stream channel. For more information see Plates 7-4 and 7-5A and Appendix 7-23.

The primary sedimentation pond diversion culvert allows discharge from the sedimentation trap to bypass the primary sedimentation pond and flow directly into the overflow pond. This culvert is also designed to allow discharge from the primary sedimentation pond to flow directly into the overflow pond. Due to this culvert acting as a bypass for the primary sedimentation pond the 18-inch CMP sedimentation trap diversion has been designed to convey the 25-year, 6-hour precipitation event. For more information see Plates 7-4 and 7-5A and Appendix 7-23.

Diversion of Miscellaneous Flows. Diversion ditches and culverts have been utilized within the permit area to divert miscellaneous flows from disturbed and undisturbed area drainages.

Diversion Ditches. A summary table of the minimum channel geometry, channel slope, peak discharge, minimum riprap requirements, maximum flow velocity and minimum freeboard values for each diversion ditch within the facilities area is presented in Table 7-9. All calculations are contained in Appendix 7-12 and 7-23. Each ditch was verified in the field and has adequate capacity and erosion protection to pass the 10-year, 6-hour precipitation event. To ensure that the overflow pond embankment remains stable during 100-year, 6-hour storm, the east and west overflow pond channels were designed to safely convey the 100-year, 6-hour storm, see R645-746-330. A description of the diversion ditches within the facilities area is presented below:

- Interception ditch along the East Side Road which drains the undisturbed watershed CBE-5. This diversion drains into the CBE bypass culvert at the substation.
- Interception ditch along the East Side Road which drains the undisturbed watersheds CBE-1 through CBE-5. This diversion drains into the CBE continuance diversion.
- Substation pad upper interception ditch which drains the undisturbed watershed CBE-4. This diversion drains into the CBE bypass culvert at the substation.
- Substation pad lower undisturbed interception ditch which drains the watershed CBE-3. This diversion drains into a drop drain for the CBE bypass culvert at the substation and is part of the alternate sediment control measures defined in Section 7.4.2.1.
- Riprap diversion channel for CBE continuance diversion. This diversion carries flows from the lower interception ditch along the East Side Road to an adjacent ephemeral drainage.
- Interception ditch for the undisturbed watershed ESC-6 north of the ATOF. This diversion discharges to the inlet of the 6-inch pipe diversion which connects into the 72-inch East Spring Canyon bypass system.

- Interception ditch for the undisturbed watershed ESC-7 north of the ATOF. This diversion drains to the 6-inch pipe diversion which connects into the 72-inch East Spring Canyon bypass system.

- Interception ditch for the undisturbed watershed MSH-2 north of the ATOF. This diversion drains to the inlet of the 42-inch Mud Spring Hollow bypass.

- Interception ditch for the undisturbed watershed MSH-2A north of the ATOF. This diversion drains to the 6-inch pipe diversion which connects into the 72-inch East Spring Canyon bypass system.

- Interception ditch draining watershed DIS-1A. This diversion drains to one of the drop drain inlets of the 10-inch mine yard drain line.

- Sedimentation pond access road diversion ditch. This diversion drains the disturbed watershed DIS-3 and discharges to the sedimentation pond.

- Main access road diversion ditch which drains undisturbed watershed DWN-1. This ditch drains to the pipe number 5 diversion.

- Link Canyon Substation No. 1 ditch which drains the watersheds LINK and ASCA-1. This diversion diverts the upper undisturbed drainage around the substation and drains to the Link Canyon Substation No. 1 road swale. This diversion ditch was reclaimed in 2000.

- Link Canyon Substation No. 1 road swale which drains watersheds LINK, ASCA-1, and ASCA-3. This diversion carries flows from the Link Canyon Substation No. 1 ditch across the substation access road to the main Link Canyon road drainage. This diversion was reclaimed in 2000.

- Link Canyon Substation No. 2 ditch which drains the watersheds LINK No.2, ASCA-4 and ASCA-7. This diversion diverts the upper undisturbed drainage around the substation and drains to the main Link Canyon road drainage.

- Link Canyon Portal access road Channel No. 1 diversion ditch. This diversion diverts the access road disturbed drainage and the undisturbed drainage above the road to the Link Canyon drainage bypass culvert inlet.

- Link Canyon Portal Pad Channel No. 2 diversion ditch. This diversion diverts the pad area disturbed drainage and the undisturbed drainage above the pad to the Link Canyon drainage bypass culvert inlet.

- The west overflow pond undisturbed area diversion channel. This channel diverts runoff from the undisturbed area immediately west of the overflow pond and conveys the runoff south to the overflow pond access road channel.

- The overflow pond access road channel. This channel diverts runoff from the undisturbed area immediately west of the overflow pond access road and runoff from the west overflow pond channel south along the west side of this road to a swale and across U.S.F.S road.

- The east overflow pond undisturbed area diversion channel (shallow section). This channel diverts runoff from the undisturbed area immediately east of the overflow pond and conveys the runoff south to the face of the overflow pond impound.

- The east overflow pond undisturbed area diversion channel (steep section). This channel collects runoff from the east overflow pond channel shallow section and diverts it down the impoundment face into the existing natural stream channel at the bottom of east spring canyon.

- The overflow pond inlet swale. This swale conveys outfall from gate box #2 south to the overflow pond. This swale will be designed to allow track hoes and bull dozers to drive across it for maintenance purposes.

A description of the diversion ditches within the waste rock disposal site can be found in Volume 3 of this M&RP.

Diversion Culverts. A summary table of the culvert size, slope, peak discharge, existing riprap at outlet, and outlet flow velocity for each culvert within the facilities area is presented in Table 7-10. All calculations are contained in Appendix 7-13. Each culvert has adequate capacity and outlet erosion protection to pass the 10-year, 6-hour precipitation event. The primary sediment diversion culvert allows discharge from the sedimentation trap to bypass the primary sedimentation pond. Therefore this culvert must have adequate capacity to safely pass the peak flow resulting from the 25-year, 6-hour precipitation event. To ensure that the overflow pond embankment remains stable during 100-year, 6-hour storm, the overflow pond bypass culvert was designed to have adequate capacity and erosion protection to pass the 100-year, 6-hour precipitation. A description of the diversion culverts within the facilities area is presented below:

- East Spring Canyon bypass culvert. This culvert drains the undisturbed watersheds ESC-1 through ESC-5 and extends under the fill area and discharges downstream below the primary sedimentation pond.

- Mud Spring Hollow bypass culvert. This culvert drains the undisturbed watershed MSH-1 and connects into the 72-inch East Spring Canyon bypass culvert system.

- CBE bypass culvert at the substation. This culvert drains the undisturbed watersheds CBE-2 through CBE-5 and discharges to the lower East Side Road interception ditch. Three drop drains direct the flows to the bypass culvert. The drop drains help reduce the time the runoff water will be on the pad area to reduce the chance of water migrating through the substation pad fill and lubricating the substation slide slip zone.

- Pipe No. 5 diversion culvert which drains the undisturbed area DWN-1. This culvert discharges below the sedimentation pond access road to the natural slope. It does not drain to the pond.

- 6-inch pipe diversion for undisturbed watersheds ESC-7, ESC-6, and MSH-2A. This pipe connects into the 72-inch East Spring Canyon bypass system.
- Link Canyon Portal bypass culvert. This culvert drains the undisturbed watersheds LCP-East and LCP-West and discharges back into the Link Canyon drainage.

- Main Mine Fan Diversion. The main mine fan is located in a depression which is nine feet below the adjacent mine yard drainage system. A sump pump with automatic float controls in front of the main fan will pump the runoff from this area into the 10-inch mine yard drain line.

- 10-inch mine yard drainage system. This drainage system was installed to handle normal surface flows in the mine yard and to reduce the occurrence of mud and erosion. The drainage system consists of drop inlets and a 10-inch pipeline discharging to the concrete sediment trap. It was not designed to pass the 10-year, 6-hour precipitation event. Instead, the surface area of the mine yard is graded to divert all runoff to the concrete sediment trap.

- The sediment trap diversion culvert allows the sedimentation pond to drain for sediment removal. This culvert discharges to the overflow pond.

- The 66-inch overflow pond bypass culvert allows watersheds DWN-1, DWN-2, DWN-3, MSH-1, MSH-2, and ESC-1 through ESC-7 to bypass the overflow pond. This culvert discharges immediately downstream of the overflow pond.

TABLE 7-9
Summary of Diversion Ditches

Diversion	Minimum Bottom Width (ft.)	Minimum Top Width (ft.)	Minimum Depth (ft.)	Side Slopes (H:V)	Minimum riprap D_{50} (in.)	Min. Slope (%)	Max. Slope (%)	Peak Flow[a] (cfs)	Minimum Free-board (ft.)	Existing ditch geometry and riprap OK?
Upper East Side Road diversion draining CBE-5	1.0	2.2	0.4	1.5:1	not required	16.0	38.0	0.09	0.36	yes
Lower East Side Road diversion draining CBE-1 through CBE-5 (lower and upper sections of ditch)	Lower 1.0 Upper 1.0	Lower 2.2 Upper 2.5	Lower 0.5 Upper 0.5	Lower 1.2:1 Upper 1.5:1	Lower 2.0 Upper not required	Upper 3.0	Lower 24.0	0.79	Lower 0.36 Upper 0.29	Lower yes Upper yes
Substation pad upper interception ditch draining CBE-4	1.0	1.6	0.4	0.8:1	not required	1.0	18.0	0.07	0.33	yes
Substation pad lower interception ditch draining CBE-3	1.0	1.6	0.4	1:1	not required	1.0	10.0	0.03	0.35	yes
CBE continuance diversion	1.0	2.5	0.5	1.5:1	3.0	33.0	38.0	0.79	0.37	yes
Interception ditch draining ESC-6 north of ATOF	1.0	1.8	0.4	1:1	not required	1.0	1.0	0.13	0.30	yes
Interception ditch draining ESC-7 north of ATOF	1.0	2.2	0.4	1.5:1	not required	21.0	32.0	0.08	0.37	yes
Interception ditch draining MSH-2 north of ATOF	1.0	2.2	0.4	1.5:1	not required	1.0	20.0	0.08	0.32	yes
Interception ditch draining MSH-2A north of ATOF	1.0	2.2	0.4	1.5:1	not required	1.0	20.0	0.03	0.32	yes
Interception ditch draining DIS-1A	1.0	2.0	.61	1.5:1	not required	1.0	1.0	0.06	0.30	yes
Sedimentation pond access road diversion ditch draining DIS-3	1.0	2.2	0.4	1.5:1	1.0	21.0	31.0	0.35[b]	0.31	yes
Main access road diversion ditch draining DWN-1	2.0	4.0	0.5	2:1	not required	1.0	3.0	0.85	0.30	yes
Link Canyon Substation No. 1 ditch draining LINK and ASCA-1 [Reclaimed in 2000]	2.0	2.81	0.41	1:1	not required	1.0	9.82	0.87	0.30	yes
Link Canyon Substation No. 1 road swale draining LINK, ASCA-1, and ASCA-3 [Reclaimed in 2000]	Parabolic	10.0	0.398	Parabolic	not required	1.0	2.0	0.89	0.30	yes
Link Canyon Substation No. 2 ditch draining Link No.2, ASCA-4, and ASCA-7	0.0	1.52	.51	Left 2:1 Right 1:1	not required	1.0	6.7	0.20	0.30	yes
Link Canyon Portal Access Road Channel No. 1	0.0	0.97	0.48	1:1	not required	7.69	11.0	0.10[b]	0.30	yes
Link Canyon Portal Pad Channel No. 2	0.0	0.90	0.45	1:1	not required	5.21	8.3	0.06[b]	0.30	yes
West Overflow Pond Undisturbed Area Diversion Channel	0.0	3.0	1.0	1.5:1	not required	0.97	.8	1.23[a]	0.49	yes
Access and Maintenance Road Channel	0.0	2.7	0.9	1.5:1	not required	1.0	0.9	1.23[a]	0.49	yes
East O. P. Undisturbed Area Dvrsn Channel (shallow sec)	0.0	3.9	1.30	1.5:1	not required	1.0	0.9	3.13[a]	0.49	yes
East O.P. Undisturbed Area Dvrsn Channel (steep sec)	0.0	2.7	0.9	1.5:1	9.0	0.24	0.25	3.13[a]	0.45	yes
Overflow Pond Inlet Swale	5.0	10.0	0.5	5:1	not required	0.025	0.025	6.26[b]	0.24	yes

[a] Peak discharge resulting from the 10-year, 6-hour precipitation event.

[b] Peak discharge resulting from the 25-year, 24 -hour precipitation event.

TABLE 7-10

Summary of Diversion Culverts

Diversion Culvert	Diameter (in.)	Material	Inlet type	Min. Slope (%)	Outlet Slope (%)	Existing riprap D_{50} (in.)	Peak Flow[a] (cfs)	Culvert inlet OK?	Existing riprap D_{50} OK?
East Spring Canyon bypass culvert at inlet	72	CMP	mitered	1.2	N/A	N/A	59.6	yes	N/A
Bypass culvert for combined East Spring Canyon and Mud Spring Hollow flows	Upper 72 Lower 48	CMP	N/A	Upper 1.2 Lower 10.0	Upper N/A Lower 10.0	Upper N/A Lower 15.0	97.7	Upper N/A Lower N/A	Upper N/A Lower yes
Mud Spring Hollow bypass - discharges to East Spring Canyon bypass	42	CMP	mitered	1.8	N/A	N/A	38.1	yes	N/A
East Spring Canyon bypass culvert emergency diversion at main mine fan	48	CMP	drop		N/A	N/A	59.6		N/A
CBE bypass at substation	18	CMP	mitered and drop	1.0	10.0	6.0	0.53	yes	yes
Pipe No. 5 diversion draining DWN-1	18	CMP	mitered	10.0	28.0	12.0	0.85	yes	yes
6-inch pipe diversion draining ESC-7, ESC-6, and MSH-2A discharges to East Spring Canyon bypass	6	steel	mitered	1.0	N/A	N/A	0.24	yes	N/A
Link Canyon Portal bypass culverts	2-36	CMP	mitered	9.09	18.2	6.0	55.32[b]	yes	yes
Main mine fan diversion				Not applicable since the mine yard drainage system is not designed to handle peak flows, only daily drainage volumes.					
10-inch mine yard drainage, discharges to sediment trap	10	Steel	drop						
Sediment Trap Diversion Culvert	18	CMP	mitered	1.2	1.25	N/A	6.26[b]	yes	yes
Overflow Pond Bypass Culvert	66	CMP	mitered	2.8	3.0	12.0	622.37[c]	yes	yes

[a] Peak discharge resulting from the 10-year, 6-hour precipitation event.

[b] Peak discharge resulting from the 25-year, 24-hour precipitation event.

[c] Peak discharge resulting from the 100-year, 6-hour precipitation event.

A description of all diversion culverts within the waste rock disposal site can be found in Volume 3 of this M&RP.

7.4.2.4 Road Drainage

All Roads. The existing roads within the facilities area are the mine access road, the primary sedimentation pond access road, ~~and~~ the east side road, and overflow pond access road. The existing road within the Link Canyon facilities area is the substation access road. All of the roads have been constructed to include adequate drainage control with the use of diversion ditches, culverts, and containment berms. None of the roads are located in the channel of an intermittent or perennial stream. All roads have been located to minimize downstream sedimentation and flooding. Diversion ditches and culverts for all roads are described in Section 7.4.2.3 above.

Primary Roads. The mine access road is the only primary road within the permit area. The mine access is located, where practical, to minimize erosion. The access road does not ford any stream channels.

The drainage control system for the mine access road includes a diversion ditch, culvert, and berm. The diversions will adequately pass the peak runoff from the 10-year, 6-hour precipitation event. Drainage details for the access road are presented in Section 7.4.2.3 above.

The culvert draining the undisturbed area DWN-1 adjacent to the mine access road is identified as pipe no. 5. It is constructed with an mitered inlet with a trash rack to avoid plugging. The outlet of the culvert, located below the primary sedimentation pond access road, is adequately lined with riprap to prevent erosion. Refer to Section 7.4.2.3 for additional drainage details. The diversion ditch and culvert will be maintained and operated as described in Section 7.3.2.3. No natural stream channels were relocated for the construction of the mine access road.

7.4.3 Impoundments

The existing impoundments within the permit area consist of the ~~three~~ four structures constructed for sediment control purposes. These structures are:

- The concrete sediment trap located near the southern end of the mine yard.
- The primary sedimentation pond located immediately below the fill on which the existing mine facilities are constructed.

- The overflow pond located approximately 800 feet below the primary sedimentation pond.
- The sedimentation pond located at the waste rock disposal site.

All pertinent information regarding these sedimentation ponds is presented in Sections 7.3.2.2 and 7.4.2.2.

7.4.4 Discharge Structures

The discharge structures within the permit area consist of the primary and emergency spillways on each sedimentation pond. The spillways on all sedimentation ponds within the permit area will adequately pass the peak discharge from the 25-year, 6-hour precipitation event. Detailed information for each sedimentation pond is presented in Sections 7.3.2.2 and 7.4.2.2.

The spillway of the concrete sediment trap consists of an overflow weir which discharges to a 24-inch CMP culvert. ~~The culvert drains directly to the sedimentation pond.~~ The culvert drains into canal box #1. From this canal box it drains either into a 24-inch culvert, then directly into the primary sediment pond, or into the 18-inch primary sediment pond bypass. Specific construction details of the spillway system for the sediment trap are presented in Plates 7-4 and 7-5A and Appendix 7-8 and 7-23.

The primary spillway on the primary sedimentation pond consists of a 12-inch steel riser with a covered oil-skimmer. The primary spillway discharges directly to ~~the rip-rap lined emergency spillway channel below the pond~~ the 18-inch primary sediment pond bypass culvert. The emergency spillway is a trapezoidal open channel lined with riprap. The bottom width is 14 feet with side slopes of 2:1 (horizontal:vertical). This spillway discharges to the downstream natural drainage system. The design calculations for the spillways are presented in Appendix 7-14 and 7-23. The details for each spillway are presented on Plate 7-5.

The primary spillway on the overflow pond consists of a 24-inch steel riser with an oil-skimmer. The primary spillway discharges directly to the riprap lined emergency spillway channel below the pond. The emergency spillway is a trapezoidal open channel lined with riprap. The top section of the spillway has a bottom width of 1 feet with side slopes of 12H:1V to allow vehicles to be driven across the spillway for maintenance access. The sloped section of the spillway, or bottom section, slopes down the face of the impoundment at 3H:1V with a 1 foot wide bottom. The

emergency spillways discharge to the downstream natural drainage system. The primary spillway discharges through a flume to measure flow and then enters the natural drainage system. The details for each spillway are presented on Plate 7-5A.

Details for the discharge structures on the waste rock disposal site sedimentation pond are presented in Volume 3 of this M&RP.

7.4.4.1 Erosion Protection

Each discharge structure was evaluated to determine the adequacy of the existing riprap, and capacity of the structure during the 25-year, 6-hour precipitation event. The calculations for the discharge structures within the facilities area are presented in Appendix 7-14.

The discharge structure on the overflow pond was evaluated to determine the size of the riprap, and capacity of the structure during the 25-year, 6-hour precipitation event. The calculation for the discharge structures within the overflow pond are presented in Appendix 7-23.

The 24-inch CMP from the concrete sediment trap discharges to the primary sedimentation pond. The outlet slope, measured in the field, is 53%. The peak discharge from the sediment trap is 2.1 cubic feet per second. Using methods discussed in Appendix 7-10, the flow velocity at the culvert outlet is 11.8 feet per second. The flow depth at the outlet is 0.21 feet.

The erosion protection at the culvert outlet consists of one large boulder, 6 to 8 feet in diameter, located approximately 10 feet below the outlet. In addition, riprap with the average size of 14 inches is located at the immediate vicinity of the outlet. Based on methods defined in Appendix 7-10 and an outlet velocity of 11.8 feet per second, an average riprap size of 15 inches is required at the outlet. Therefore, the combination 14-inch riprap and 6-foot boulder erosion protection at the culvert outlet is adequate.

The 12-inch primary spillway on the primary sedimentation pond discharges to ~~the channel from the emergency spillway~~ 18-inch primary sediment pond bypass. The emergency spillway channel has a bottom width of 14 feet, side slopes of 2H:1V, and an average riprap size of 15 inches.

The adequacy of the existing riprap was initially evaluated assuming the peak discharge of 2.2 cfs flows exclusively down the emergency spillway. In this case, assuming a maximum channel

slope of 71%, the maximum flow velocity is 3.7 feet per second. This is considered non-erosional. Finally, the riprap was evaluated assuming the peak discharge flows exclusively through the 12-inch primary spillway. In this case, assuming an outlet slope of 35%, the maximum flow velocity is 11.1 feet per second at the culvert outlet. Using methods defined in Appendix 7-10, the required average riprap size to provide adequate protection is 12 inches. Therefore, the existing 15-inch riprap is acceptable.

The 18-inch primary spillway on the overflow pond discharges into a flume to measure the outlet flow. From the flume discharge enters the historic natural drainage path. The top or upper emergency spillway channel has a bottom width of 1 feet, side slopes of 12H:1V and an average riprap size of 2-inches. The bottom section, which slopes down the face of the impoundment, has a 1 foot wide bottom, with 2H:1V side slopes and slopes down the impoundment at a 3H:1V.

Assuming a maximum channel slope of 33.3%, the maximum flow velocity for the emergency spillway is 5.53 feet per second. The riprap was evaluated assuming the peak discharge flows exclusively through the 18-inch primary spillway. In this case, assuming an outlet slope of 5.88%, the maximum flow velocity is 4.35 feet per second at the culvert outlet. Using methods defined in Appendix 7-10; the required average riprap size to provide adequate protection for the channel above the primary spillway outfall is 2-inches, and the required average riprap size to provide adequate protection for the channel below the primary spillway outfall is 2-inches.

The riprap design for the discharge structures on the waste rock disposal site sedimentation pond is presented in Volume 3 of this M&RP.

7.4.4.2 Design Standards

All discharge structures within the permit area were designed and constructed according to standard engineering design procedures.

7.4.5 Disposal of Excess Spoil

There is no excess spoil within the permit area.

7.4.6 Coal Mine Waste

7.4.6.1 General Requirements

All coal mine waste is contained within the waste rock disposal site. All coal mine waste will be placed in a controlled manner to minimize adverse effects of leachate and surface water runoff on surface and groundwater quality and quantity. A description of the methods of placement can be found in Volume 3.

7.4.6.2 Refuse Piles

A detailed description of the refuse piles at the waste rock disposal site can be found in Chapter 5 and Volume 3 of this M&RP.

Based on the size, configuration, and open graded structure of the waste rock fill and its location at the site, no underdrains or rock core chimney drains were required. There are no springs or seeps within the fill area which require special treatment.

All surface precipitation falling on the fill is channeled to the sedimentation pond located down gradient from the toe of the disposal area fill. All surface drainage from the areas above the site is diverted around the disposal area using diversion ditches. Surface drainage from the county road above the site is controlled by a shoulder ditch and diverted away from the fill area. All diversions are lined with either riprap, concrete, or vegetation to minimize surface erosion at the site.

No permanent impoundments will exist on the completed refuse pile.

