GENWAL MINE

015/032

CRANDALL CANYON #1 MINE
and the
SOUTH CRANDALL MINE

CHANGE TO THE DRAINAGE CONTROL PLAN
FOR THE

MINE DISCHARGE WATER AERATION TREATMENT FACILITY

SUBMITTED: APRIL 3, 2009

0012

C015/0032 Incoming
OK
3261

COPY

GENWAL™ RESOURCES, INC.

P.O. Box 1077, Price, Utah 84501 794 North "C" Canyon Rd, East Carbon, Utah 84520
Telephone (435) 888-4000 Fax (435) 888-4002

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

April 6, 2009

Re: Crandall Canyon Mines, C/015/032
Change to Drainage Control Plan, Water Aeration Treatment Area

Dear Mr. Haddock:

Enclosed are six copies of changes to Mining & Reclamation Plan for the Crandall Canyon Mines. These changes reflect the proposal to utilize the old loadout area as a treatment area for the mine discharge water. This is needed in order to treat the iron through aeration to comply with the UPDES discharge permit. As you are aware, we are now in a violation situation with DWQ due to the high iron. This aeration treatment system is being proposed to abate the violation.

This treatment area will also treat the mine-induced seepage from the ledge below the portals, which is now reporting to the sediment pond. Based upon on-site discussions with Division personnel it was determined that we should implement the treatment of the mine water and seepage water on an operational basis, and then, after seeing how well this works, address the final reclamation plan as required by Division Order DO08A (Task 3092). As you will recall we submitted a response to the Division Order, but the submittal was rejected, primarily on the grounds that additional operational data from the seepage area, and the water treatment requirements, would need to be factored into a final reclamation plan regarding how to handle the long-term mine discharge water. We will submit a revised reclamation plan to address this situation in the near future, as per our recent discussion.

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File in:
C/015/032 2009 Incoming
Refer to:
☐ Confidential
☐ Shelf
☒ Expandable - 2
Date 04/6/09 For additional information

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We also to plan to extend the existing French drain near the old portals to collect some of the mine seepage water which is currently reporting to the sed pond.

Because we need to abate the DWQ violation as soon as possible I would like to request an expedited review of this change.

If you have any questions or comments regarding this submittal please contact me at 435 888-4017.

Sincerely,

David Shaver
Resident Agent

Form DOGM - C1 (Last Revised March 17, 2009)

File Folder # 3

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APPLICATION FOR PERMIT PROCESSING

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

Permit Number: 015/032

Mine: Crandall Canyon Mines

Permittee: **GENWAL Resources, Inc.**

ıe of Proposal

Change to Drainage Control Plan, Water Aeration Treatment Area

Description, include reason for application and timing required to implement:.

Instructions: *If you answer yes to any of the first 8 questions (gray), submit the application to the Salt Lake Office. Otherwise, you may submit it to your reclamation specialist.*

☐ Yes	☒ No	1. Change in the size of the Permit Area? _____ acres Disturbed Area? _____ acres ☐ increase ☐ decrease.
☐ Yes	☒ No	2. Is the application submitted as a result of a Division Order?
☐ Yes	☒ No	3. Does application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes	☒ No	4. Does application include operations in hydrologic basins other than as currently approved?
☐ Yes	☒ No	5. Does 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?
☒ Yes	☐ No	10. Is the application submitted as a result of other laws or regulations or policies? Explain: DWQ violation
☐ 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?
☐ 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 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 calculations?
☐ Yes	☒ No	20. Does the application require or include subsidence control or monitoring?
☐ Yes	☒ No	21. Have reclamation costs for bonding been provided for?
☒ Yes	☐ No	22. Does application involve a perennial stream, a stream buffer zone or discharges to a stream? UPDES
☒ Yes	☐ No	23. Does the application affect permits issued by other agencies or permits issued to other entities? DWQ

☐ **Attach _3_ complete copies of the application.**

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. (R645-301-123)

Signed - Name - Position - Date

agent 3/17/09

Received by Oil, Gas & Mining

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APR 06 2009

DIV. OF OIL, GAS & MINING

ASSIGNED TRACKING NUMBER

Subscribed and sworn to before me this 17th day of March 2009

Notary Public

My Commission Expires: 04.06.09

Attest: STATE OF Utah

COUNTY OF Carbon

Notary Public
LINDA KERNS
345 N. 700 E.
Price, UT 84501
My Commission Expires
April 6, 2009
State of Utah

Application for Permit Processing
Detailed Schedule of Changes to the MRP

COPY

Title of Application: Change to Drainage Control Plan, Water Aeration Treatment Area	Permit Number: 015/032
	Mine: CRANDALL CANYON MINESA
	Permittee: GENWAL RESOURCES