7.4.6.3 Impounding Structures

There are no impounding structures within the permit area that are constructed of coal mine waste or are used to impound coal mine waste.

7.4.6.4 Return of Coal Processing Waste to Abandoned Underground Workings

Coal processing waste is not returned to abandoned underground workings at this facility.

7.4.7 Disposal of Noncoal Mine Waste

Disposal of noncoal mine waste is discussed in Chapter 5.

7.4.8 Casing and Sealing of Wells

Each water well has been cased, sealed, or otherwise managed, as approved by the UDOGM, to prevent acid or other toxic drainage from entering ground or surface water, to minimize disturbance to the hydrologic balance, and to ensure the safety of people, livestock, fish and wildlife, and machinery in the permit and adjacent area. The drill logs and completion diagrams for the water wells are contained in Appendix 6-1.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the UDOGM.

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APPENDIX 5-9

Reclamation Bond Estimate

Bonding Calculations

Direct Costs		
Subtotal Demolition and Removal	$1,052,417.00	
Subtotal Backfilling and Grading	$548,005.00	
Subtotal Revegetation	$171,967.00	
Direct Costs	$1,772,389.00	
Indirect Costs		
Mob/Demob	$177,239.00	10.0%
Contingency	$88,619.00	5.0%
Engineering Redesign	$44,310.00	2.5%
Main Office Expense	$120,522.00	6.8%
Project Mainagement Fee	$44,310.00	2.5%
Subtotal Indirect Costs	$475,000.00	26.8%
Total Cost	$2,247,389.00	
Escalation factor		0.0444
Number of years		4
Escalation	$426,514.00	
Reclamation Cost Escalated	$2,673,903.00	
Bond Amount (rounded to nearest $1,000) 2009 Dollars	$2,674,000.00	
Posted Bond	$4,439,000.00	
Difference Between Cost Estimate and Bond	$1,765,000.00	
Percent Difference	39.76%	

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Ambulance Garage																			$2,504.00
	Belt Deicer Tank																			$13.00
	Blast Channels A																			$143,211.00
	Blast Channels B																			$53,488.00
	Bulk and Used Oil Storage																			$1,518.00
	Cap Magazine																			$22.00
	Chlorinator Bld																			$18.00
	Covered Storage																			$17,169.00
	Diesel Tank																			$995.00
	Drainage Culvets																			$15,944.00
	Electrical Bld																			$602.00
	Fan																			$7,781.00
	Fire Water Tank 300000 Gal																			$11,126.00
	Fuel Dock																			$928.00
	Guard House																			$349.00
	Loadout Belt																			$2,593.00
	Lower Stacker Coal Storage																			$2,149.00
	Lump Coal Storage																			$711.00
	No 1 Belt																			
	Office Building																			$67,377.00
	Pavement Removal																			$29,153.00
	Powder Magazine																			$22.00
	Pulley Racks																			$972.00
	Pump Houses																			$3,040.00
	Riprap Filter Fabric																			$259,568.00
	Rock Dust Bin																			$3,557.00
	ROM Coal Storage																			$1,022.00
	ROM MCC Bld																			$21,139.00
	Sampler Building																			$991.00
	Sand and Salt Storage																			$1,516.00
	Seal Portals																			$46,800.00
	Sediment Trap																			$1,533.00
	Septic Tanks																			$0.00
	Shelves																			$80,022.00
	Shop and Warehouse																			$11,941.00
	Shop Garage																			$2,322.00
	Shop Office																			$3,763.00
	Side Release Tank																			$161.00
	Steam Cleaner Building																			$7,713.00
	Stoker Belt																			$6,626.00
	Stoker Bin																			$1,104.00
	Stoker Coal Storage																			$6,755.00
	Stoker Oil Tanks																			$1,539.00
	Storage Trailers																			$1,256.00
	Substation Lower*																			$72,822.00
	Substation Upper*																			$0.00
	Ticket Printers																			$69.00
	Tipple Building																			$36,194.00
	Tipple MCC Buidling																			$3,161.00
	Tipple Office Building																			$2,759.00
	Transfer Building																			$10,303.00
	Truck Loader Bin																			$1,895.00
	Truck Scale																			$36,352.00
	Water Tank Upper																			$0.00
	Water Tank Lower																			$0.00
	Link Canyon Facilities																			
	Link Canyon Portals																			$8,042.00
	Link Canyon Substation																			$39,150.00
	Fourth East Facilities																			
	Fan Generator Building																			$2,591.00
	Four East Fan																			$18,066.00
	Total																			**$1,052,417.00**

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Drainage Culvets																			
	42" Mud Spring Canyon CMP removal																			
	42" Culvert Excavate	Excavation Bulk Bank 2 CY (322BL)	02315 424 0260	1.7	/CY	180	3.5	7								FT		163	CY	277
	42" Culvert Backfill	Backfill Trench Mininal Haul 2 1/4 CY	02315 610 3080	1.53	/CY	180	3.5	7								FT		163	CY	249
	72" East Spring Canyon CMP																			
	72" Culvert Excavate	Excavation Bulk Bank 2 CY (322BL)	02315 424 0260	1.7	/CY	1075	6	12								FT		2867	CY	4874
	72" Culvert Backfill	Backfill Trench Mininal Haul 2 1/4 CY	02315 610 3080	1.53	/CY	1075	6	12								FT		2867	CY	4387
	48" East Spring Canyon CMP																			
	48" Culvert Excavate	Excavation Bulk Bank 2 CY (322BL)	02315 424 0260	1.7	/CY	505	4	8								FT		599	CY	1018
	48" Culvert Backfill	Backfill Trench Mininal Haul 2 1/4 CY	02315 610 3080	1.53	/CY	505	4	8								FT		599	CY	916
	24" East Spring Canyon CMP																			
	24" Culvert Excavate	Excavation Bulk Bank 2 CY (322BL)	02315 424 0260	1.7	/CY	250	2	4								FT		74	CY	126
	24" Culvert Backfill	Backfill Trench Mininal Haul 2 1/4 CY	02315 610 3080	1.53	/CY	250	2	4								FT		74	CY	113
	66" East Spring Canyon Contech Pipe																			
	66" Culvert Excavate	Excavation Bulk Bank 2 CY (322BL)	02315 424 0260	1.7	/CY	340	5.5	4								FT		277	CY	471
	66" Culvert Backfill	Backfill Trench Mininal Haul 2 1/4 CY	02315 610 3080	1.53	/CY	340	5.5	4								FT		277	CY	424
	18" CMP Sediment Pond Diversion																			
	18" Culvert Excavate	Excavation Bulk Bank 2 CY (322BL)	02315 424 0260	1.7	/CY	1300	2	4								FT		385	CY	655
	18" Culvert Backfill	Backfill Trench Mininal Haul 2 1/4 CY	02315 610 3080	1.53	/CY	1300	2	4								FT		385	CY	589
	6" ADS Sediment Pond Diversion																			
	6" Culvert Excavate	Excavation Bulk Bank 2 CY (322BL)	02315 424 0260	1.7	/CY	230	2	4								FT		68	CY	116
	6" Culvert Backfill	Backfill Trench Mininal Haul 2 1/4 CY	02315 610 3080	1.53	/CY	230	2	4								FT		68	CY	104
	Backfill ROM 84" Escapeway CMP	Backfill Trench Mininal Haul 2 1/4 CY	02315 610 3080	1.53	/CY						108					CY		108	CY	165
	Backfill Concrete Reclaim Tunnel	Backfill Trench Mininal Haul 2 1/4 CY	02315 610 3080	1.53	/CY						600					CY		600	CY	918
	Subtotal																			**15402**
	Concrete Demolition																			
	Demolition Cost	Concrete demolition	ConcreteDemo1	3.97	/CY						26.7					CY		27	CY	107
	Concrete's Vol. Demolished																1.3	35	CY	
	Loading Cost	Front end loader 3 CY	02315 424 1300	1.39	/CY													35	CY	49
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. trip	02315 490 0320	3.44	/CY													35	CY	120
	Disposal Costs	On site disposal	02220 240 5550	7.6	/CY													35	CY	266
	Subtotal																			**542**
	Concrete Demolition																			
	Demolition Cost																			
	Concrete's Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete's Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Total																			**15944**

	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Cut and Fill Mine Site															490713
Waste Rock Site															52770
Link Canyon Substation 03															401
Link Canyon Portals 04															2041
SITLA Muddy Tract Exploration															2080
Subtotal															548005

	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Cut and Fill Mine Site															
D9R Semi-U EROPS (9-54) (2H04)	17115	72.3	0.1	52	238.5	1	238.5	$/HR	93606	CY	144	CY/HR	650	HR	155025
816F ((6-12) (2N04)	12835	50.3	0.1	52	187.55	1	187.55	$/HR					650	HR	121908
CLAB					41.55	1.5	62.33	$/HR					650	HR	40515
8,000 gal H2O truck Diesel (20-17) (2N04)	11835	72.35	0.1	42	195.55	1	195.55	$/HR					650	HR	127108
Pickup Truck Crew 4x4 1 ton (20-17) (2N04)	820	7.8	0.1	0	13.71	1	13.71	$/HR					650	HR	8912
Foreman Average, Outside					57.3	1	57.3	$/HR					650	HR	37245
Subtotal															490713

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Vegetation																			
	Waste Rock Site																			
	Fertilize	Water Soluable, hydro spread	02935 100 0180	3.8	MSF					8.733						AC		380	MSF	1444
	Seed	SUFCo WasteRock	SUFCo1	450.05	/AC					8.733						AC		8.73	AC	3929
	Seed	Hydro Spreader (equip. & labor) B-81 80MS	Reveg002	19.13	/MSF					8.733						AC		380	MSF	7269
	Mulch	Hay, 1" deep, power mulcher large	02910 500 0350	70.5	MSF					8.733						AC		380	MSF	26790
	Plant Seedlings	SUFCoTransplants	SUFCo3	320.75	/AC					8.733						AC		8.73	AC	2800
	Plant Seedlings														425	/AC				
	Plant Seedlings	Bare root seedlings 6 to 10 inch heavy soil	M0291203500711	0	EA					8.733						AC		3712	EA	0
	All Others Except Link Canyon																			
	Fertilize	Water Soluable, hydro spread	02935 100 0180	3.8	MSF					19.214						AC		837	MSF	3181
	Seed	SUFCo WasteRock	SUFCo1	450.05	/AC					19.214						AC		19.21	AC	8645
	Seed	Hydro Spreader (equip. & labor) B-81 80MS	Reveg002	19.13	/MSF					19.214						AC		837	MSF	16012
	Mulch	Hay, 1" deep, power mulcher large	02910 500 0350	70.5	MSF					19.214						AC		837	MSF	59009
	Plant Seedlings	SUFCoTransplants	SUFCo3	320.75	/AC					19.214						AC		19.21	AC	6162
															425	/AC				
	Plant Seedlings	Bare root seedlings 6 to 10 inch heavy soil	M0291203500711	0	EA					19.214						AC		8166	EA	0
	Subtotal																			**135241**
	Revegetation																			
	25% Revegetation Rate																			33810
	Subtotal																			**33810**
	Link Canyon - Portal & Substations																			
	Fertilize	Water Soluable, hydro spread	02935 100 0180	3.8	MSF					0.48						AC		21	MSF	80
	Seed	SUFCo WasteRock	SUFCo1	450.05	/AC					0.48						AC		0.48	AC	216
	Seed	Hydro Spreader (equip. & labor) B-81 80MS	Reveg002	19.13	/MSF					0.48						AC		21	MSF	402
	Mulch	Hay, 1" deep, power mulcher large	02910 500 0350	70.5	MSF					0.48						AC		21	MSF	1481
	Plant Seedlings	SUFCoTransplants	SUFCo3	320.75	/AC					0.48						AC		0.48	AC	154
															425	/AC				
	Plant Seedlings	Bare root seedlings 6 to 10 inch heavy soil	M0291203500711	0	EA					0.48						AC		204	EA	0
	Subtotal																			**2333**
	Revegetation																			
	25% Revegetation Rate																			583
	Subtotal																			**583**
	Total																			**171967**

APPENDIX 7-23

Overflow Pond Calculations

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 38.92 N 111.42 W 8202 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Mon May 4 2009

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs | Return to State Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.12	0.19	0.23	0.31	0.39	0.48	0.54	0.71	0.89	1.04	1.21	1.45	1.76	2.03	2.74	3.35	4.17	4.94
2	0.16	0.24	0.30	0.41	0.50	0.61	0.69	0.88	1.10	1.29	1.50	1.80	2.19	2.53	3.42	4.16	5.20	6.16
5	0.22	0.34	0.42	0.57	0.70	0.81	0.89	1.10	1.35	1.60	1.85	2.22	2.70	3.12	4.21	5.10	6.34	7.52
10	0.28	0.42	0.52	0.70	0.87	1.00	1.07	1.28	1.56	1.86	2.15	2.58	3.12	3.59	4.82	5.81	7.22	8.53
25	0.36	0.55	0.68	0.91	1.13	1.29	1.35	1.55	1.85	2.21	2.57	3.08	3.69	4.23	5.62	6.74	8.35	9.83
50	0.43	0.66	0.81	1.10	1.36	1.55	1.60	1.78	2.08	2.49	2.90	3.49	4.14	4.72	6.22	7.44	9.17	10.77
100	0.52	0.79	0.97	1.31	1.62	1.84	1.89	2.06	2.32	2.78	3.26	3.93	4.61	5.22	6.83	8.13	9.99	11.70
200	0.61	0.93	1.16	1.56	1.93	2.19	2.23	2.38	2.63	3.08	3.62	4.39	5.09	5.73	7.43	8.80	10.79	12.59
500	0.77	1.17	1.45	1.95	2.42	2.74	2.79	2.95	3.18	3.49	4.14	5.04	5.74	6.41	8.21	9.68	11.80	13.72
1000	0.91	1.38	1.72	2.31	2.86	3.25	3.29	3.46	3.70	3.81	4.55	5.56	6.25	6.93	8.80	10.33	12.55	14.54

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

*** Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)**

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.14	0.22	0.27	0.36	0.45	0.55	0.61	0.78	0.97	1.14	1.31	1.58	1.93	2.23	3.03	3.68	4.61	5.43
2	0.19	0.28	0.35	0.47	0.58	0.69	0.77	0.97	1.20	1.42	1.63	1.96	2.40	2.78	3.78	4.58	5.75	6.77
5	0.26	0.39	0.48	0.65	0.81	0.93	1.00	1.21	1.47	1.76	2.02	2.42	2.96	3.43	4.64	5.60	7.00	8.26
10	0.32	0.49	0.60	0.81	1.00	1.14	1.21	1.41	1.70	2.04	2.33	2.81	3.41	3.95	5.32	6.38	7.96	9.37
25	0.42	0.63	0.79	1.06	1.31	1.47	1.53	1.71	2.03	2.42	2.79	3.36	4.04	4.66	6.21	7.41	9.20	10.79
50	0.50	0.77	0.95	1.28	1.58	1.78	1.81	1.98	2.29	2.73	3.16	3.81	4.54	5.21	6.88	8.18	10.12	11.85
100	0.61	0.92	1.14	1.54	1.91	2.14	2.17	2.31	2.57	3.05	3.56	4.30	5.07	5.78	7.57	8.96	11.05	12.88
200	0.73	1.11	1.37	1.85	2.29	2.56	2.58	2.70	2.94	3.39	3.98	4.81	5.61	6.37	8.25	9.73	11.97	13.91
500	0.93	1.42	1.76	2.36	2.93	3.27	3.29	3.41	3.62	3.86	4.58	5.56	6.38	7.16	9.18	10.76	13.15	15.26
1000	1.12	1.71	2.11	2.85	3.52	3.94	3.95	4.06	4.26	4.30	5.06	6.19	6.99	7.79	9.88	11.55	14.05	16.25

* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.

Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

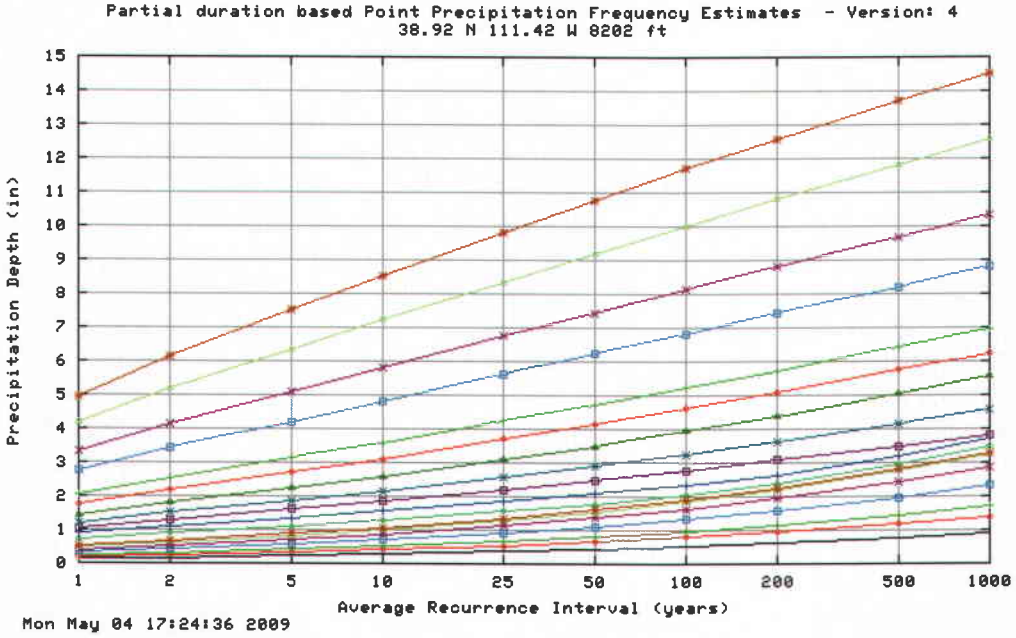
*** Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)**

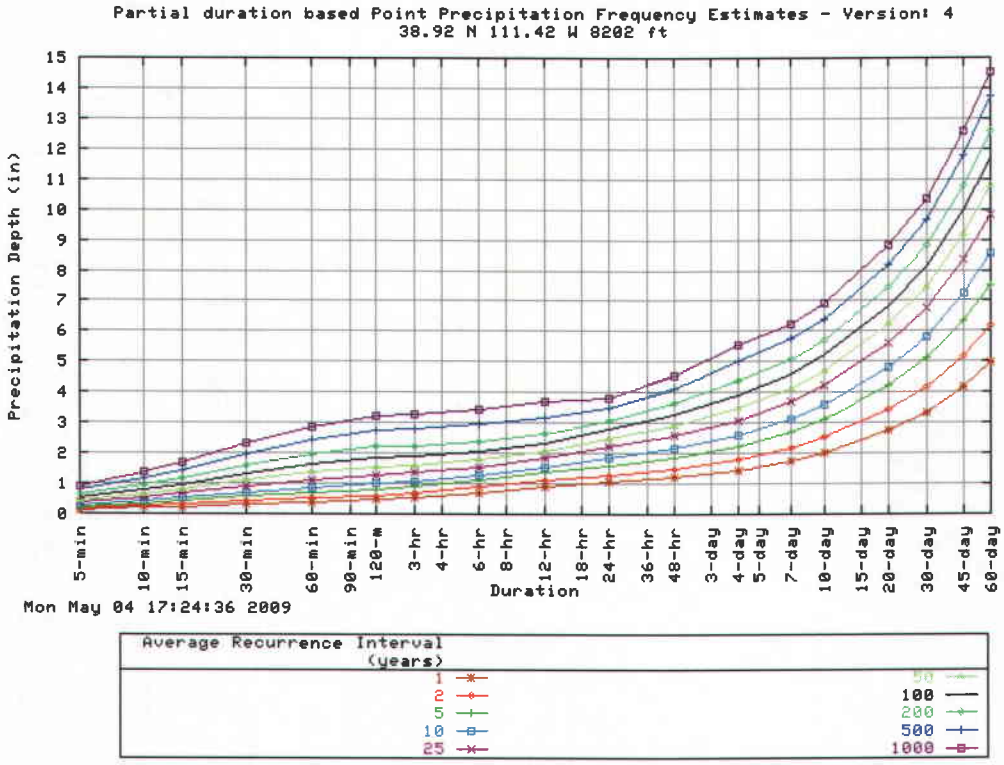
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.11	0.17	0.20	0.28	0.34	0.42	0.49	0.65	0.81	0.95	1.12	1.34	1.61	1.86	2.48	3.05	3.79	4.51
2	0.14	0.21	0.27	0.36	0.44	0.54	0.62	0.81	1.01	1.19	1.39	1.66	2.00	2.31	3.09	3.79	4.72	5.62
5	0.19	0.29	0.36	0.49	0.61	0.71	0.80	1.00	1.23	1.47	1.71	2.04	2.48	2.85	3.80	4.64	5.75	6.85
10	0.24	0.36	0.45	0.60	0.75	0.87	0.96	1.17	1.42	1.70	1.99	2.37	2.85	3.26	4.34	5.28	6.52	7.77
25	0.30	0.46	0.57	0.77	0.95	1.10	1.19	1.39	1.67	2.02	2.35	2.82	3.36	3.83	5.05	6.11	7.52	8.92
50	0.36	0.54	0.67	0.91	1.12	1.29	1.38	1.58	1.86	2.26	2.64	3.18	3.75	4.25	5.57	6.71	8.24	9.74
100	0.42	0.63	0.79	1.06	1.31	1.50	1.60	1.80	2.06	2.51	2.94	3.54	4.15	4.67	6.08	7.30	8.93	10.52
200	0.48	0.73	0.91	1.22	1.51	1.74	1.85	2.05	2.30	2.76	3.24	3.91	4.54	5.09	6.57	7.86	9.59	11.26
500	0.58	0.88	1.09	1.46	1.81	2.09	2.23	2.47	2.74	3.09	3.65	4.43	5.06	5.63	7.20	8.56	10.41	12.15
1000	0.66	1.00	1.24	1.67	2.07	2.38	2.55	2.83	3.14	3.34	3.96	4.83	5.46	6.03	7.66	9.06	11.00	12.79

* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.

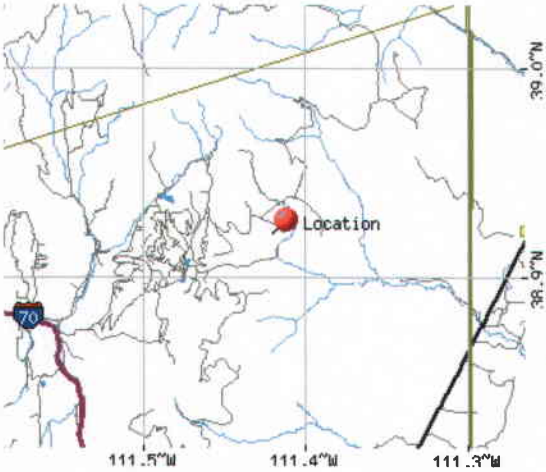
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Text version of tables





Maps -



These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.

LEGEND

State
County
Indian Resv
Lake/Pond/Ocean
Street
Expressway
Highway
Connector
Stream
Military Area
National Park
Other Park
City
County

Scale 1:226583
0 2 4 6 8 mi
0 2 4 6 8 10 km
*average--true scale depends on monitor resolution

Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to NOAA Atlas 14 Document.

Using the National Climatic Data Center's (NCDC) station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (38.92/-111.42). Digital ASCII data can be obtained directly from NCDC.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the Western Regional Climate Center's state-specific SNOTEL station maps.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

UPDES PT002 - Sediment Pond Discharge

Date	GPD	GPM
10/06/99	0	
10/20/99	0	
11/03/99	49,248	34.2
11/17/99	7,920	5.5
12/01/99	0	
12/15/99	0	
01/05/00	49,248	34.2
01/19/00	12,816	8.9
01/26/00	8,712	6.1
02/02/00	0	
02/16/00	0	
03/01/00	49,248	34.2
03/22/00	17,856	12.4
04/05/00	0	
04/18/00	0	
05/03/00	72,432	50.3
05/17/00	5,515	3.8
06/07/00	0	
06/21/00	0	
07/05/00	0	
07/19/00	0	
08/02/00	0	
08/16/00	0	
09/06/00	0	
09/20/00	0	
10/04/00	72,432	50.3
10/18/00	12,816	8.9
11/01/00	101,088	70.2
11/15/00	101	0.1
12/06/00	0	
12/20/00	0	
01/03/01	8,712	6.1
01/17/01	12,816	8.9
01/24/01	24,048	16.7
02/07/01	31,248	21.7
02/21/01	49,248	34.2
03/07/01	60,192	41.8
03/21/01	31,248	21.7
04/04/01	0	
04/18/01	0	

04/23/01	17,856	12.4
05/02/01	49,248	34.2
05/16/01	49,248	34.2
06/06/01	31,248	21.7
06/27/01	49,248	34.2
07/11/01	72,432	50.3
07/25/01	0	
08/06/01	0	0.0
08/22/01	0	
09/05/01	0	
09/19/01	0	
10/03/01	0	
10/17/01	0	
11/07/01	49,248	34.2
11/20/01	17,856	12.4
12/05/01	0	
12/19/01	0	
01/16/02	0	
01/30/02	0	
02/06/02	0	
02/20/02	0	
03/06/02	0	
03/20/02	0	
04/03/02	0	
04/17/02	0	
05/01/02	0	
05/15/02	0	
06/05/02	0	
06/19/02	0	
07/10/02	0	
07/24/02	0	
08/07/02	0	
08/21/02	0	
09/04/02	0	
09/18/02	0	
10/02/02	0	
10/16/02	0	
11/06/02	0	
11/20/02	0	
12/04/02	33,120	23.0
12/18/02	28,800	20.0
01/08/03	0	
01/22/03	0	
02/05/03	0	

02/19/03	0	
03/12/03	86,400	60.0
03/26/03	70,560	49.0
04/02/03	0	
04/16/03	47,520	33.0
04/30/03	20,592	14.3
05/07/03	36,000	25.0
05/21/03	25,344	17.6
06/04/03	0	
06/18/03	12,384	8.6
07/09/03	14,400	10.0
07/23/03	72,000	50.0
08/06/03	86,400	60.0
08/20/03	108,000	75.0
09/03/03	28,800	20.0
09/17/03	38,880	27.0
10/08/03	0	0.0
10/29/03	0	0.0
11/05/03	0	0.0
11/19/03	17,856	12.4
12/03/03	0	
12/17/03	0	
01/07/04	3,168	2.2
01/21/04	31,248	21.7
02/04/04	72,432	50.3
02/18/04	39,600	27.5
03/03/04	200,160	139.0
03/17/04	17,856	12.4
04/07/04	12,802	8.9
04/21/04	8,712	6.1
05/05/04	3,154	2.2
05/26/04	8,712	6.1
06/09/04	49,248	34.2
06/30/04	24,048	16.7
07/14/04	31,248	21.7
07/28/04	3,154	2.2
08/04/04	8,712	6.1
08/25/04	562	0.4
09/08/04	562	0.4
09/22/04	3,154	2.2
10/13/04	0	
10/17/04	0	
11/10/04	0	
11/17/04	0	

12/08/04	49,248	34.2
12/27/04	31,248	21.7
01/05/05	8,712	6.1
01/26/05	12,802	8.9
02/02/05	17,856	12.4
02/16/05	49,248	34.2
03/01/05	49,248	34.2
03/16/05	31,248	21.7
04/07/05	8,712	6.1
04/20/05	3,154	2.2
05/06/05	0	0.0
05/25/05	0	0.0
06/09/05	31,248	21.7
06/29/05	17,856	12.4
07/13/05	17,856	12.4
07/27/05	17,856	12.4
08/03/05	12,802	8.9
08/23/05	49,248	34.2
09/14/05	8,712	6.1
09/28/05	177,120	123.0
10/05/05	49,248	34.2
10/19/05	8,712	6.1
11/02/05	3,154	2.2
11/28/05	1,541	1.1
12/07/05	31,248	21.7
12/21/05	31,248	21.7
01/04/06	31,248	21.7
01/18/06	72,432	50.3
02/08/06	17,856	12.4
02/22/06	177,120	123.0
03/08/06	101,088	70.2
03/22/06	31,248	21.7
04/05/06	101,088	70.2
04/19/06	8,712	6.1
05/04/06	8,712	6.1
05/17/06	3,154	2.2
05/24/06	8,712	6.1
05/31/06	3,154	2.2
06/07/06	8,712	6.1
06/21/06	3,154	2.2
07/05/06	3,154	2.2
07/19/06	0	0.0
08/02/06	0	0.0
08/24/06	0	0.0

09/07/06	17,856	12.4
09/20/06	49,248	34.2
10/04/06	49,248	34.2
10/19/06	49,248	34.2
10/25/06	3,154	2.2
11/01/06	17,856	12.4
11/15/06	31,248	21.7
12/13/06	60,192	41.8
12/20/06	49,248	34.2
01/03/07	101,088	70.2
01/17/07	31,248	21.7
02/07/07	101,088	70.2
02/21/07	49,248	34.20
03/08/07	49,248	34.20
03/21/07	3,154	2.19
04/04/07	3,154	2.19
04/18/07	8,712	6.05
05/01/07	0	0.00
05/17/07	0	0.00
06/06/07	49,248	34.20
06/20/07	224,640	156.00
07/03/07	8,712	6.05
07/18/07	3,154	2.19
08/07/07	3,154	2.19
08/16/07	8,712	6.05
08/22/07	8,712	6.05
08/30/07	3,154	2.19
09/06/07	101,088	70.20
09/19/07	72,432	50.30
10/03/07	3,154	2.19
10/17/07	101,088	70.20
10/31/07	3,154	2.19
11/08/07	17,856	12.40
11/28/07	8,712	6.05
11/29/07	3,154	2.19
12/06/07	49,248	34.20
12/17/07	49,248	34.20
01/09/08	3,154	2.19
01/24/08	5,515	3.83
02/07/08	17,856	12.40
02/20/08	8,712	6.05
03/05/08	49,248	34.20
03/19/08	49,248	34.20
04/02/08	8,712	6.05

04/29/08	8,712	6.05
05/14/08	17,856	12.40
05/21/08	3,154	2.19
06/04/08	3,154	2.19
06/19/08	3,154	2.19
06/20/08	3,154	2.19
06/25/08	3,154	2.19
06/26/08	3,154	2.19
07/02/08	3,154	2.19
07/03/08	3,154	2.19
07/09/08	562	0.39
Max	224,640	156.00
Average	22,667	21.66
Min	0	0.00

Assumed constant flow from minning facilities = 0.046 cfs (from attached Sediment Pond Discharge Sheet)
Volume per 1 day period = 3975 cubic ft.
Assume water shed sediment loading = 0 due to upstream area undisturbed

Direct Contributing Watershed

S=(1000/CN)-10
Q={(P-0.2S)^2}/(P+0.8S)

P*=10yr.-24hr.=1.86 P*=25yr.-6hr.=1.55
*From NOAA website (see attached printout)

DIS-6 Area= 26625 cubic ft.

CN=100	CN=100
S=(1000/100)-10=0	S=(1000/100)-10=0
Q=1.86 in.	Q=1.55 in.
Q=0.155 ft.	Q=0.129 ft.
4126.875 cubic ft.	3434.625 cubic ft.

Contributing Sedimentation Area

WS Area	Volume cf
DIS-1	4816
DIS-2	16920
DIS-3	2555
DIS-4	4062
DIS-5	2375
CBW-1	27170
TOTAL	57898

From Appendix 7-14

From Contributing Sedimentation Area table above assume 0.035 Ac-ft of sediment per Ac.
692,000 sq. ft.= 15.88 Ac.
(15.88 Ac)x(0.035 Ac-ft/Ac) = 0.556 Ac-ft = 24210 cubic ft

Required 10yr. 24hr. Volume = 90210 cubic ft

Sized for only DIRECT contributing watersheds and mainenance runoff, assuming sediment at 100% capacity

Volume at 7,252.5 = 93388 cubic ft

Design volume larger than required to allow for ease of construction. The required elveation of 7,252.26 was rounded up to 7,252.5

Volume Table for Overflow Pond

El (feet)	S.A. (sf)	Volume (cf)	Cumulative Volume (cf)	Volume with sediment (cf)	Full volume at primary spillway elevation
7238	928				
7238.5	1170	525	525	-23685	-92863
7239	1413	646	1170	-23040	-92218
7239.5	1655	767	1937	-22273	-91451
7240	1897	888	2825	-21385	-90563
7240.5	2253	1037	3862	-20348	-89526
7241	2609	1215	5078	-19132	-88310
7241.5	2964	1393	6471	-17739	-86917
7242	3320	1571	8042	-16168	-85346
7242.5	3727	1762	9804	-14406	-83584
7243	4135	1965	11769	-12441	-81619
7243.5	4542	2169	13938	-10272	-79450
7244	4949	2373	16311	-7899	-77077
7244.5	5397	2586	18897	-5313	-74491
7245	5844	2810	21708	-2503	-71681
7245.5	6292	3034	24741	531	-68647
7246	6739	3258	27999	3789	-65389
7246.5	7217	3489	31488	7278	-61900
7247	7695	3728	35216	11006	-58172
7247.5	8173	3967	39183	14973	-54205
7248	8651	4206	43389	19179	-49999
7248.5	9178	4457	47846	23636	-45542
7249	9705	4721	52567	28357	-40821
7249.5	10232	4984	57551	33341	-35837
7250	10759	5248	62799	38589	-30589
7250.5	11348	5527	68326	44116	-25062
7251	11937	5821	74147	49937	-19241
7251.5	12525	6115	80262	56052	-13126
7252	13114	6410	86672	62462	-6716
7252.5	13750	6716	93388	69178	0
7253	14386	7034	100422	76212	7034
7253.5	15022	7352	107774	83564	14386
7254	15658	7670	115444	91234	22056
7254.5	16359	8004	123448	99238	30060
7255	17060	8355	131803	107593	38415

Topsoil Volume Calculation

Disturbed Area (ft^2)	Average Topsoil Depth (in)	Topsoil Volume (yd^3)
49,952	6	925

Notes

Topsoil Volume = Disturbed Area * Average Topsoil Depth

Topsoil Stockpile Capacity Calculation

Elevation	Surface Area (ft)	Incremental Volume (cy)	Cumulative Volume (cy)
7,250	0		
7,251	80	1.5	1
7,252	200	5.2	7
7,253	310	9.4	16
7,254	440	13.9	30
7,255	540	18.1	48
7,256	810	25.0	73
7,257	1,160	36.5	110
7,258	1,610	51.3	161
7,259	2,370	73.7	235
7,260	2,910	97.8	332
7,261	2,830	106.3	439
7,262	2,750	103.3	542
7,263	2,720	101.3	643
7,264	2,720	100.7	744
7,265	2,650	99.4	844
7,266	850	64.8	908
7,267	40	16.5	925
Total			**925**

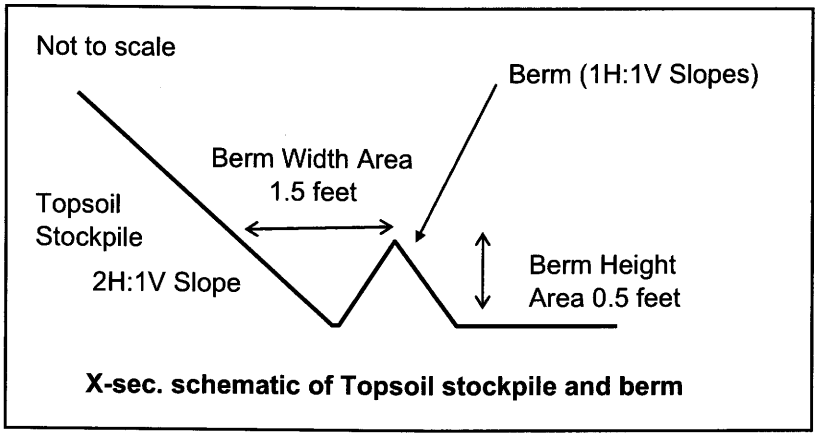
Notes

Surface area at given elevations based on AutoCAD topography of site. Assume 2:1 (H:V) side slope on Topsoil Stockpile.

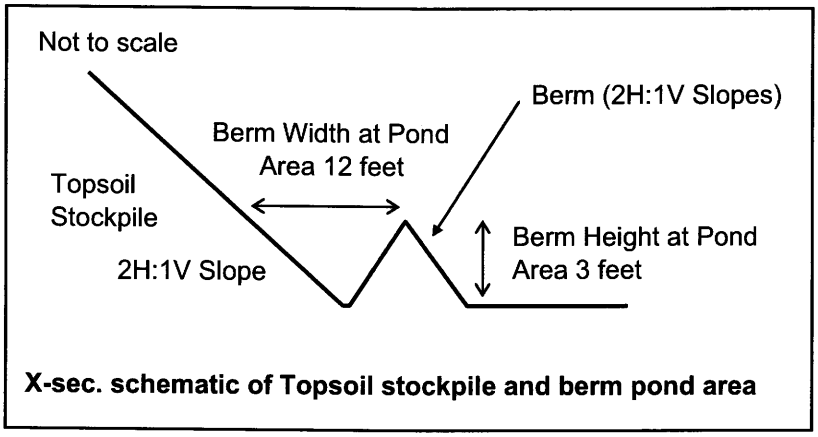
Topsoil Stockpile Berm Storm Water Storage Capacity Calculation

Elevation	Surface Area (ft)	Incremental Volume (cf)	Cumulative Volume (cf)
7251	0		
7252	117	58.5	58.5
7253	342	229.5	288
7254	420	381	669
Total			**669**

Notes
Required volume from Hydro CAD Topsoil Berm calculation sheets in Appendix 7-23.
Surface area at given elevations based on AutoCAD topography of site.



X-sec. schematic of Topsoil stockpile and berm



X-sec. schematic of Topsoil stockpile and berm pond area

Notes

The top width is the horizontal distance between the crest of the berm and the salvage soil stockpile. (see schematic)
The Fill Required for Berm is the volume of subsoil required to construct each berm, and is based on the length, height, and width of each berm. Berms shall be constructed with 1H:1V slopes.
The Containment Volume = Length * Cross sectional area of the space between the salvage soil stockpile and the berm.

Riprap Sizing

Channel	Velocity (ft/s)	D_{50} (inches)
East Spring/Mud Spring (Existing 48" CMP) Outfall	54.14	Several Large boulders
Overflow Pond Bypass (66" CMP Bypass Culvert) Outfall	29.94	Several 36" boulders
East Overflow Pond Channel Steep Section	5.03	9
Overflow Pond Primary Spillway Outfall	6.34	4
Overflow Pond Secondary Spillway (bottom)	5.19	3

Notes

Assuming K/d>1 therefore $V_s/V=1$ from figure 5-1 in Appendix 7-23.

If channel or pipe outfall not listed above riprap is not required.

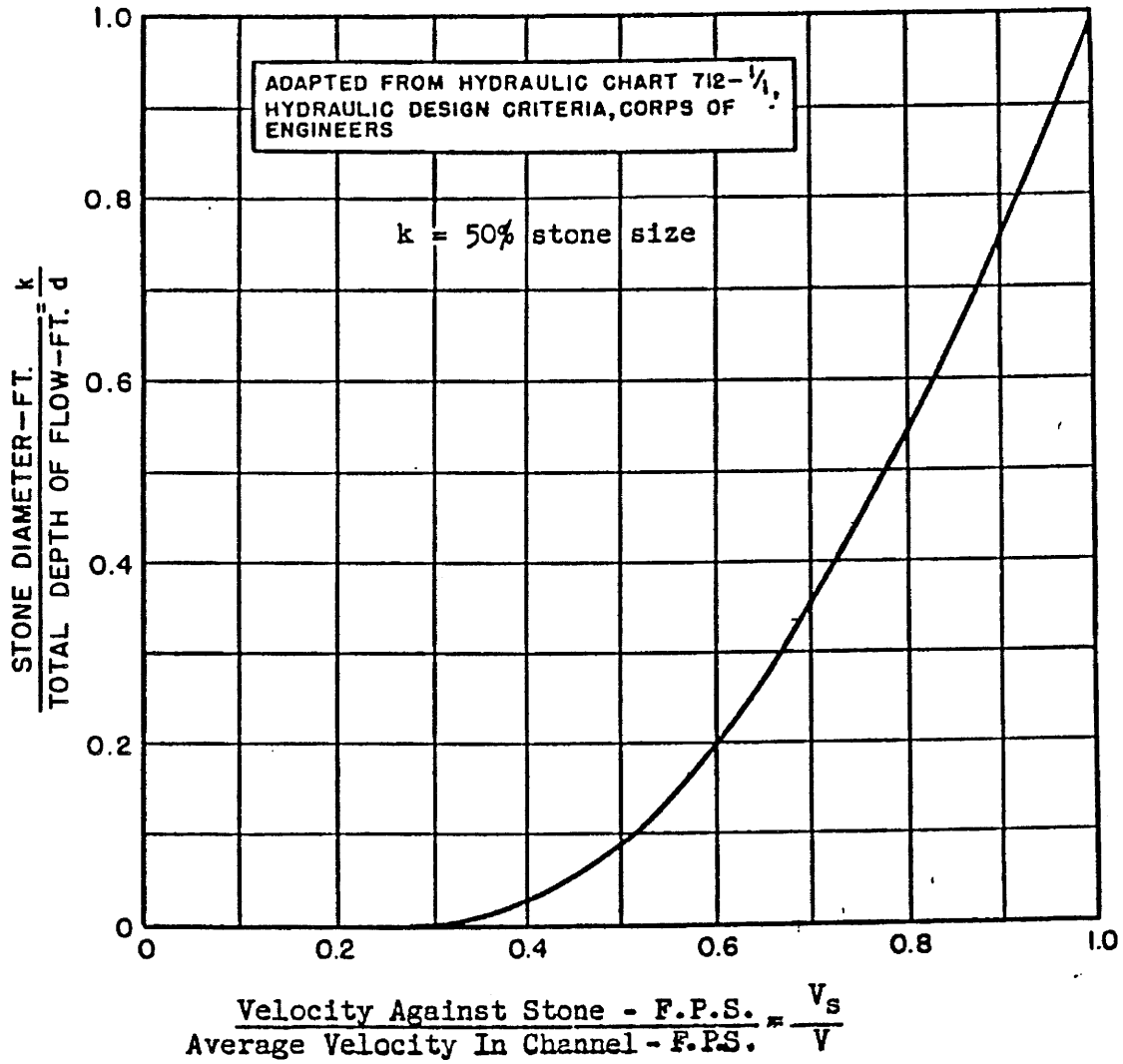


FIGURE 5-1 Velocity Against Stone on Channel Bottom (U.S. Department of Transportation, 1978).