Provide a detailed listing of all changes to the mining and reclamation plan which will be required as a result of this proposed permit application. Individually list all maps and drawings which are to be added, replaced, or removed from the plan. Include changes of the table of contents, section of the plan, pages, or other information as needed to specifically locate, identify and revise the existing mining and reclamation plan. Include page, section and drawing numbers as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIALS TO BE CHANGED
☐ ADD	☒ REPLACE	☐ REMOVE	Chapter 5: pgs 5-32 thru 5-51
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☒ REPLACE	☐ REMOVE	Chapter 7: pg 7-viii
☐ ADD	☐ REPLACE	☐ REMOVE	pgs 7-46 thru 7-56
☐ ADD	☐ REPLACE	☐ REMOVE	
☒ ADD	☐ REPLACE	☐ REMOVE	Chapter 7: Figure 7-13 (a, b, c)
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☒ REPLACE	☐ REMOVE	Chapter 7: Appendix 7-4 (text)
☒ ADD	☐ REPLACE	☐ REMOVE	" " (computer worksh
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☒ REPLACE	☐ REMOVE	Plate 5-3
☐ ADD	☒ REPLACE	☐ REMOVE	Plate 7-5
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Any other specific or special instructions required for insertion of this proposal into the Mining and Reclamation Plan?

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5.26.13 Surface Equipment

Underground supply equipment will be used on the surface as needed. The following is a list of equipment used exclusively on the surface:

Fork Lift	Snow Plow	Front End Loader
Pick-up Trucks	Diesel Tractors	Bobcat tractor
Dozer		

5.26.14 Culinary Water System

The culinary water used at the mine is purchased from a vendor who is supplied from a state approved water system, or taken from the deep well (MW-1) located at the mine portals. This deep well has been installed in accordance with state health regulations for culinary use. The culinary water is placed in containers designed for this purpose. Drinking water at the mine is provided as bottled water.

The water used underground is placed in the mine sumps located underground. The location of the sumps will change as mining progresses across the reserve and will not remain in any one area permanently.

5.26.15 Sewage System

The bathhouse, located underground, and a new proposed bathhouse for the culvert expansion project is designed and constructed in accordance with the State Health Department's rules and regulations. The sewage will be contained in a concrete holding tank and pumped by a licensed contractor and disposed of at a State approved sewage treatment plant. The sanitary facilities underground will comply with all MSHA regulations. The sewage facility can be found in Appendix 5-12.

5.26.16 Sedimentation Control Structures and Water Treatment Facilities

The existing sedimentation pond was reconstructed during the 1986 and 1989 construction seasons and enlarged during the culvert expansion project in accordance with R645-301-526.300, as detailed in the Runoff and Sediment Control Plan located in Chapter 7.

Underground sumps will be built in order to effectively treat underground water before discharging into Crandall Creek, refer to Plate 5-4 for the sump locations. All discharge into the creek will meet effluent limitations of the UPDES permit and monitored in accordance with that permit, (Appendix 5-14). ~~The sediment pond and the underground sumps are the only water treatment facilities proposed at the mine site.~~

As a result of the Crandall Canyon Mine disaster of August 6, 2007, the mine has been de-activated and the portals have been sealed. Mine water inflow has built up to the extent that water is now discharging from the portals and is discharged through a 12" pipe into Crandall Creek under UPDES permit UT0024368. The mine is presently discharging approximately 400-500 gallons per minute, with the flow fluctuating with barametric pressure and seasons. In early 2009 the iron concentrations in the water began to exceed UPDES limits. Because there is no way to treat the water underground the company is proposing to treat the water with an aeration system located on the surface in the "old loadout" area, immediately below the portal bench. The existing water discharge pipeline would be re-routed so that the mine water would discharge at the upper end of the area. The water would then run across a series of low riffles to spread the flow out over as much area as possible and provide maximum contact with oxygen in the air. The treated water would then be collected at the lower end of the area, routed through a culvert under the road, and would then be discharged into Crandall Creek at the currently approved UPDES outfall monitoring point.

It should be noted that the "old loadout area" is located primarily within a large notch that was blasted out of the solid Star Point Sandstone when the facility was originally constructed in the early 1980's. The area will first be cleaned of all coal materials to reveal the under-lying granular borrow base. The area will then be leveled in a north-south direction (transverse to the water flow) and smooth-graded in the west-east direction (along the direction of flow). The area will then be surfaced with a water-proof treatment (i.e., concrete, asphalt, impervious liner, etc.) to make certain that the water flow across the treatment pad does not saturate the underlying fill material. Because the floor of the treatment pad will be at a lower elevation than the adjacent roadway, the aeration waterflow will be contained at all times within a lined treatment basin. This will ensure that the adjacent fill under the roadway stays dry and retains its full stability.