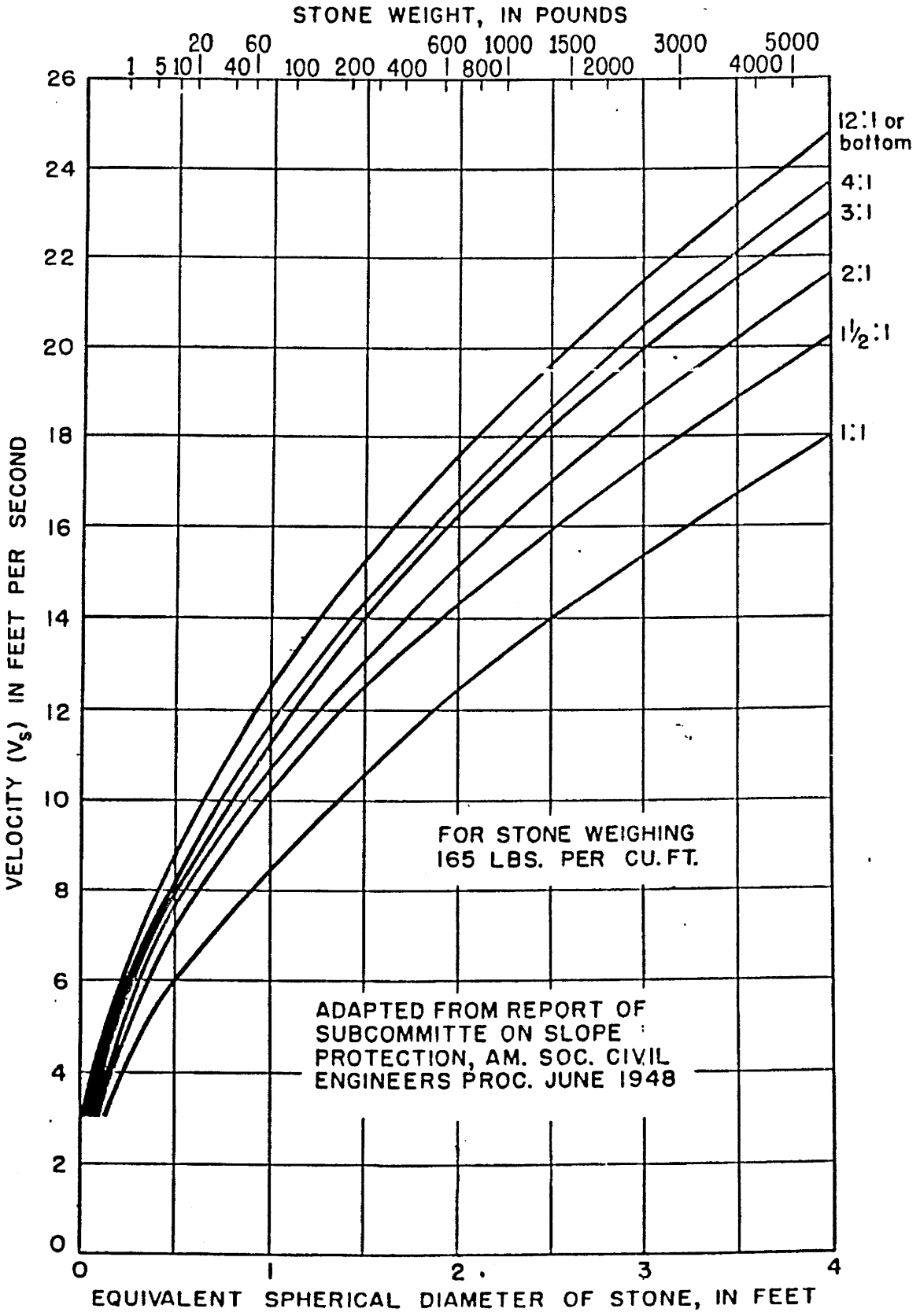
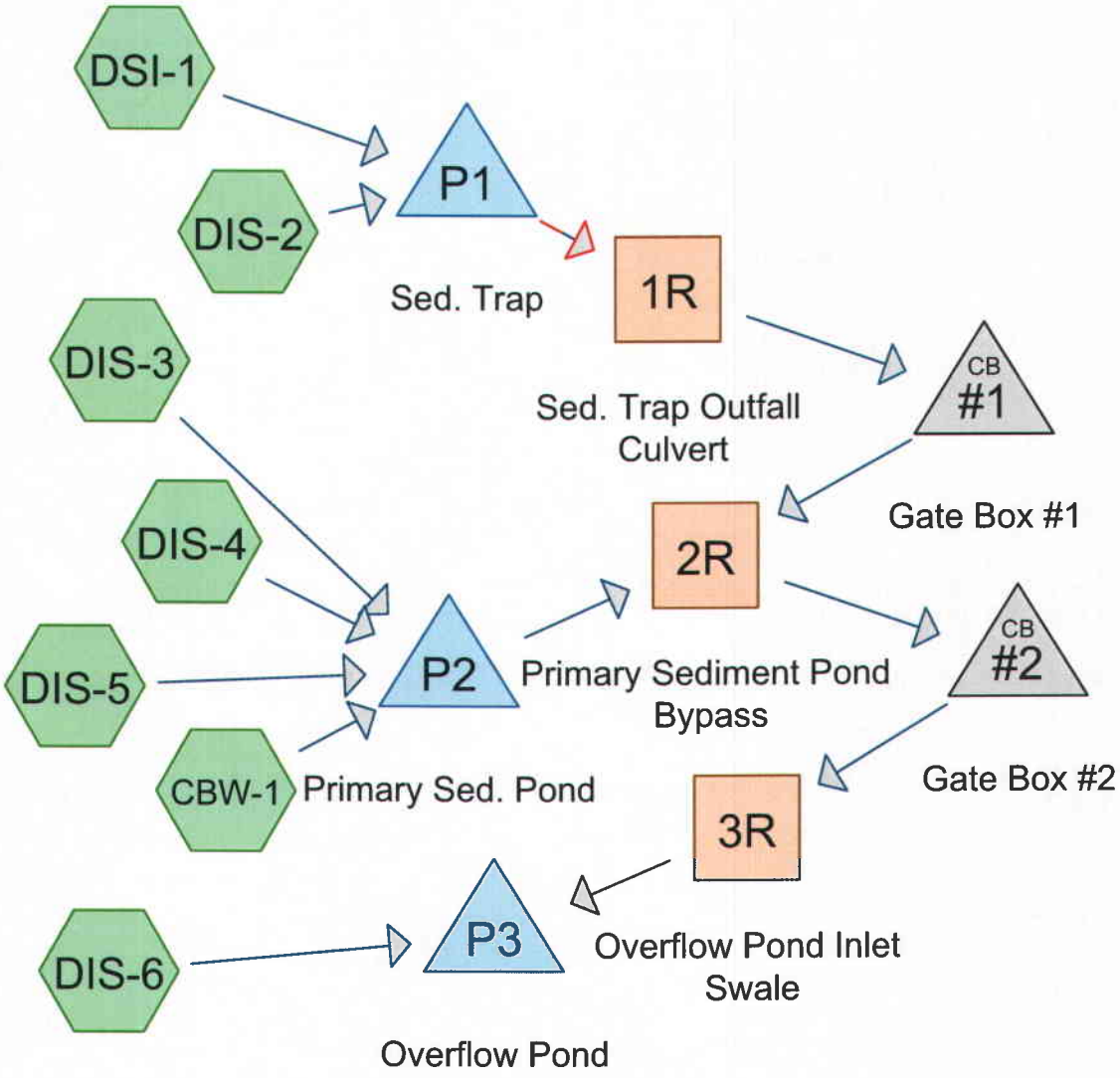


FIGURE 5-2 Size of Stone that will Resist Displacement for Various Velocities and Side Slopes (U.S. Department of Transportation, 1978).



Subcat Reach Pond Link

Drainage Diagram for Overflow Pond 25yr 6hr
Prepared by EarthFax Engineering, Inc., Printed 6/9/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-12.00 hrs, dt=0.01 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment CBW-1: Runoff Area=29.800 ac Runoff Depth=0.13"
Flow Length=2,100' Slope=0.4380 '/' Tc=11.0 min CN=72 Runoff=4.36 cfs 0.318 af

Subcatchment DIS-2: Runoff Area=9.275 ac Runoff Depth=0.31"
Flow Length=830' Slope=0.0410 '/' Tc=13.5 min CN=80 Runoff=5.14 cfs 0.240 af

Subcatchment DIS-3: Runoff Area=1.400 ac Runoff Depth=0.31"
Flow Length=700' Slope=0.3670 '/' Tc=3.9 min CN=80 Runoff=1.84 cfs 0.036 af

Subcatchment DIS-4: Runoff Area=2.227 ac Runoff Depth=0.31"
Flow Length=230' Slope=0.5530 '/' Tc=1.3 min CN=80 Runoff=4.59 cfs 0.058 af

Subcatchment DIS-5: Runoff Area=0.344 ac Runoff Depth=0.31"
Flow Length=100' Slope=0.2000 '/' Tc=1.1 min CN=80 Runoff=0.74 cfs 0.009 af

Subcatchment DIS-6: Runoff Area=0.611 ac Runoff Depth=1.55"
Flow Length=160' Slope=0.1130 '/' Tc=0.9 min CN=100 Runoff=5.64 cfs 0.079 af

Subcatchment DSI-1: Runoff Area=2.640 ac Runoff Depth=0.31"
Flow Length=220' Slope=0.5610 '/' Tc=1.3 min CN=80 Runoff=5.44 cfs 0.068 af

Reach 1R: Sed. Trap Outfall Culvert Avg. Depth=0.35' Max Vel=15.34 fps Inflow=5.58 cfs 0.308 af
D=24.0" n=0.025 L=225.0' S=0.5267 '/' Capacity=85.37 cfs Outflow=5.57 cfs 0.308 af

Reach 2R: Primary Sediment Pond Bypass Avg. Depth=0.59' Max Vel=9.73 fps Inflow=6.32 cfs 0.508 af
D=18.0" n=0.025 L=702.0' S=0.1239 '/' Capacity=19.23 cfs Outflow=6.26 cfs 0.508 af

Reach 3R: Overflow Pond Inlet Swale Avg. Depth=0.26' Max Vel=3.82 fps Inflow=6.26 cfs 0.508 af
n=0.022 L=20.0' S=0.0250 '/' Capacity=20.69 cfs Outflow=6.26 cfs 0.508 af

Pond #1: Gate Box #1 Peak Elev=7,422.43' Inflow=5.57 cfs 0.308 af
18.0" x 403.0' Culvert Outflow=5.57 cfs 0.308 af

Pond #2: Gate Box #2 Peak Elev=7,256.29' Inflow=6.26 cfs 0.508 af
Outflow=6.26 cfs 0.508 af

Pond P1: Sed. Trap Peak Elev=7,540.96' Storage=1,000 cf Inflow=5.65 cfs 0.308 af
Primary=1.10 cfs 0.201 af Secondary=4.48 cfs 0.108 af Outflow=5.58 cfs 0.308 af

Pond P2: Primary Sed. Pond Peak Elev=7,418.33' Storage=0.041 af Inflow=6.31 cfs 0.420 af
Primary=0.75 cfs 0.199 af Secondary=4.43 cfs 0.221 af Outflow=5.18 cfs 0.420 af

Pond P3: Overflow Pond Peak Elev=7,253.29' Storage=11,295 cf Inflow=6.53 cfs 0.587 af
Outflow=1.50 cfs 0.425 af

Total Runoff Area = 46.297 ac Runoff Volume = 0.808 af Average Runoff Depth = 0.21"

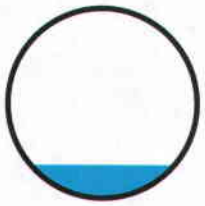
Summary for Reach 1R: Sed. Trap Outfall Culvert

Inflow Area = 11.915 ac, Inflow Depth = 0.31"
Inflow = 5.58 cfs @ 3.17 hrs, Volume= 0.308 af
Outflow = 5.57 cfs @ 3.18 hrs, Volume= 0.308 af, Atten= 0%, Lag= 0.4 min

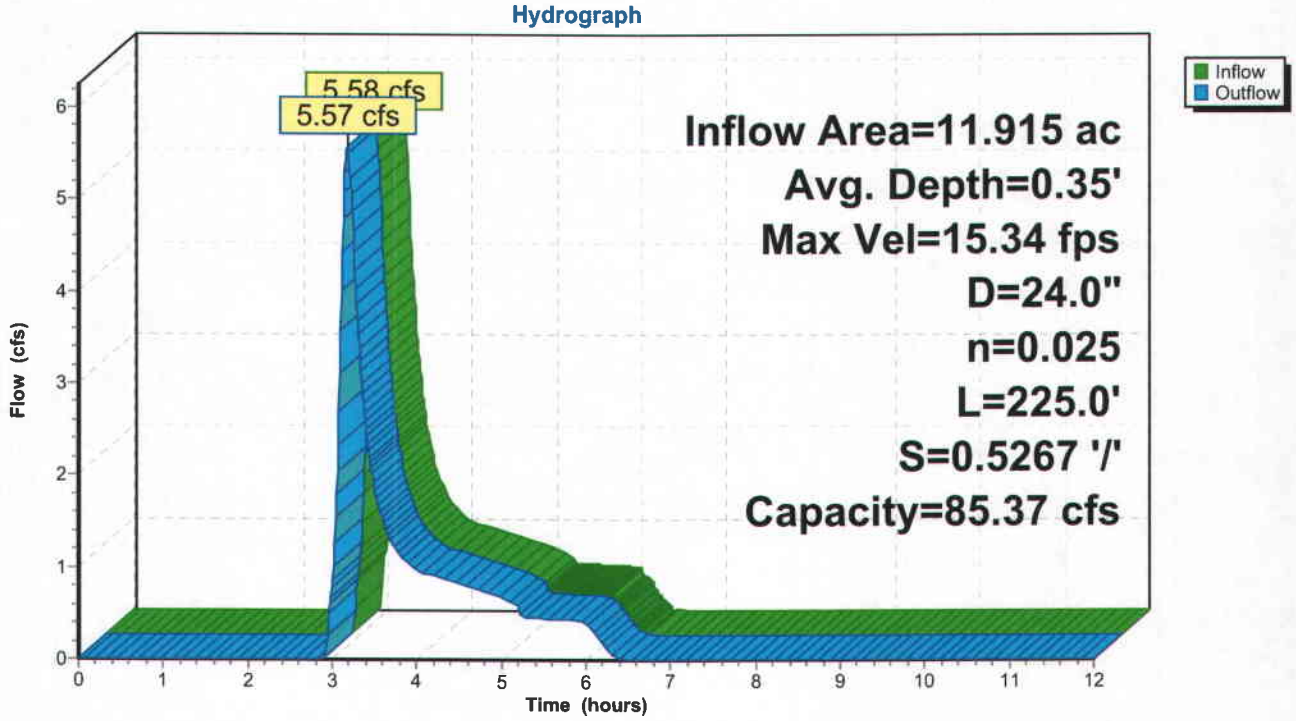
Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 15.34 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 8.06 fps, Avg. Travel Time= 0.5 min

Peak Storage= 82 cf @ 3.18 hrs, Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 85.37 cfs

24.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 225.0' Slope= 0.5267 '/'
Inlet Invert= 7,539.50', Outlet Invert= 7,421.00'



Reach 1R: Sed. Trap Outfall Culvert



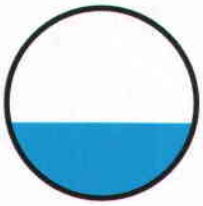
Summary for Reach 2R: Primary Sediment Pond Bypass

Inflow Area = 45.686 ac, Inflow Depth = 0.13"
Inflow = 6.32 cfs @ 3.18 hrs, Volume= 0.508 af
Outflow = 6.26 cfs @ 3.22 hrs, Volume= 0.508 af, Atten= 1%, Lag= 2.1 min

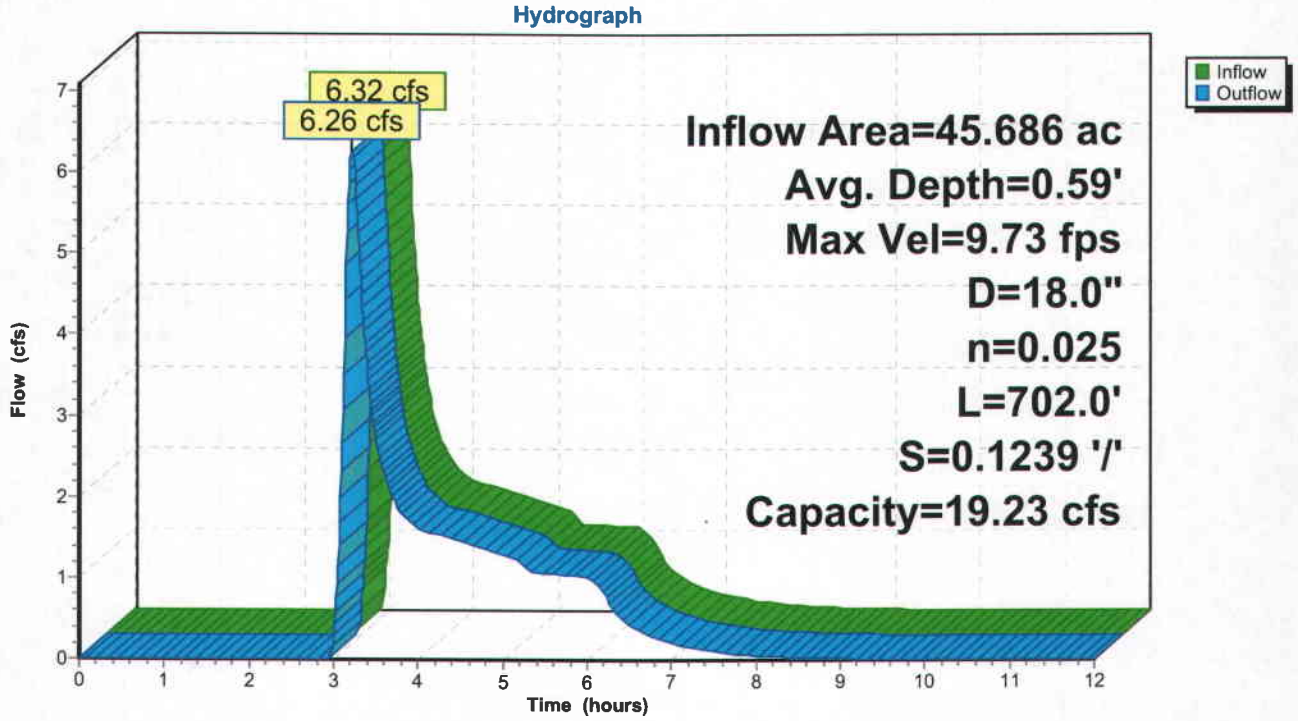
Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.73 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 3.62 fps, Avg. Travel Time= 3.2 min

Peak Storage= 452 cf @ 3.20 hrs, Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 19.23 cfs

18.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 702.0' Slope= 0.1239 '/'
Inlet Invert= 7,340.00', Outlet Invert= 7,253.00'



Reach 2R: Primary Sediment Pond Bypass



Summary for Reach 3R: Overflow Pond Inlet Swale

Inflow Area = 45.686 ac, Inflow Depth = 0.13"
Inflow = 6.26 cfs @ 3.22 hrs, Volume= 0.508 af
Outflow = 6.26 cfs @ 3.22 hrs, Volume= 0.508 af, Atten= 0%, Lag= 0.2 min

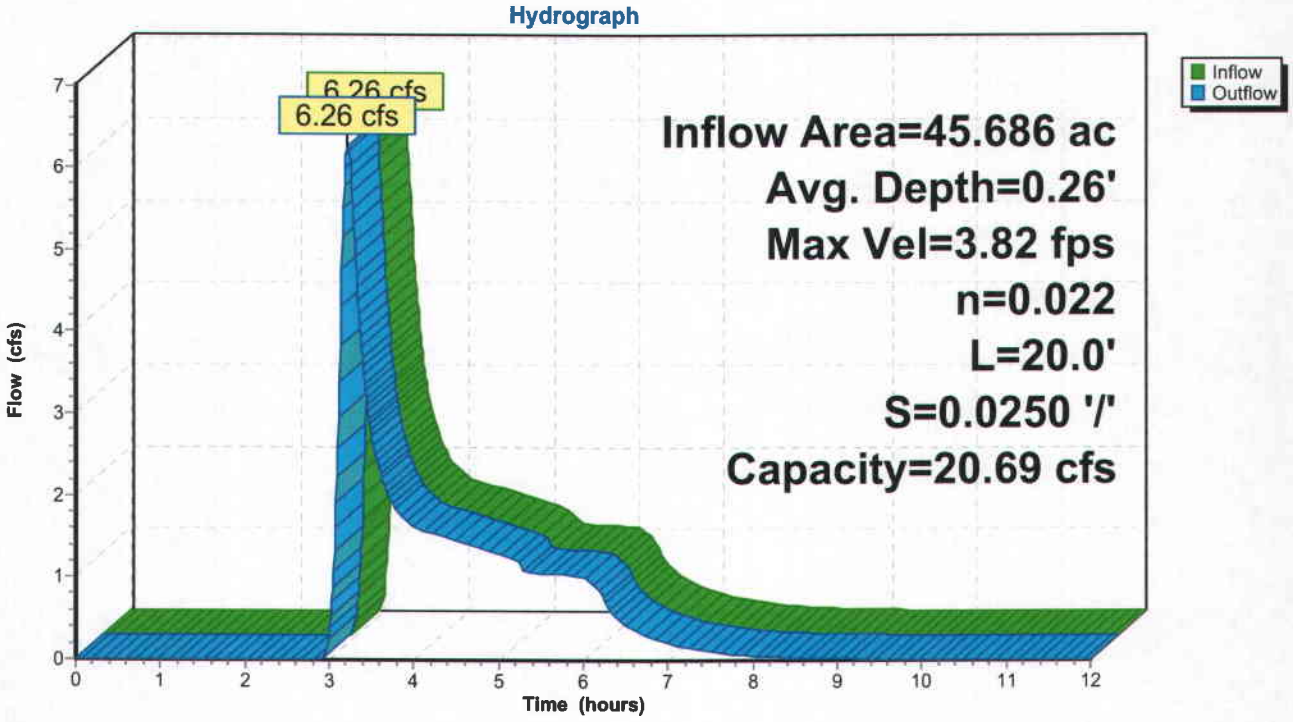
Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.82 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.24 fps, Avg. Travel Time= 0.3 min

Peak Storage= 33 cf @ 3.22 hrs, Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 20.69 cfs

5.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 5.0 '/' Top Width= 10.00'
Length= 20.0' Slope= 0.0250 '/'
Inlet Invert= 7,255.00', Outlet Invert= 7,254.50'

‡

Reach 3R: Overflow Pond Inlet Swale



Summary for Pond #1: Gate Box #1

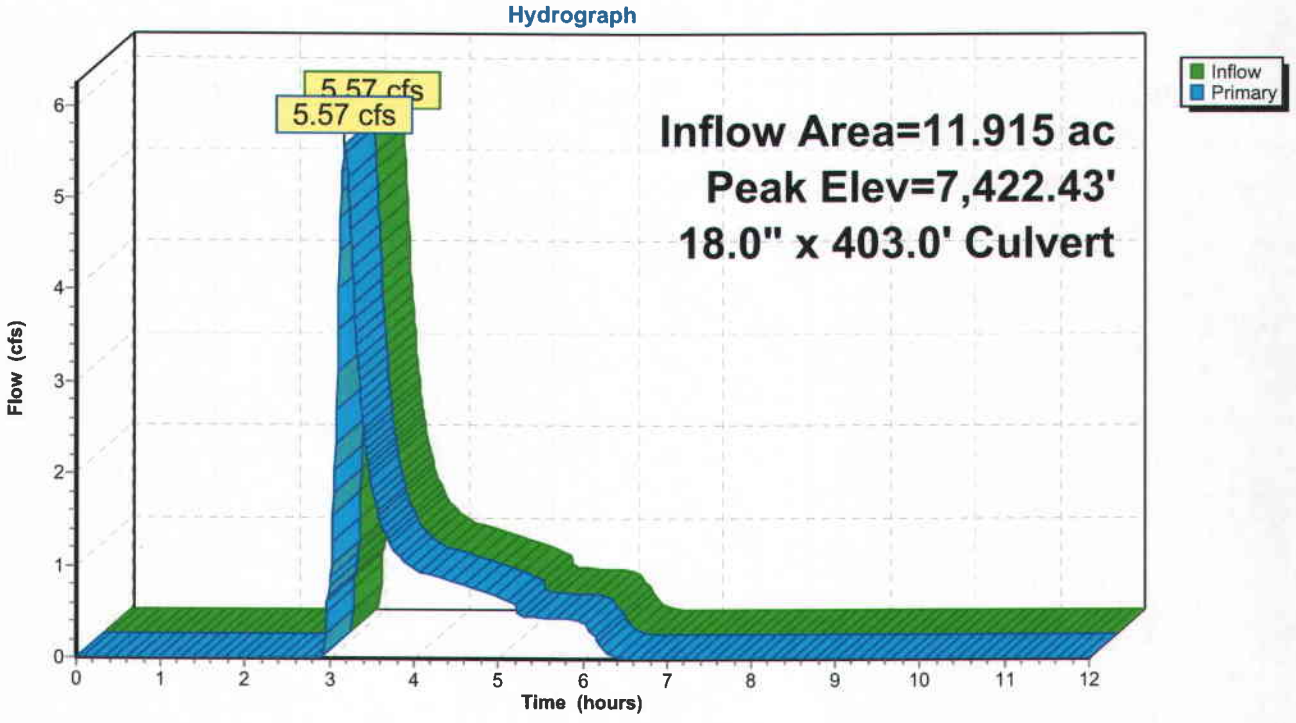
Inflow Area = 11.915 ac, Inflow Depth = 0.31"
Inflow = 5.57 cfs @ 3.18 hrs, Volume= 0.308 af
Outflow = 5.57 cfs @ 3.18 hrs, Volume= 0.308 af, Atten= 0%, Lag= 0.0 min
Primary = 5.57 cfs @ 3.18 hrs, Volume= 0.308 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Peak Elev= 7,422.43' @ 3.18 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	7,421.00'	**18.0" x 403.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 7,340.00' S= 0.2010 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=5.57 cfs @ 3.18 hrs HW=7,422.43' TW=7,253.50' (Fixed TW Elev= 7,253.50')
↑—**1=Culvert** (Inlet Controls 5.57 cfs @ 3.21 fps)

Pond #1: Gate Box #1



Summary for Pond #2: Gate Box #2

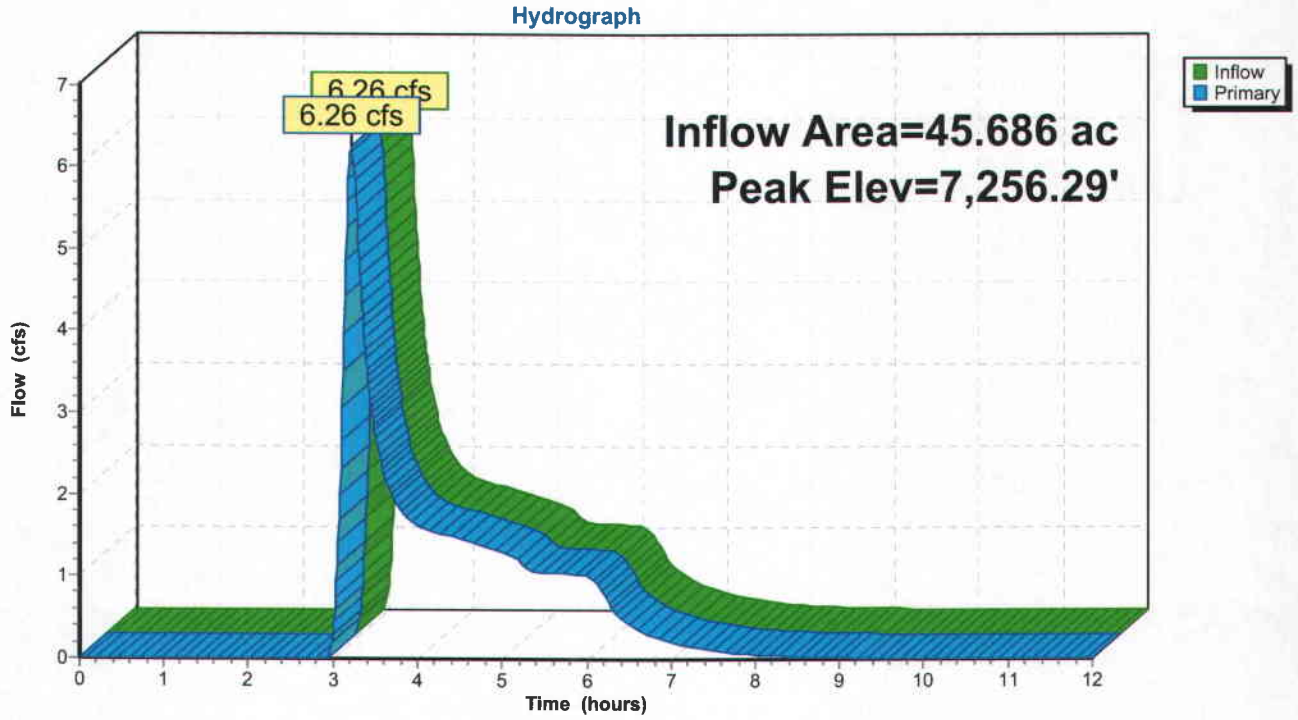
Inflow Area = 45.686 ac, Inflow Depth = 0.13"
Inflow = 6.26 cfs @ 3.22 hrs, Volume= 0.508 af
Outflow = 6.26 cfs @ 3.22 hrs, Volume= 0.508 af, Atten= 0%, Lag= 0.0 min
Primary = 6.26 cfs @ 3.22 hrs, Volume= 0.508 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Peak Elev= 7,256.29' @ 3.22 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	7,255.00'	**18.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=6.26 cfs @ 3.22 hrs HW=7,256.29' (Free Discharge)
1=Orifice/Grate (Orifice Controls 6.26 cfs @ 3.87 fps)

Pond #2: Gate Box #2



Summary for Pond P1: Sed. Trap

Inflow Area =	11.915 ac,	Inflow Depth =	0.31"	
Inflow =	5.65 cfs @	3.16 hrs, Volume=	0.308 af	
Outflow =	5.58 cfs @	3.17 hrs, Volume=	0.308 af,	Atten= 1%, Lag= 0.9 min
Primary =	1.10 cfs @	3.17 hrs, Volume=	0.201 af	
Secondary =	4.48 cfs @	3.17 hrs, Volume=	0.108 af	

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Peak Elev= 7,540.96' @ 3.17 hrs Surf.Area= 1,069 sf Storage= 1,000 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 5.2 min (236.0 - 230.8)

Volume	Invert	Avail.Storage	Storage Description
#1	7,539.50'	1,682 cf	**Custom Stage Data (Prismatic)**Listed below

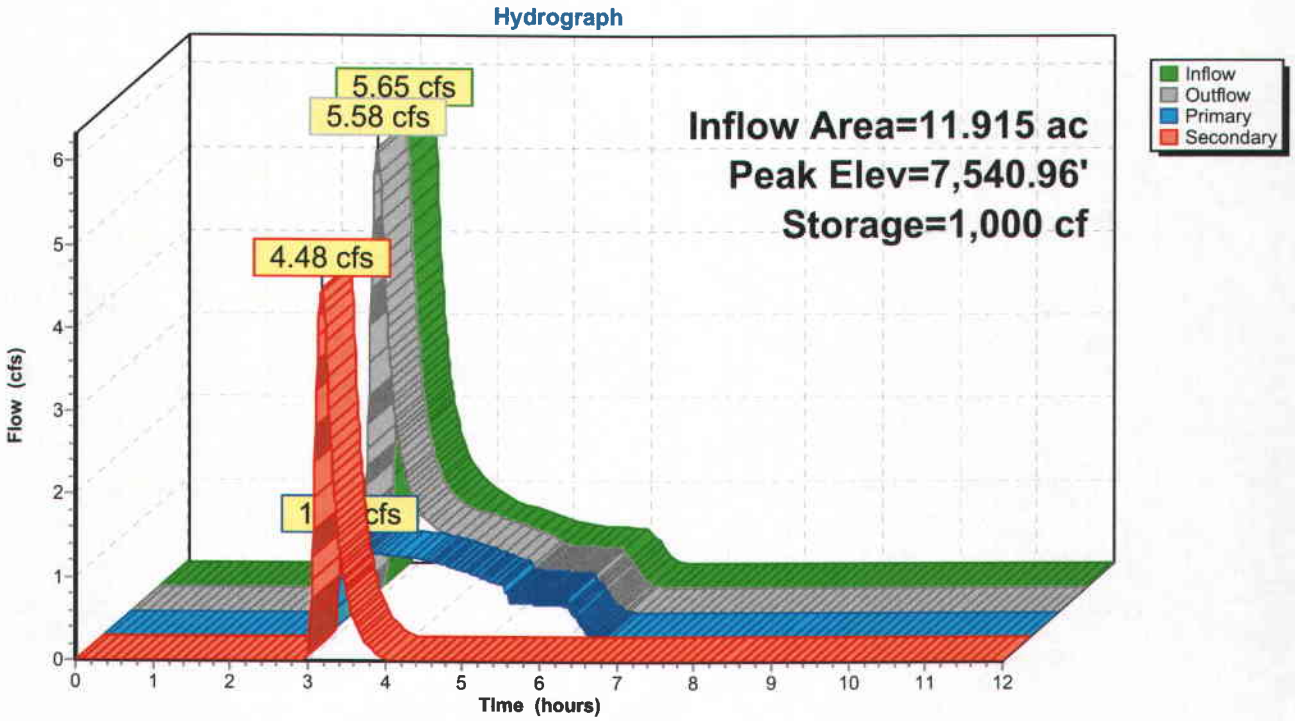
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7,539.50	895	0.0	0	0
7,539.60	911	0.0	0	0
7,540.00	974	0.0	0	0
7,540.60	1,069	100.0	613	613
7,541.60	1,069	100.0	1,069	1,682

Device	Routing	Invert	Outlet Devices
#1	Primary	7,539.60'	**2.0" Horiz. Orifice/Grate X 9.00** Limited to weir flow C= 0.600
#2	Secondary	7,540.60'	**24.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=1.10 cfs @ 3.17 hrs HW=7,540.96' TW=7,402.00' (Fixed TW Elev= 7,402.00')
↑—**1=Orifice/Grate** (Orifice Controls 1.10 cfs @ 5.62 fps)

Secondary OutFlow Max=4.47 cfs @ 3.17 hrs HW=7,540.96' TW=7,402.00' (Fixed TW Elev= 7,402.00')
↑—**2=Orifice/Grate** (Weir Controls 4.47 cfs @ 1.97 fps)

Pond P1: Sed. Trap



Summary for Pond P2: Primary Sed. Pond

Inflow Area = 33.771 ac, Inflow Depth = 0.15"
Inflow = 6.31 cfs @ 3.00 hrs, Volume= 0.420 af
Outflow = 5.18 cfs @ 3.17 hrs, Volume= 0.420 af, Atten= 18%, Lag= 10.1 min
Primary = 0.75 cfs @ 3.17 hrs, Volume= 0.199 af
Secondary = 4.43 cfs @ 3.17 hrs, Volume= 0.221 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Peak Elev= 7,418.33' @ 3.17 hrs Surf.Area= 0.238 ac Storage= 0.041 af

Plug-Flow detention time= 20.2 min calculated for 0.420 af (100% of inflow)
Center-of-Mass det. time= 20.2 min (261.2 - 241.0)

Volume	Invert	Avail.Storage	Storage Description
#1	7,401.40'	0.461 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Voids (%)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
7,401.40	0.114	0.0	0.000	0.000
7,411.00	0.122	0.0	0.000	0.000
7,412.00	0.135	0.0	0.000	0.000
7,413.00	0.149	0.0	0.000	0.000
7,414.00	0.167	0.0	0.000	0.000
7,415.00	0.185	0.0	0.000	0.000
7,416.00	0.201	0.0	0.000	0.000
7,417.00	0.217	0.0	0.000	0.000
7,417.70	0.228	0.0	0.000	0.000
7,418.15	0.235	0.0	0.000	0.000
7,418.30	0.238	100.0	0.035	0.035
7,418.90	0.247	100.0	0.145	0.181
7,419.00	0.248	100.0	0.025	0.206
7,419.50	0.256	100.0	0.126	0.332
7,420.00	0.263	100.0	0.130	0.461

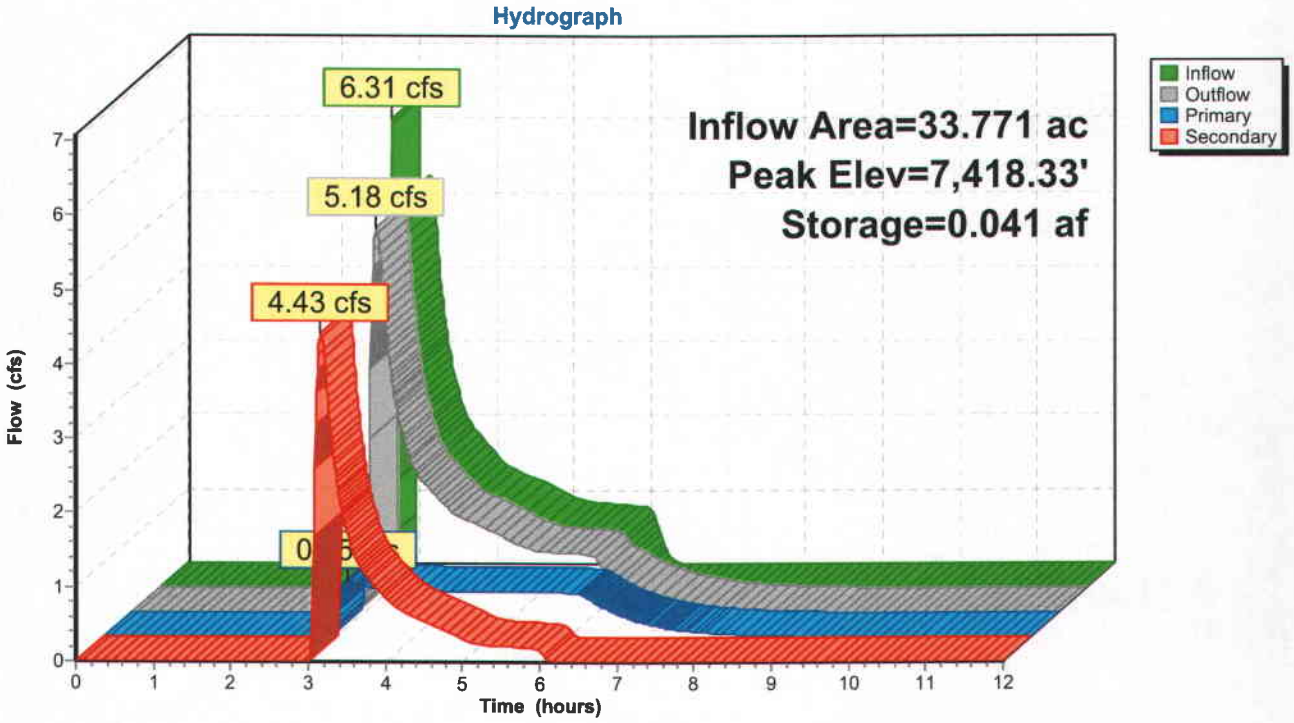
Device	Routing	Invert	Outlet Devices
#1	Primary	7,418.15'	**12.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
#2	Secondary	7,418.30'	**Special & User-Defined**

Elev. (feet) 7,418.30 7,418.90 7,419.00 7,419.50 7,420.00
Disch. (cfs) 0.000 105.900 139.900 351.300 613.100

Primary OutFlow Max=0.75 cfs @ 3.17 hrs HW=7,418.33' TW=7,400.00' (Fixed TW Elev= 7,400.00')
└─**1=Orifice/Grate** (Weir Controls 0.75 cfs @ 1.37 fps)

Secondary OutFlow Max=4.43 cfs @ 3.17 hrs HW=7,418.33' (Free Discharge)
└─**2=Special & User-Defined** (Custom Controls 4.43 cfs)

Pond P2: Primary Sed. Pond



Overflow Pond Primary Spillway
Worksheet for Circular Channel

Project Description	
Worksheet	Primary Spillwa
Flow Element	Circular Chann
Method	Manning's For
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.024	
Slope	045300	ft/ft
Diameter	18	in
Discharge	6.31	cfs

Results		
Depth	0.77	ft
Flow Area	0.9	ft²
Wetted Perime	2.39	ft
Top Width	1.50	ft
Critical Depth	0.97	ft
Percent Full	51.2	%
Critical Slope	0.021738	ft/ft
Velocity	6.92	ft/s
Velocity Head	0.74	ft
Specific Energ	1.51	ft
Froude Numbe	1.57	
Maximum Disc	13.03	cfs
Discharge Full	12.11	cfs
Slope Full	0.012300	ft/ft
Flow Type	Supercritical	

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Summary for Pond P3: Overflow Pond

Assuming all ponds full and all runoff from the 10 yr-24 hr storm enters the overflow pond and is retained with 100% sediment load.
Assuming a 25 yr-6 hr storm on top of 10 yr-24 hr storm.

Inflow Area =	46.297 ac,	Inflow Depth =	0.15"	
Inflow =	6.53 cfs @	3.22 hrs, Volume=	0.587 af	
Outflow =	1.50 cfs @	4.60 hrs, Volume=	0.425 af,	Atten= 77%, Lag= 83.1 min
Secondary =	1.50 cfs @	4.60 hrs, Volume=	0.425 af	

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Peak Elev= 7,253.29' @ 4.60 hrs Surf.Area= 0 sf Storage= 11,295 cf

Plug-Flow detention time= 112.5 min calculated for 0.425 af (72% of inflow)
Center-of-Mass det. time= 75.3 min (328.0 - 252.7)

Volume	Invert	Avail.Storage	Storage Description
#1	7,252.50'	38,415 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
7,252.50	0
7,253.00	7,034
7,253.50	14,386
7,254.00	22,056
7,254.50	30,060
7,255.00	38,415

Device	Routing	Invert	Outlet Devices
#1	Secondary	7,253.00'	**Special & User-Defined** Head (feet) 0.00 0.29 Disch. (cfs) 0.000 1.500

Secondary OutFlow Max=1.50 cfs @ 4.60 hrs HW=7,253.29' (Free Discharge)
↳**1=Special & User-Defined** (Custom Controls 1.50 cfs)

Overflow Pond Secondary Spillway (Top)
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Overflow Pond Secondary Spill\
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	010000	ft/ft
Left Side Slope	12.00	H : V
Right Side Slope	12.00	H : V
Bottom Width	1.00	ft
Discharge	1.50	cfs

Results		
Depth	0.30	ft
Flow Area	1.3	ft²
Wetted Perim	8.11	ft
Top Width	8.08	ft
Critical Depth	0.21	ft
Critical Slope	0.046998	ft/ft
Velocity	1.12	ft/s
Velocity Head	0.02	ft
Specific Energ	0.31	ft
Froude Numb	0.48	
Flow Type	Subcritical	

Overflow Pond Secondary Spillway (Bottom)
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Overflow Pond Secondary Spillwa
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	330000	ft/ft
Left Side Slope	4.00	H : V
Right Side Slope	4.00	H : V
Bottom Width	1.00	ft
Discharge	1.50	cfs

Results		
Depth	0.17	ft
Flow Area	0.3	ft²
Wetted Perim	2.41	ft
Top Width	2.37	ft
Critical Depth	0.29	ft
Critical Slope	0.041985	ft/ft
Velocity	5.19	ft/s
Velocity Head	0.42	ft
Specific Energ	0.59	ft
Froude Numb	2.62	
Flow Type	Supercritical	

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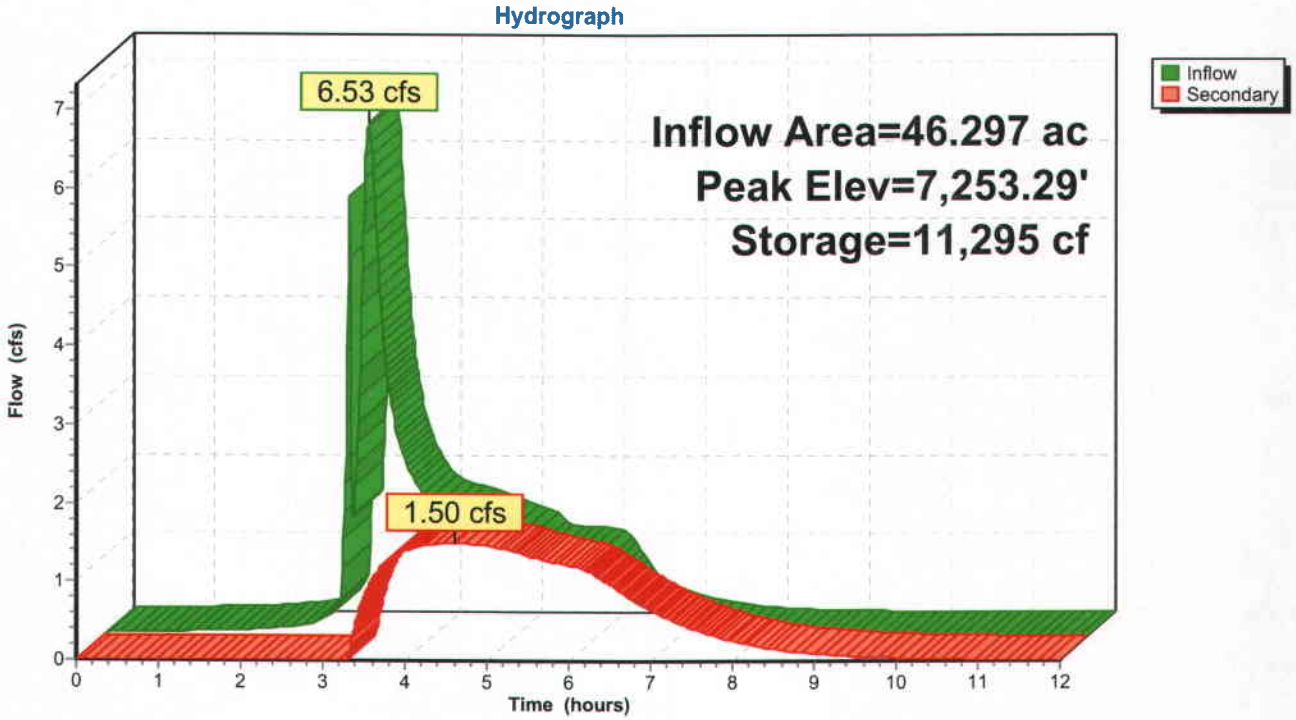
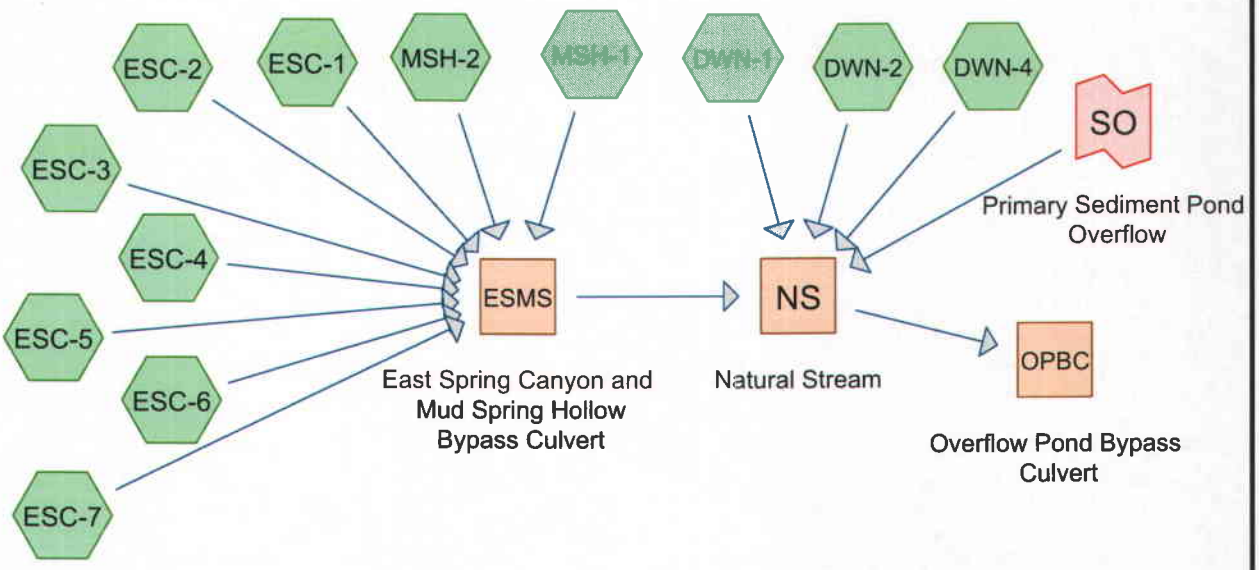
Pond P3: Overflow Pond





Subcat Reach Pond Link

Drainage Diagram for Overflow Pond Bypass Culvert 100yr 6hr
Prepared by EarthFax Engineering, Inc., Printed 6/9/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-12.00 hrs, dt=0.05 hrs, 241 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DWN-1: Runoff Area=7.230 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=1,720' Slope=0.5900 '/' Tc=6.6 min CN=79 Runoff=12.95 cfs 0.336 af

Subcatchment DWN-2: Runoff Area=6.017 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=420' Slope=0.6930 '/' Tc=2.0 min CN=79 Runoff=17.09 cfs 0.280 af

Subcatchment DWN-4: Runoff Area=36.740 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=3,060' Slope=0.3830 '/' Tc=13.0 min CN=79 Runoff=41.70 cfs 1.708 af

Subcatchment ESC-1: Runoff Area=882.000 ac 0.00% Impervious Runoff Depth=0.32"
Flow Length=14,700' Slope=0.1790 '/' Tc=81.5 min CN=72 Runoff=130.52 cfs 23.368 af

Subcatchment ESC-2: Runoff Area=1,010.000 ac 0.00% Impervious Runoff Depth=0.32"
Flow Length=8,400' Slope=0.1770 '/' Tc=52.4 min CN=72 Runoff=198.45 cfs 26.760 af

Subcatchment ESC-3: Runoff Area=211.000 ac 0.00% Impervious Runoff Depth=0.32"
Flow Length=4,000' Slope=0.2010 '/' Tc=27.1 min CN=72 Runoff=65.05 cfs 5.590 af

Subcatchment ESC-4: Runoff Area=468.000 ac 0.00% Impervious Runoff Depth=0.32"
Flow Length=9,000' Slope=0.1080 '/' Tc=70.9 min CN=72 Runoff=74.24 cfs 12.400 af

Subcatchment ESC-5: Runoff Area=487.000 ac 0.00% Impervious Runoff Depth=0.32"
Flow Length=9,500' Slope=0.2740 '/' Tc=46.5 min CN=72 Runoff=102.19 cfs 12.903 af

Subcatchment ESC-6: Runoff Area=0.920 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=540' Slope=0.6450 '/' Tc=2.5 min CN=79 Runoff=2.43 cfs 0.043 af

Subcatchment ESC-7: Runoff Area=0.570 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=580' Slope=0.4500 '/' Tc=3.2 min CN=79 Runoff=1.30 cfs 0.027 af

Subcatchment MSH-1: Runoff Area=1,956.000 ac 0.00% Impervious Runoff Depth>0.32"
Flow Length=19,300' Slope=0.1440 '/' Tc=113.0 min CN=72 Runoff=229.47 cfs 51.824 af

Subcatchment MSH-2: Runoff Area=0.550 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=500' Slope=0.4740 '/' Tc=2.7 min CN=79 Runoff=1.40 cfs 0.026 af

Reach ESMS: East Spring Canyon and Avg. Depth=3.41' Max Vel=54.14 fps Inflow=616.16 cfs 132.940 af
D=48.0" n=0.020 L=470.0' S=0.4085 '/' Capacity=596.76 cfs Outflow=616.06 cfs 132.940 af

Reach NS: Natural Stream Avg. Depth=3.34' Max Vel=13.95 fps Inflow=622.62 cfs 135.517 af
n=0.050 L=760.0' S=0.1158 '/' Capacity=1,006.87 cfs Outflow=622.37 cfs 135.516 af

Reach OPBC: Overflow Pond Bypass Avg. Depth=4.50' Max Vel=29.94 fps Inflow=622.37 cfs 135.516 af
D=66.0" n=0.012 L=340.0' S=0.0294 '/' Capacity=623.90 cfs Outflow=622.33 cfs 135.516 af

Link Outflow Imported from Sed. Trap and Sed. Pond Overflow 100yr 6hr~Pond P2.hce Inflow=1.83 cfs 0.253 af
Area= 45.686 ac Primary=1.83 cfs 0.253 af

Total Runoff Area = 5,066.027 ac Runoff Volume = 135.264 af Average Runoff Depth = 0.32"
100.00% Pervious = 5,066.027 ac 0.00% Impervious = 0.000 ac

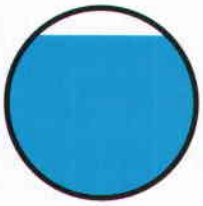
Summary for Reach ESMS: East Spring Canyon and Mud Spring Hollow Bypass Culvert

Inflow Area = 5,016.040 ac, 0.00% Impervious, Inflow Depth = 0.32"
Inflow = 616.16 cfs @ 4.08 hrs, Volume= 132.940 af
Outflow = 616.06 cfs @ 4.08 hrs, Volume= 132.940 af, Atten= 0%, Lag= 0.0 min

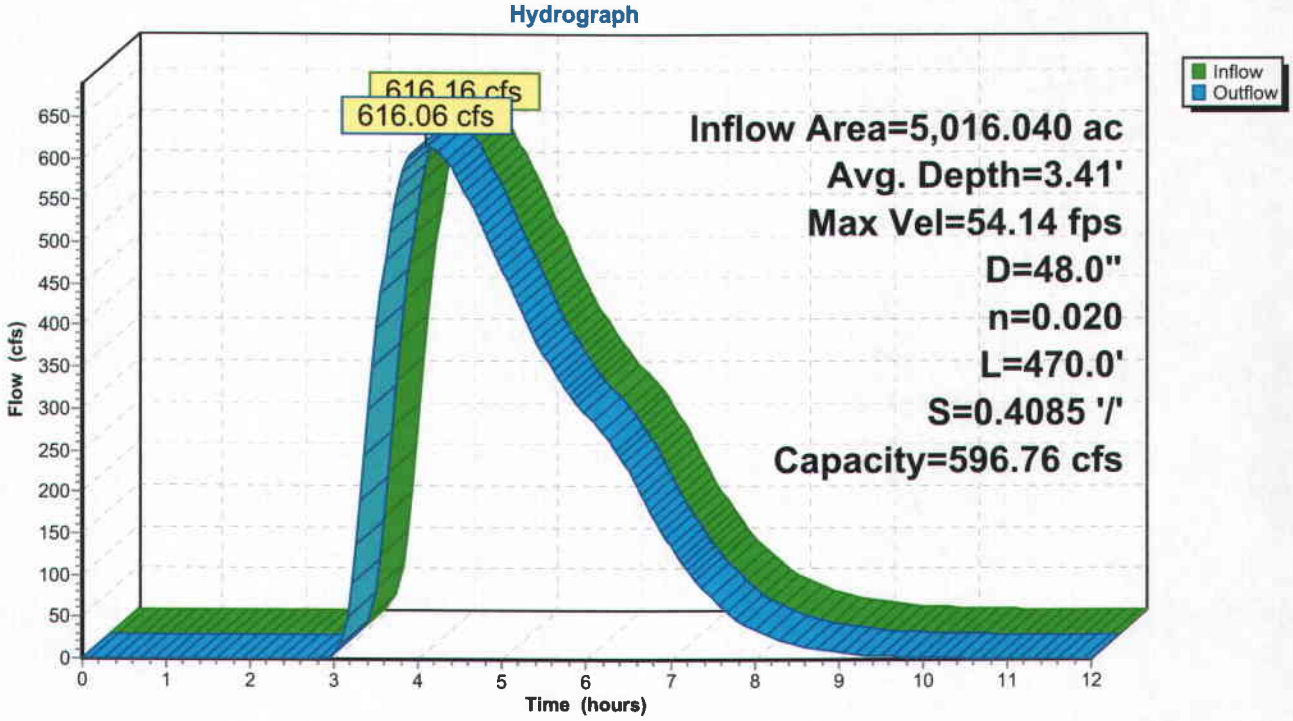
Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 54.14 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 29.87 fps, Avg. Travel Time= 0.3 min

Peak Storage= 5,363 cf @ 4.08 hrs, Average Depth at Peak Storage= 3.41'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 596.76 cfs

48.0" Diameter Pipe, n= 0.020
Length= 470.0' Slope= 0.4085 '/'
Inlet Invert= 7,545.00', Outlet Invert= 7,353.00'



Reach ESMS: East Spring Canyon and Mud Spring Hollow Bypass Culvert



Summary for Reach NS: Natural Stream

Inflow Area = 5,111.713 ac, 0.00% Impervious, Inflow Depth = 0.32"
Inflow = 622.62 cfs @ 4.07 hrs, Volume= 135.517 af
Outflow = 622.37 cfs @ 4.10 hrs, Volume= 135.516 af, Atten= 0%, Lag= 1.8 min

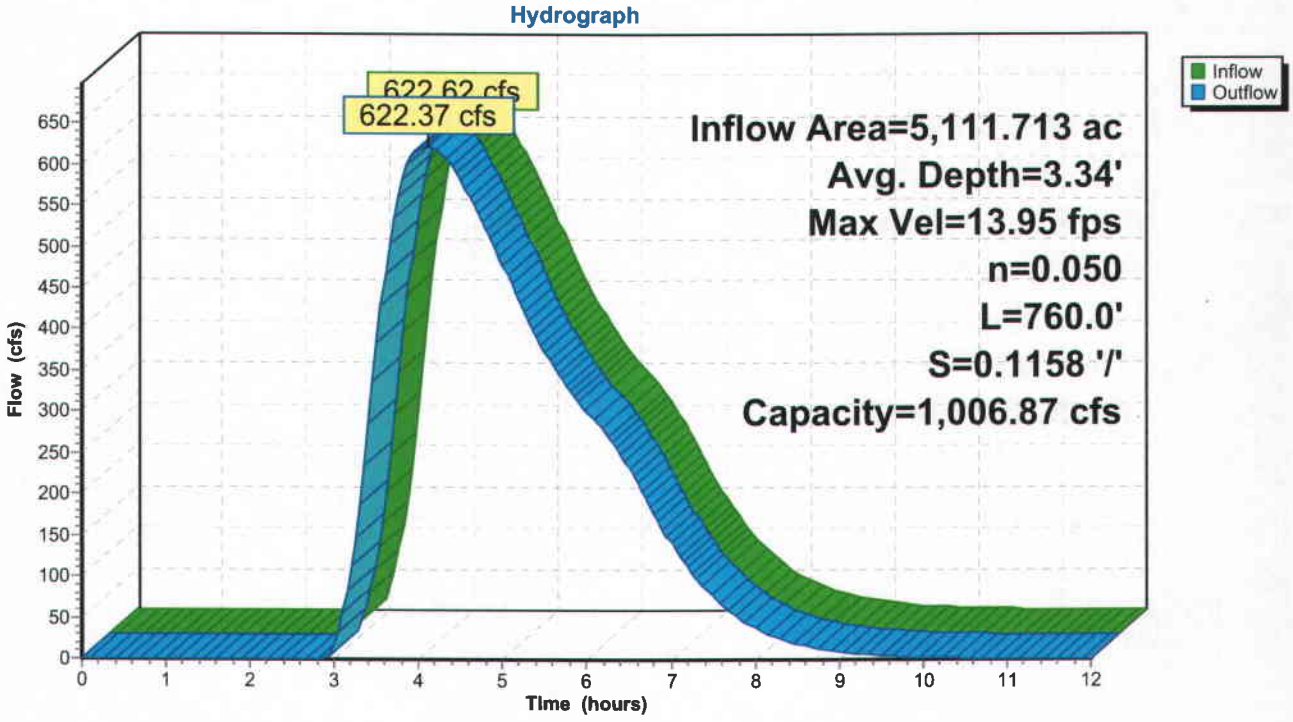
Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.95 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 7.78 fps, Avg. Travel Time= 1.6 min

Peak Storage= 33,914 cf @ 4.09 hrs, Average Depth at Peak Storage= 3.34'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 1,006.87 cfs

0.00' x 4.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 4.0 '/' Top Width= 32.00'
Length= 760.0' Slope= 0.1158 '/'
Inlet Invert= 7,353.00', Outlet Invert= 7,265.00'

‡

Reach NS: Natural Stream



Summary for Reach OPBC: Overflow Pond Bypass Culvert

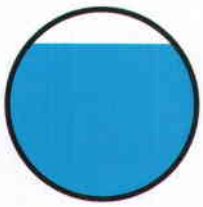
Two 48" pipes could also be used.

Inflow Area = 5,111.713 ac, 0.00% Impervious, Inflow Depth > 0.32"
Inflow = 622.37 cfs @ 4.10 hrs, Volume= 135.516 af
Outflow = 622.33 cfs @ 4.11 hrs, Volume= 135.516 af, Atten= 0%, Lag= 0.4 min

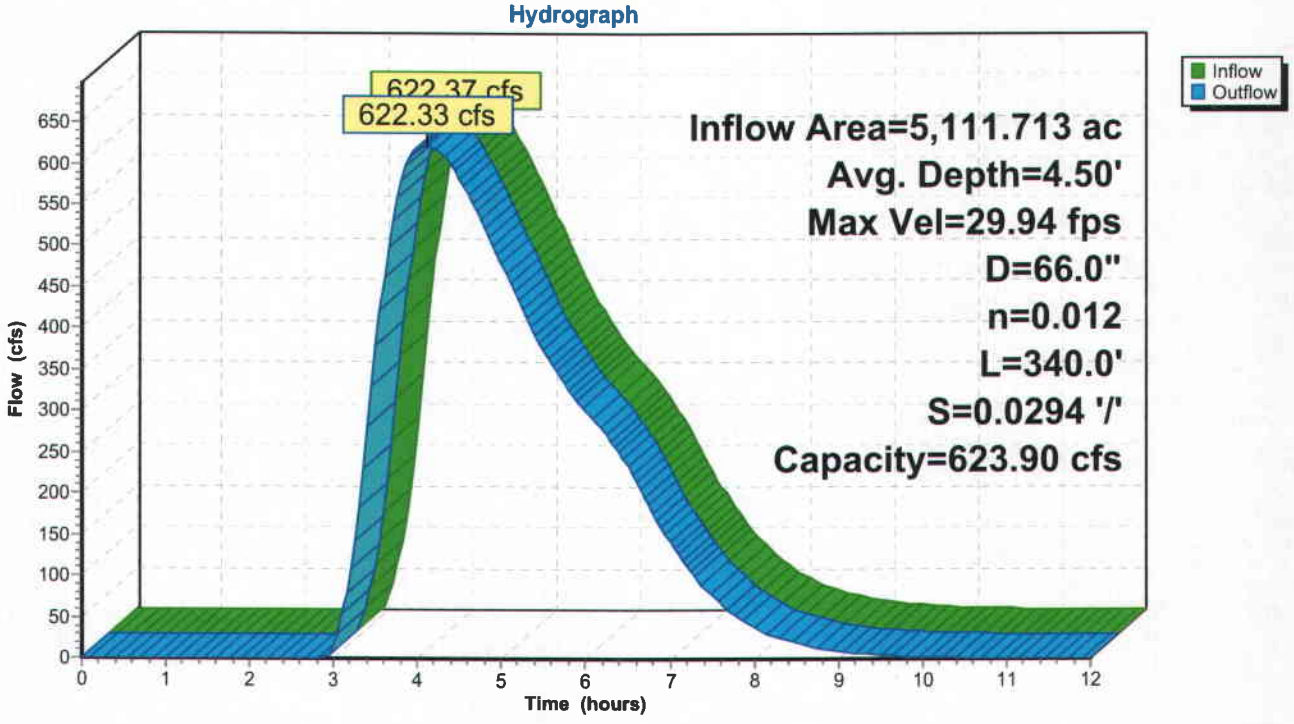
Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 29.94 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 16.59 fps, Avg. Travel Time= 0.3 min

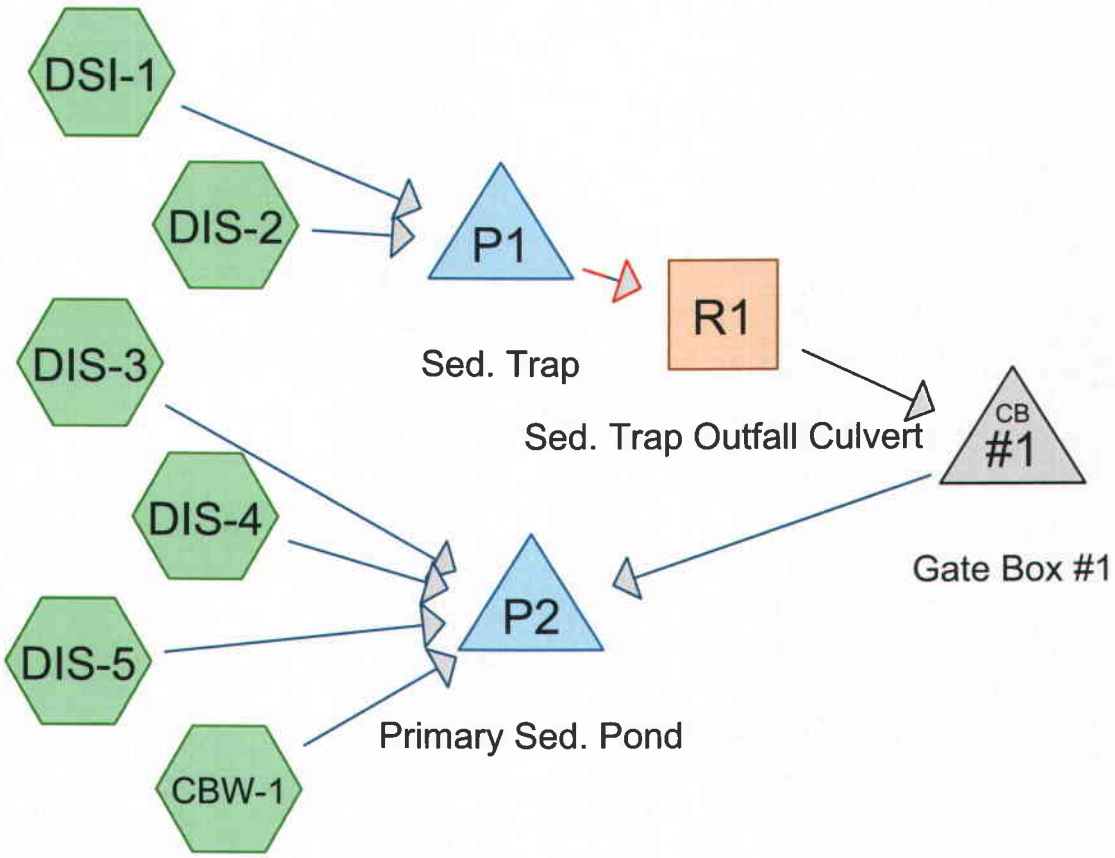
Peak Storage= 7,069 cf @ 4.10 hrs, Average Depth at Peak Storage= 4.50'
Bank-Full Depth= 5.50', Capacity at Bank-Full= 623.90 cfs

66.0" Diameter Pipe, n= 0.012
Length= 340.0' Slope= 0.0294 '/'
Inlet Invert= 7,248.00', Outlet Invert= 7,238.00'



Reach OPBC: Overflow Pond Bypass Culvert





Subcat Reach Pond Link

Drainage Diagram for Sed. Trap and Sed. Pond Overflow 100yr 6hr
Prepared by EarthFax Engineering, Inc., Printed 6/9/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-12.00 hrs, dt=0.01 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment CBW-1: Runoff Area=29.800 ac Runoff Depth=0.32"
Flow Length=2,100' Slope=0.4380 '/' Tc=11.0 min CN=72 Runoff=17.03 cfs 0.790 af

Subcatchment DIS-2: Runoff Area=9.275 ac Runoff Depth=0.60"
Flow Length=830' Slope=0.0410 '/' Tc=13.5 min CN=80 Runoff=11.40 cfs 0.463 af

Subcatchment DIS-3: Runoff Area=1.400 ac Runoff Depth=0.60"
Flow Length=700' Slope=0.3670 '/' Tc=3.9 min CN=80 Runoff=3.99 cfs 0.070 af

Subcatchment DIS-4: Runoff Area=2.227 ac Runoff Depth=0.60"
Flow Length=230' Slope=0.5530 '/' Tc=1.3 min CN=80 Runoff=9.51 cfs 0.111 af

Subcatchment DIS-5: Runoff Area=0.344 ac Runoff Depth=0.60"
Flow Length=100' Slope=0.2000 '/' Tc=1.1 min CN=80 Runoff=1.52 cfs 0.017 af

Subcatchment DSI-1: Runoff Area=2.640 ac Runoff Depth=0.60"
Flow Length=220' Slope=0.5610 '/' Tc=1.3 min CN=80 Runoff=11.27 cfs 0.132 af

Reach R1: Sed. Trap Outfall Culvert Avg. Depth=0.51' Max Vel=19.32 fps Inflow=12.29 cfs 0.595 af
D=24.0" n=0.025 L=225.0' S=0.5267 '/' Capacity=85.37 cfs Outflow=12.27 cfs 0.595 af

Pond #1: Gate Box #1 Peak Elev=7,421.71' Inflow=12.27 cfs 0.595 af
Outflow=12.27 cfs 0.595 af

Pond P1: Sed. Trap Peak Elev=7,541.26' Storage=1,321 cf Inflow=12.37 cfs 0.595 af
Primary=1.22 cfs 0.261 af Secondary=11.07 cfs 0.334 af Outflow=12.29 cfs 0.595 af

Pond P2: Primary Sed. Pond Peak Elev=7,418.46' Storage=0.074 af Inflow=30.64 cfs 1.583 af
Primary=1.83 cfs 0.253 af Secondary=28.36 cfs 1.330 af Outflow=30.19 cfs 1.583 af

Total Runoff Area = 45.686 ac Runoff Volume = 1.583 af Average Runoff Depth = 0.42"

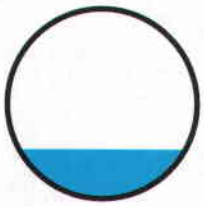
Summary for Reach R1: Sed. Trap Outfall Culvert

Inflow Area = 11.915 ac, Inflow Depth = 0.60"
Inflow = 12.29 cfs @ 3.16 hrs, Volume= 0.595 af
Outflow = 12.27 cfs @ 3.16 hrs, Volume= 0.595 af, Atten= 0%, Lag= 0.3 min

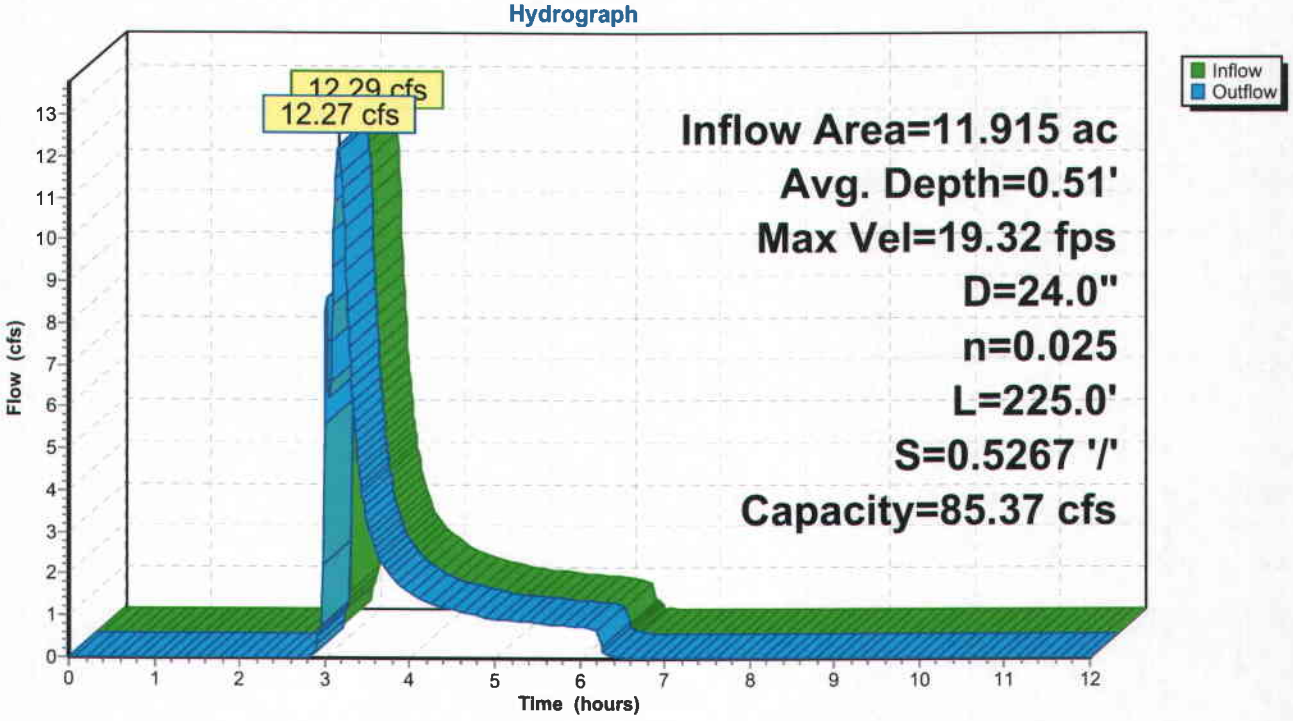
Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 19.32 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 9.40 fps, Avg. Travel Time= 0.4 min

Peak Storage= 143 cf @ 3.16 hrs, Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 85.37 cfs

24.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 225.0' Slope= 0.5267 '/'
Inlet Invert= 7,539.50', Outlet Invert= 7,421.00'



Reach R1: Sed. Trap Outfall Culvert



Summary for Pond #1: Gate Box #1

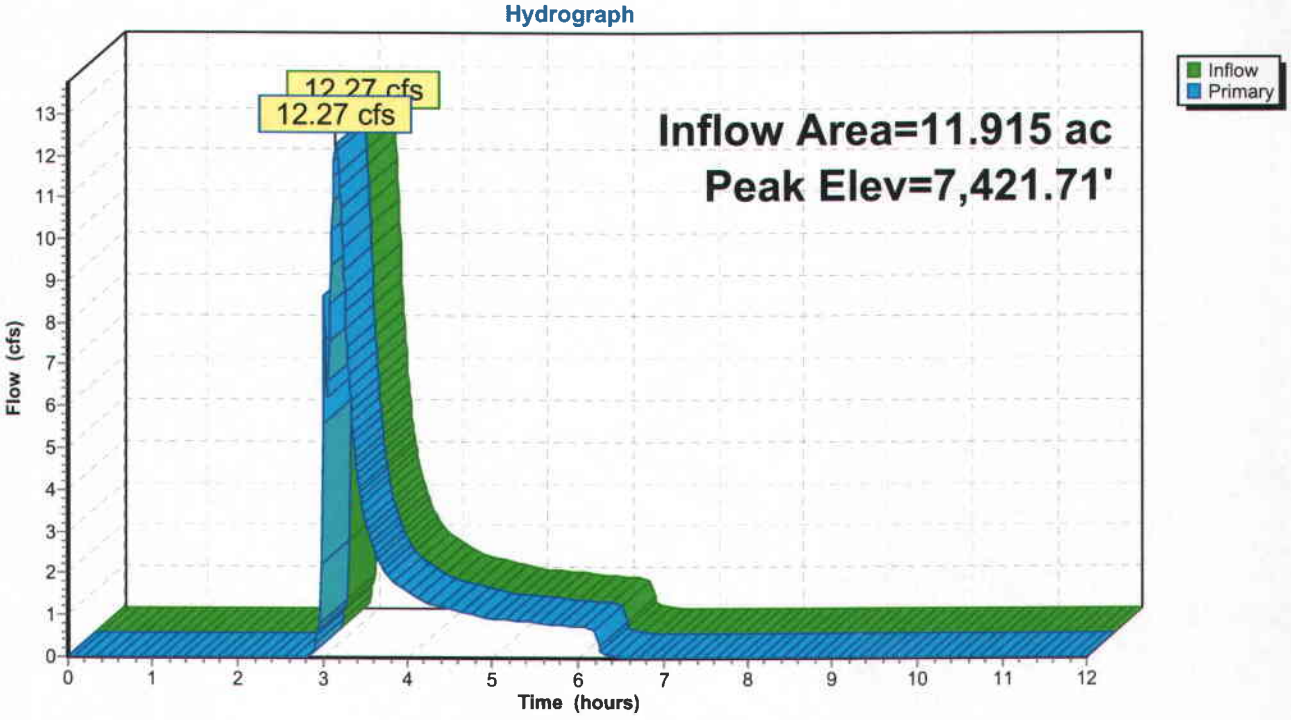
Inflow Area = 11.915 ac, Inflow Depth = 0.60"
Inflow = 12.27 cfs @ 3.16 hrs, Volume= 0.595 af
Outflow = 12.27 cfs @ 3.16 hrs, Volume= 0.595 af, Atten= 0%, Lag= 0.0 min
Primary = 12.27 cfs @ 3.16 hrs, Volume= 0.595 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Peak Elev= 7,421.71' @ 3.16 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	7,421.00'	**24.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=12.26 cfs @ 3.16 hrs HW=7,421.71' (Free Discharge)
↑**1=Orifice/Grate** (Weir Controls 12.26 cfs @ 2.75 fps)

Pond #1: Gate Box #1



Summary for Pond P1: Sed. Trap

Inflow Area = 11.915 ac, Inflow Depth = 0.60"
Inflow = 12.37 cfs @ 3.14 hrs, Volume= 0.595 af
Outflow = 12.29 cfs @ 3.16 hrs, Volume= 0.595 af, Atten= 1%, Lag= 0.9 min
Primary = 1.22 cfs @ 3.16 hrs, Volume= 0.261 af
Secondary = 11.07 cfs @ 3.16 hrs, Volume= 0.334 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Peak Elev= 7,541.26' @ 3.16 hrs Surf.Area= 1,069 sf Storage= 1,321 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 4.8 min (229.8 - 225.0)

Volume	Invert	Avail.Storage	Storage Description
#1	7,539.50'	1,682 cf	**Custom Stage Data (Prismatic)**Listed below

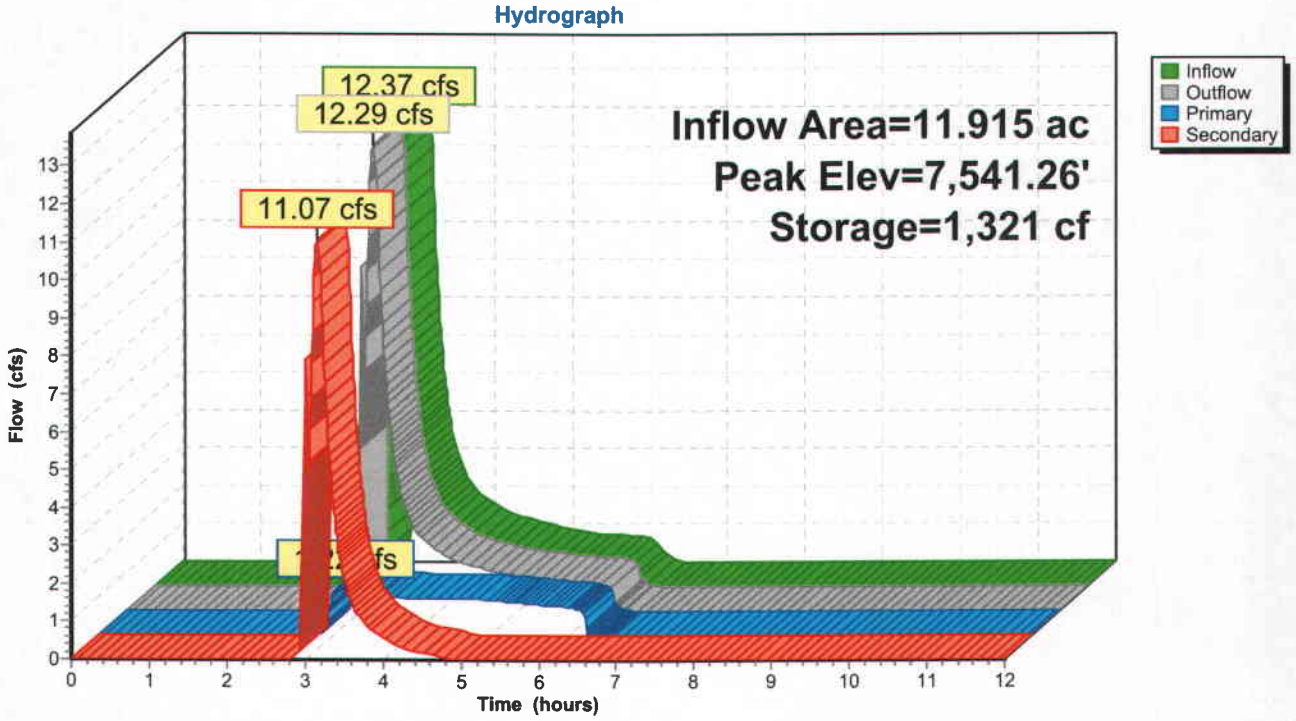
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7,539.50	895	0.0	0	0
7,539.60	911	0.0	0	0
7,540.00	974	0.0	0	0
7,540.60	1,069	100.0	613	613
7,541.60	1,069	100.0	1,069	1,682

Device	Routing	Invert	Outlet Devices
#1	Primary	7,539.60'	**2.0" Horiz. Orifice/Grate X 9.00** Limited to weir flow C= 0.600
#2	Secondary	7,540.60'	**24.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=1.22 cfs @ 3.16 hrs HW=7,541.26' TW=7,402.00' (Fixed TW Elev= 7,402.00')
↑**1=Orifice/Grate** (Orifice Controls 1.22 cfs @ 6.21 fps)

Secondary OutFlow Max=11.06 cfs @ 3.16 hrs HW=7,541.26' TW=7,402.00' (Fixed TW Elev= 7,402.00')
↑**2=Orifice/Grate** (Weir Controls 11.06 cfs @ 2.66 fps)

Pond P1: Sed. Trap



Summary for Pond P2: Primary Sed. Pond

Inflow Area = 45.686 ac, Inflow Depth = 0.42"
Inflow = 30.64 cfs @ 3.14 hrs, Volume= 1.583 af
Outflow = 30.19 cfs @ 3.16 hrs, Volume= 1.583 af, Atten= 1%, Lag= 1.0 min
Primary = 1.83 cfs @ 3.16 hrs, Volume= 0.253 af
Secondary = 28.36 cfs @ 3.16 hrs, Volume= 1.330 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Peak Elev= 7,418.46' @ 3.16 hrs Surf.Area= 0.240 ac Storage= 0.074 af

Plug-Flow detention time= 6.1 min calculated for 1.582 af (100% of inflow)
Center-of-Mass det. time= 6.3 min (237.4 - 231.1)

Volume	Invert	Avail.Storage	Storage Description
#1	7,401.40'	0.461 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

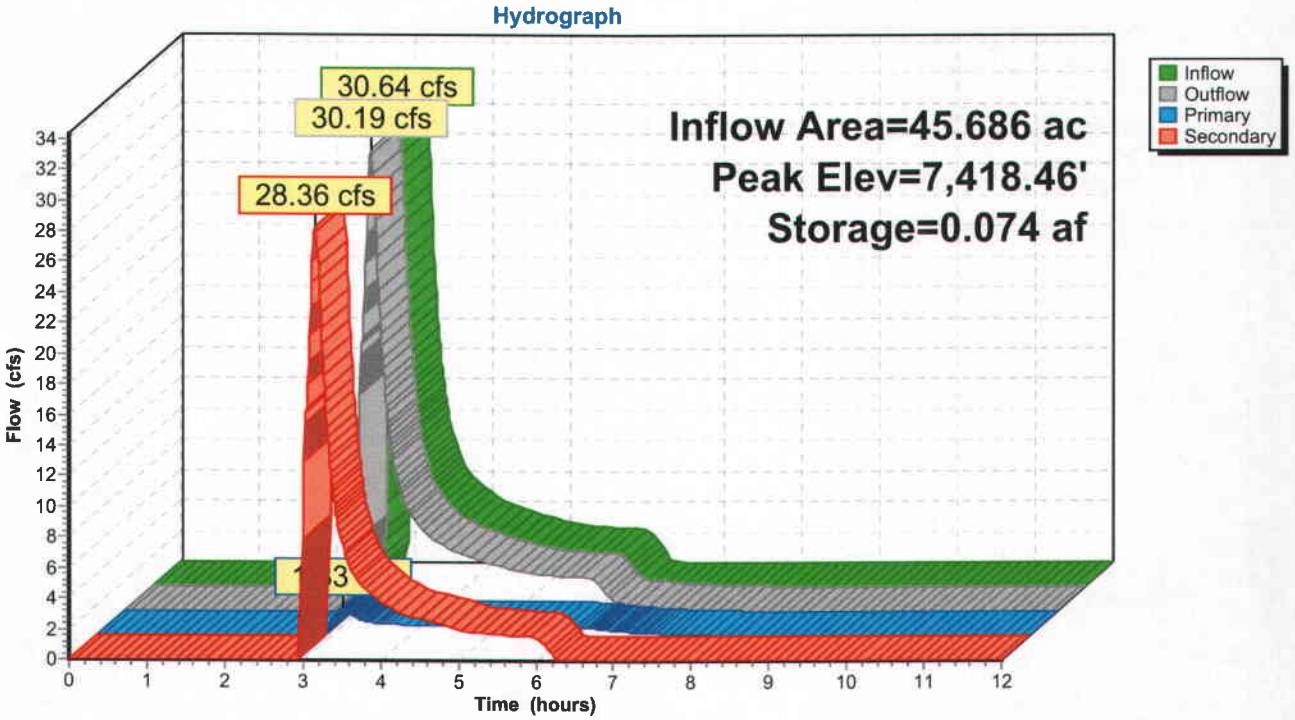
Elevation (feet)	Surf.Area (acres)	Voids (%)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
7,401.40	0.114	0.0	0.000	0.000
7,411.00	0.122	0.0	0.000	0.000
7,412.00	0.135	0.0	0.000	0.000
7,413.00	0.149	0.0	0.000	0.000
7,414.00	0.167	0.0	0.000	0.000
7,415.00	0.185	0.0	0.000	0.000
7,416.00	0.201	0.0	0.000	0.000
7,417.00	0.217	0.0	0.000	0.000
7,417.70	0.228	0.0	0.000	0.000
7,418.15	0.235	0.0	0.000	0.000
7,418.30	0.238	100.0	0.035	0.035
7,418.90	0.247	100.0	0.145	0.181
7,419.00	0.248	100.0	0.025	0.206
7,419.50	0.256	100.0	0.126	0.332
7,420.00	0.263	100.0	0.130	0.461

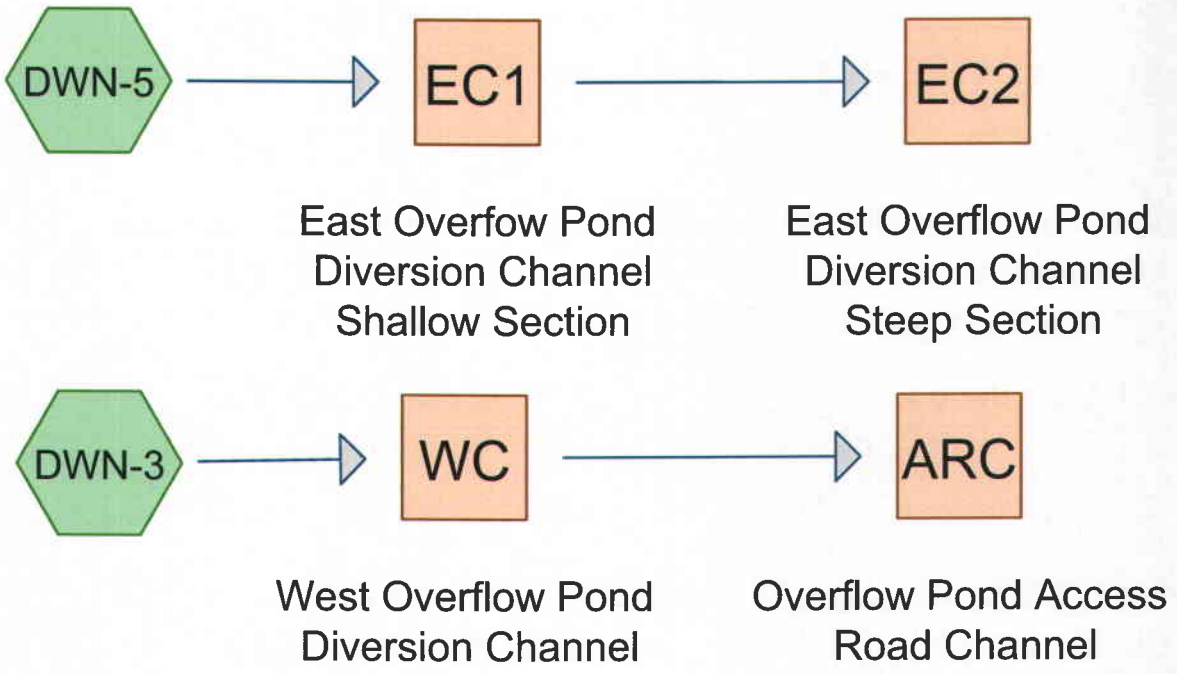
Device	Routing	Invert	Outlet Devices
#1	Primary	7,418.15'	**12.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
#2	Secondary	7,418.30'	**Special & User-Defined** Elev. (feet) 7,418.30 7,418.90 7,419.00 7,419.50 7,420.00 Disch. (cfs) 0.000 105.900 139.900 351.300 613.100

Primary OutFlow Max=1.78 cfs @ 3.16 hrs HW=7,418.46' TW=7,400.00' (Fixed TW Elev= 7,400.00')
↑—**1=Orifice/Grate** (Weir Controls 1.78 cfs @ 1.82 fps)

Secondary OutFlow Max=28.32 cfs @ 3.16 hrs HW=7,418.46' (Free Discharge)
↑—**2=Special & User-Defined** (Custom Controls 28.32 cfs)

Pond P2: Primary Sed. Pond





Subcat Reach Pond Link

Drainage Diagram for Overflow Pond Channels 10yr 6hr
Prepared by EarthFax Engineering, Inc., Printed 6/9/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-12.00 hrs, dt=0.05 hrs, 241 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DWN-3: Runoff Area=3.440 ac 0.00% Impervious Runoff Depth=0.16"
Flow Length=380' Slope=0.8160 '/' Tc=1.7 min CN=79 Runoff=2.11 cfs 0.047 af

Subcatchment DWN-5: Runoff Area=12.650 ac 0.00% Impervious Runoff Depth=0.16"
Flow Length=2,540' Slope=0.4290 '/' Tc=10.5 min CN=79 Runoff=3.35 cfs 0.173 af

Reach ARC: Overflow Pond Access Road Avg. Depth=0.44' Max Vel=4.36 fps Inflow=1.23 cfs 0.047 af
n=0.022 L=270.0' S=0.0407 '/' Capacity=8.61 cfs Outflow=1.12 cfs 0.047 af

Reach EC1: East Overfow Pond Diversion Avg. Depth=0.81' Max Vel=3.41 fps Inflow=3.35 cfs 0.173 af
n=0.022 L=275.0' S=0.0109 '/' Capacity=11.87 cfs Outflow=3.13 cfs 0.173 af

Reach EC2: East Overflow Pond Diversion Avg. Depth=0.44' Max Vel=10.85 fps Inflow=3.13 cfs 0.173 af
n=0.022 L=60.0' S=0.2500 '/' Capacity=21.32 cfs Outflow=3.13 cfs 0.173 af

Reach WC: West Overflow Pond Diversion Avg. Depth=0.61' Max Vel=2.65 fps Inflow=2.11 cfs 0.047 af
n=0.022 L=310.0' S=0.0097 '/' Capacity=5.55 cfs Outflow=1.23 cfs 0.047 af

Total Runoff Area = 16.090 ac Runoff Volume = 0.220 af Average Runoff Depth = 0.16"
100.00% Pervious = 16.090 ac 0.00% Impervious = 0.000 ac

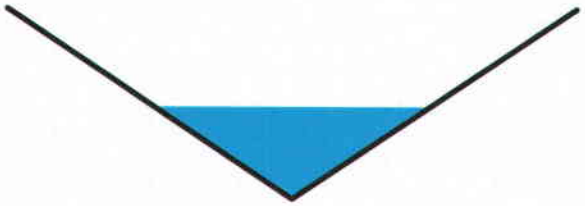
Summary for Reach ARC: Overflow Pond Access Road Channel

Inflow Area = 3.440 ac, 0.00% Impervious, Inflow Depth = 0.16"
Inflow = 1.23 cfs @ 3.08 hrs, Volume= 0.047 af
Outflow = 1.12 cfs @ 3.11 hrs, Volume= 0.047 af, Atten= 9%, Lag= 1.9 min

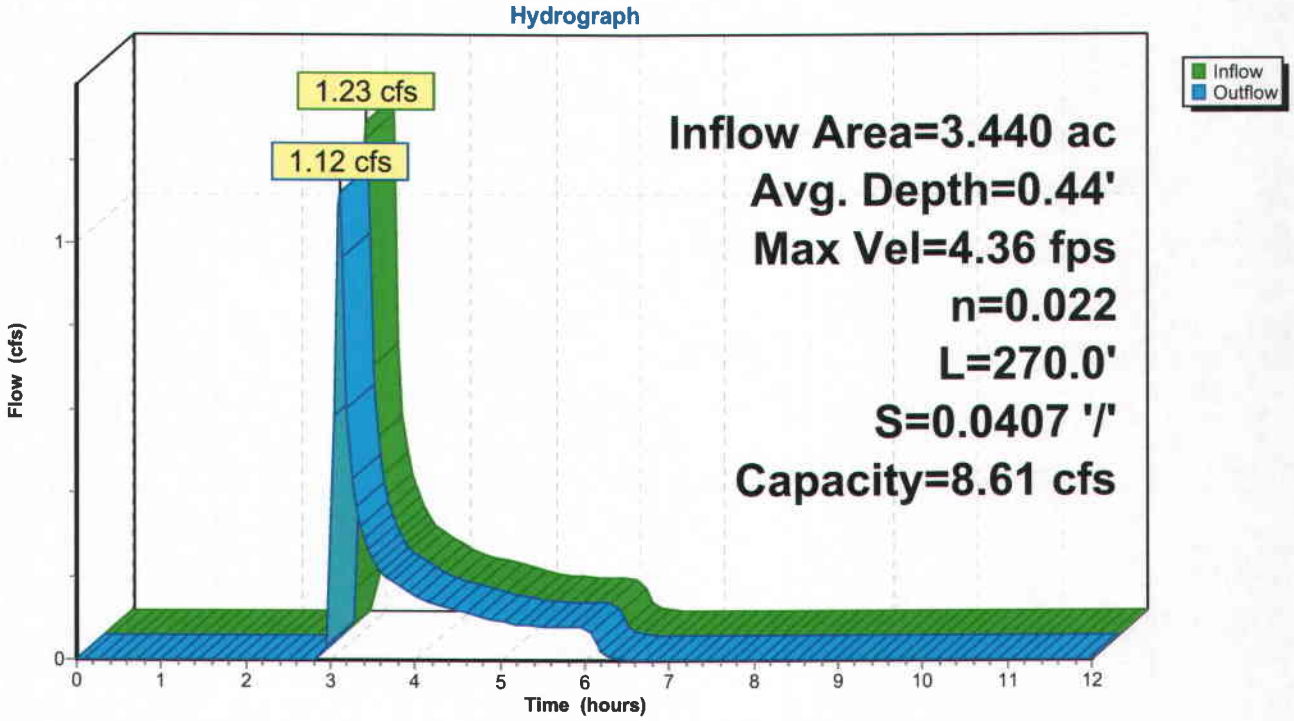
Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.36 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 2.3 min

Peak Storage= 77 cf @ 3.10 hrs, Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 8.61 cfs

0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 1.5 '/' Top Width= 2.70'
Length= 270.0' Slope= 0.0407 '/'
Inlet Invert= 7,253.00', Outlet Invert= 7,242.00'



Reach ARC: Overflow Pond Access Road Channel



Summary for Reach EC1: East Overfow Pond Diversion Channel Shallow Section

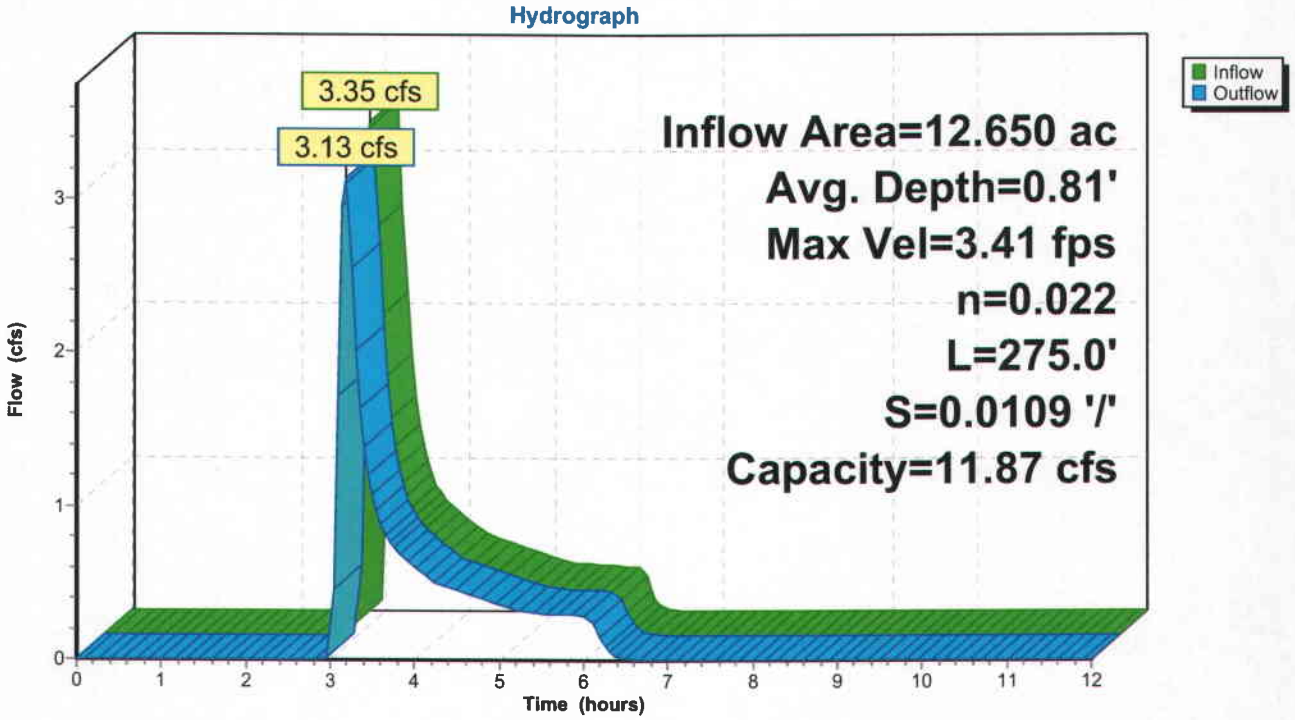
Inflow Area = 12.650 ac, 0.00% Impervious, Inflow Depth = 0.16"
Inflow = 3.35 cfs @ 3.14 hrs, Volume= 0.173 af
Outflow = 3.13 cfs @ 3.19 hrs, Volume= 0.173 af, Atten= 6%, Lag= 3.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.41 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 2.8 min

Peak Storage= 271 cf @ 3.16 hrs, Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 1.30', Capacity at Bank-Full= 11.87 cfs

0.00' x 1.30' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 1.5 '/' Top Width= 3.90'
Length= 275.0' Slope= 0.0109 '/'
Inlet Invert= 7,256.00', Outlet Invert= 7,253.00'

Reach EC1: East Overfow Pond Diversion Channel Shallow Section



Summary for Reach EC2: East Overflow Pond Diversion Channel Steep Section

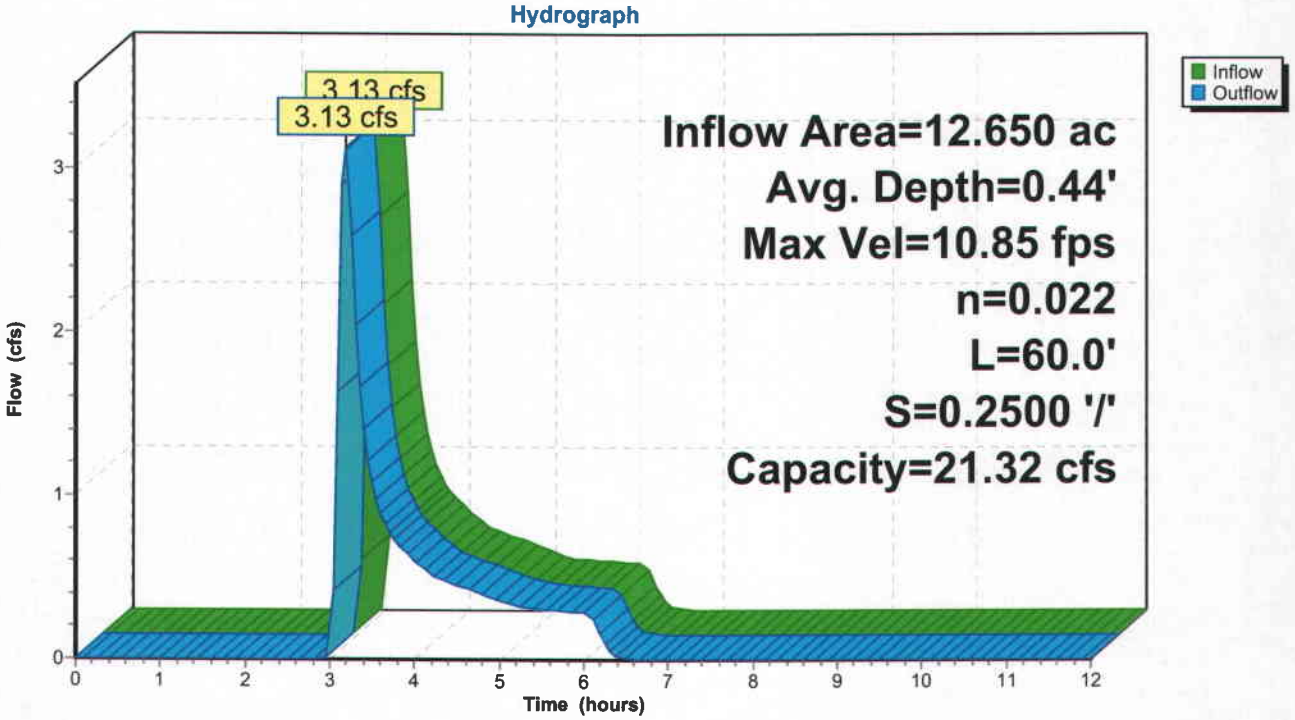
Inflow Area = 12.650 ac, 0.00% Impervious, Inflow Depth = 0.16"
Inflow = 3.13 cfs @ 3.19 hrs, Volume= 0.173 af
Outflow = 3.13 cfs @ 3.19 hrs, Volume= 0.173 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.85 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 5.85 fps, Avg. Travel Time= 0.2 min

Peak Storage= 17 cf @ 3.19 hrs, Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 21.32 cfs

0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 1.5 '/' Top Width= 2.70'
Length= 60.0' Slope= 0.2500 '/'
Inlet Invert= 7,253.00', Outlet Invert= 7,238.00'

Reach EC2: East Overflow Pond Diversion Channel Steep Section



Summary for Reach WC: West Overflow Pond Diversion Channel

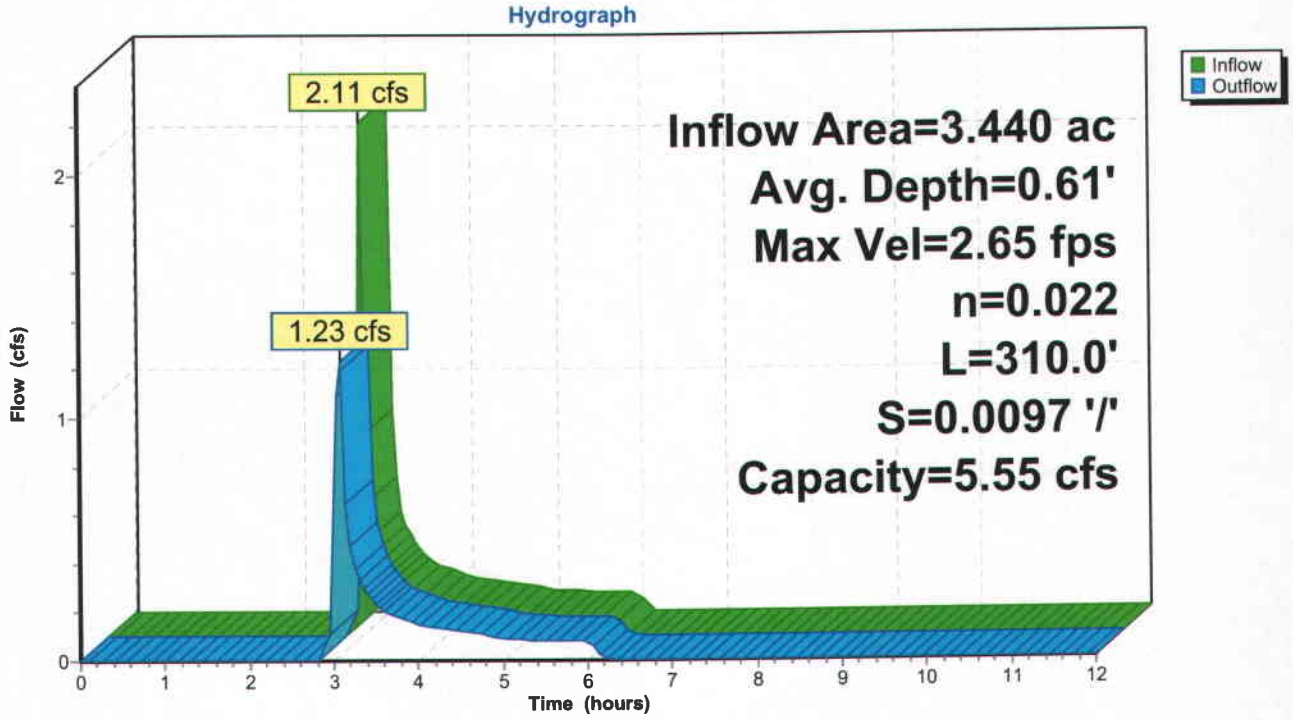
Inflow Area = 3.440 ac, 0.00% Impervious, Inflow Depth = 0.16"
Inflow = 2.11 cfs @ 3.01 hrs, Volume= 0.047 af
Outflow = 1.23 cfs @ 3.08 hrs, Volume= 0.047 af, Atten= 42%, Lag= 4.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.65 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.13 fps, Avg. Travel Time= 4.6 min

Peak Storage= 171 cf @ 3.05 hrs, Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.55 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 1.5 '/' Top Width= 3.00'
Length= 310.0' Slope= 0.0097 '/'
Inlet Invert= 7,256.00', Outlet Invert= 7,253.00'

Reach WC: West Overflow Pond Diversion Channel



APPENDIX 7-23 REFERENCES

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Slope Stability for SUFCO Sedimentation Pond

Approach:

The slope stability for the sedimentation pond was analyzed using Slide 5.0 by RocScience. This software uses an iterative procedure to evaluate factors of safety against failure for various failure surfaces that may occur throughout the slope. The failure surface is discretized into small slices and the driving and resisting forces/moments are calculated for each and summed over the entire failure surface to obtain a factor of safety. In this instance the factor of safety is defined as follows:

$$FS = \frac{\sum \text{Re}sistingForces}{\sum DrivingForces}$$

A typical minimum acceptable factor of safety for an embankment of this type is 1.5.

This embankment's stability was analyzed for both the inside and outside slopes. The inside slope was analyzed without water in the sedimentation pond. This is the more critical state since the water helps to retain the inside slope. The outside slope was analyzed with the sedimentation pond at its maximum level and seepage occurring throughout the slope. This is the most critical state for the outside slope since the water acts as a driving force against the outside slope as well as reduces the soil's effective strength by creating pore pressure within the embankment.

Model Parameters:

The sedimentation pond embankment was analyzed within Slide using Bishop's Simplified Method. This method is the most common used in practice since it has been found to compare well with actual failure surfaces that occur in the field (Dunn et al, 1980).

The input parameters for this model are as follows:

Fill unit weight: 135 lb/ft^3 – Typical unit weight compacted mixed grain fills (Dunn et al, 1980).

Fill cohesion: 0 – Assumed to be cohesionless due to the large percentage of rocks and sand within the soil. Conservative measure since cohesion helps resist sliding.

Internal angle of friction (Φ) of fill: 40° - Typical expected value for well graded, compacted sandy gravels. Conservative when compared to the friction angle of the soil observed at the borrow site which has an angle of repose of roughly 45° (Dunn et al, 1980).

Minimum depth of sliding surface: 5 ft – The minimum depth for a sliding surface was limited to five feet. This allows the software to only evaluate failure surfaces with significant mass movement of fill material.

Embankment permeability: 3.5 x 10^{-6} ft/s – A typical value for sand, silt and clay mixtures (Terzaghi and Peck, 1968).

Results:

Nearly 5,000 various failure surfaces were evaluated within the boundaries of the embankment fill. The critical failure surface and corresponding factor of safety are displayed as follows for both the inside and outside slopes. The grid shown above the soil profile represents the origins of various failure surfaces with varying radii.

Figure 1 shows the critical failure surface for the inside slope. As previously mentioned, this scenario was modeled with the sedimentation pond dry. The resulting factor of safety against failure is 1.98.

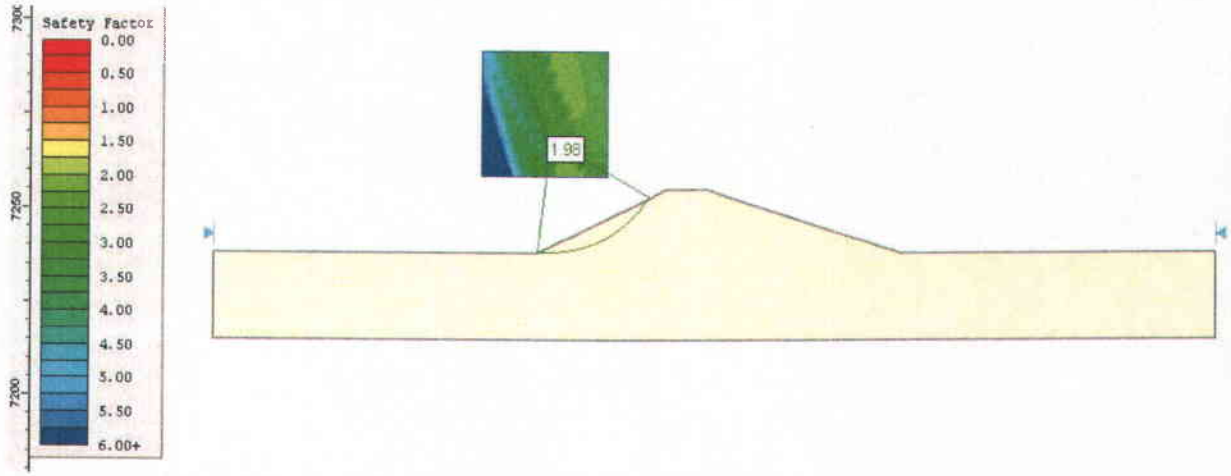

Figure 1: Critical failure surface for inside slope, FS = 1.98

Figure 2 shows the critical failure surface for the outside slope. This scenario was modeled with the pond water at its maximum possible level. The pink line represents the location of the water surface throughout the embankment and the shading within the embankment represents the pressure head as a result of the water. The resulting factor of safety against failure is 1.76.

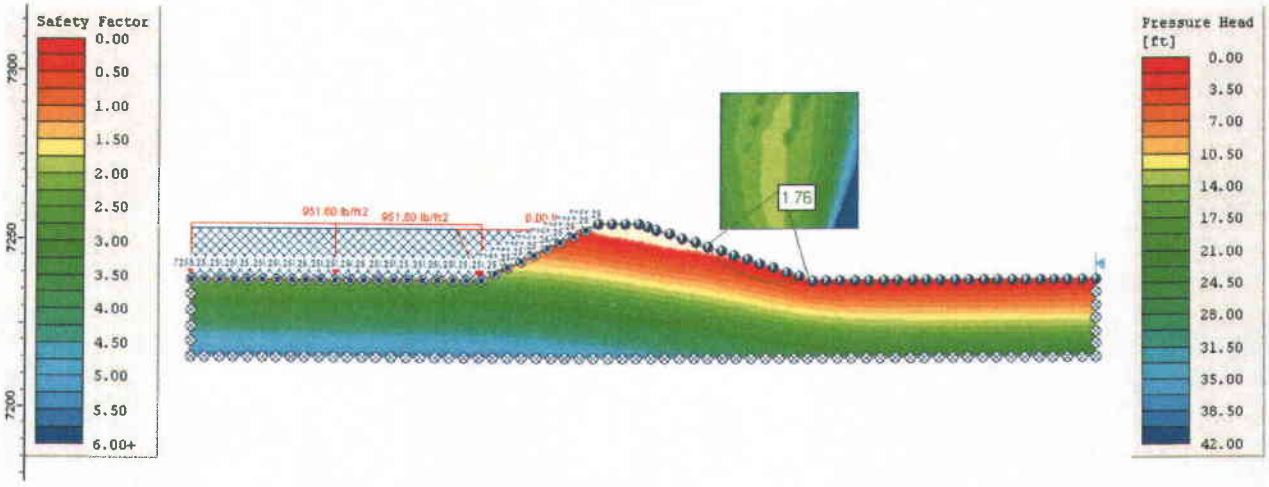

Figure 2: Critical failure surface for outside slope, FS = 1.76

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CANYON FUEL COMPANY
SUFCO MINE

MATERIALS LIST

OVERFLOW POND INSTALLATION
JUNE 2009

Item	Quantity	Unit
Earth Moving		
Cut (including removed material from trenching, excluding 6" topsoil)	3000	Cubic Yards
Fill	2800	Cubic Yards
Topsoil	925	Cubic Yards
6" pipe trenching	230	Linear Feet
12"-18" pipe trenching	1,300	Linear Feet
66" pipe trenching	340	Linear Feet
Piping		
66 inch diameter Contech Ultra-Flow (or equal)	16	20 Foot Sections
30 inch diameter corrugated metal	1.5	Linear Feet
24 inch diameter corrugated metal	1	20 Foot Sections
18 inch diameter corrugated metal	70	20 Foot Sections
12 inch diameter corrugated metal	9	20 Foot Sections
6 inch diameter coil perforated ADS w/sock (0624HA) (or equal)	20	Linear Feet
6 inch diameter coil solid ADS (or equal)	1	250 Foot Coils
Elbows		
18 inch diameter corrugated metal 45° bend (5 foot center elbow to end)	5	
18 inch diameter corrugated metal 22.5° bend (5 foot center elbow to end)	9	
18 inch diameter corrugated metal 11.25° bend (5 foot center elbow to end)	3	
12 inch diameter corrugated metal 22.5° bend (5 foot center elbow to end)	1	
66 inch diameter Contech Ultra-Flow (or equal) 22.5° bend	3	
Custum Joints		
Reducing Tee (18 inch diameter CMP to 24 inch diameter CMP)	1	
Wye (18 inch diameter CMP 22.5°)	1	
Wye(18 inch diameter CMP 45°)	1	
Reducer (18 inch diameter CMP to 12 inch diameter CMP)	1	
Couplers		
66 inch diameter Contech 5-C Band w/flat sleeve gasket (or equal)	20	
18 inch diameter Contech 5-C Band w/O-ring gasket (or equal)	102	
12 inch diameter Contech 5-C Band w/O-ring gasket (or equal)	9	
6 inch diameter ADS split coupler s/w (0611AA) (or equal)	1	
Valves and Gates		
6 inch gate valve	1	
18 inch Waterman C-10 Canal Gate (or equal)	4	
Concrete		
Gate Box #1	3.5	Cubic Yards
Gate Box #2	3.5	Cubic Yards
Overflow Pond Bypass Inlet Culvert	10	Cubic Yards
Overflow Pond Bypass Outlet Culvert	6.6	Cubic Yards
Trancom 2.0' H Flume Footing	1	Cubic Yards
Overflow Pond Primary Spillway Footing	1.6	Cubic Yards
Trash rack footings	0.3	Cubic Yards
Overflow pond primary spillway gate valve extinsion handle footing	0.2	Cubic Yards

Item	Quantity	Unit
Riprap		
2 inch Angular Stone	1.5	Cubic Yards
3 inch Angular Stone	10	Cubic Yards
9 inch Angular Stone	8	Cubic Yards
12 inch Angular Stone	90	Cubic Yards
Steel		
2 inch diameter schedule 80 pipe	85	Linear Feet
5 inch x 1/2 inch flat bar	18	Linear Feet
Miscellaneous		
Gilsulate 500 XR (6"over seep collection system and pipes within pond)	90	Cubic Yards
18 inch diameter anti-seep collars	2	
Trancom 2.0' H Flume	1	
40 mil. PVC Geomembrane	200	Square Yard
U.S. Fabric nonwoven US 205NW (or equal)	30	Square Yard
Silt fencing	26	Linear Feet
Pea Gravel	15	Cubic Yards
Swellstop Waterstop	80	Linear Feet