The existing mine-water discharge pipeline, which comes down the bank from the portals, will be equipped with a tee and valve assembly. From this tee a new distribution line will be installed to carry the discharge water to the upper (western) end of the treatment area. This distribution pipeline will be suspended either from off the existing concrete wall (left over from the old loadout facility) or suspended from rock anchors affixed to the solid ledgerock. The distribution line will be valved at the tee so that water can be turned into the treatment area, or can be directed back into the existing discharge line. This ability to bypass the treatment facility will be advantageous at time when the facility needs to be taken off-line for construction, maintenance or adjustments.

A suitably constructed barricade would be constructed around the treatment facility along the outer edge of the treatment basin (between the treatment basin and the road) which will prevent any disturbed area drainage from entering the treatment facility area, and similarly will prevent any of the mine discharge water from spreading over the adjacent disturbed area and reporting to the sediment pond. See Plate 5-3 for the location of the facility. This treatment area is also designated as ASCA 12 in the Sedimentation and Drainage Control Plan found in Appendix 7-4 and Plate 7-5. See Figure 7-14 for a schematic representation of the aeration facility, as well and the mine-water discharge piping and French drain collection system at the portals.

The discharge water will flow down-gradient over the treatment basin from the upper (western) end down to the lower (eastern) end. Along the way it will pass over and around a series of low-lying baffle structures placed at right angles to the flow pattern. As currently envisioned, these structures could be precast concrete parking curbs (wheel stops) measuring approximately 4" high x 6" wide x 8' long. The purpose of these curb structures is to slow down the flow velocity and spread it out over as much surface area as possible. This will maximize the amount of exposure of the water to the air to enhance the aeration precipitation of the iron. The curbs can be individually adjusted to maximize the spread the waterflow

Between the curbs will be a 2"-3" layer of sorted gravel which will help trap the iron precipitate particles to prevent them from continuing on downstream to the UPDES outfall. The gravel material will also provide a better surface area for the iron sulfides to adhere. This gravel may consist of a crushed limestone to help chemically in the iron removal process. It will also be possible to add a chemical flocculant and/or coagulant to the water at the upstream end to aid in the iron removal process. This gravel/crushed rock layer will be removed and replaced as necessary as it becomes overloaded with iron precipitates.

At the lower end of the treatment basin, the water will be collected into a buried pipeline. This pipeline will cross underneath the road and will connect into the existing discharge line. In this manner the treated water end up reporting to the Crandall Canyon drainage (by way of the main bypass culvert) at the existing approved UPDES outfall point.

There is every reason to believe that water will permanently discharge from the Crandall Mine portals. The iron level of the mine water historically was very low, and began rising only after the water began to build up and impound within the mine workings following the mine collapse of 2007. There is a possibility that the iron is the result of dissolved pyrites in the coal, and that after the pyrites have been leached out, the iron level will drop back down to its pre-existing compliance levels. Until then, the treatment will have to continue, but if the situation stabilizes the aeration treatment can later be discontinued. Therefore, it is not known at this time if the iron treatment facility will be a temporary structure or if it will be needed on a long-term (i.e., permanent) basis. This question will be addressed in more detail in the Reclamation Plan, Appendix 5-22.

The area of the treatment pad is about 13,400 sq. ft. Assuming an average thickness of the pavement (concrete or asphalt) of 4", this would require require approximately 165 yds. of material to be disposed of during final reclamation. Using the currently approved Division calculations for bonding costs, the increased reclamation cost due to the treatment pad would be as follows;

a) pavement removal	$4.11/SY x 1499 SY =	$6120
b) loading cost	$1.43/CY x 165 CY =	236
c) transportation cost	$3.49/CY x 165 CY =	576
d) disposal cost	$7.75/CY x 165 CY =	1279
Subtotal demolition		$8211
Indirect costs (x 26.8%)		$2200
Total cost		$10,411
Escalated cost (5 yrs @ 1.6%/yr)		$11,272

The current posted reclamation bond is $2,061,000. Therefore, the additional bonding cost of $11,272 represents less than 1% of the present bond.

5.26.21 Utility Installation and Protection

All coal mining and reclamation operations will be conducted in a manner which minimizes damage, destruction, or disruption of services provided by oil, gas, and water wells; oil, gas, and coal slurry pipelines, railroads; public utilities; etc. which pass over, under, or through the permit area, unless otherwise approved by the owner of those facilities and the Division.

5.26.22 Operation of Support Facilities

Support facilities will be operated in accordance with a permit issued for the mine to which it is incident or from which its operation results.

5.26.3 Water Pollution Control

See "Waste Disposal Plans" under the Mining Operation section of this chapter.

5.26.4 Air Pollution Control

Coal mining and reclamation activities will be conducted in accordance with R645-301-420 and the Air Quality Approval Order issued by the Utah Division of Air Quality (Appendix 4-7).

5.27 Transportation Facilities

The coal from the mine will be transported to the rail loadout or final destination by truck. The trucks are typical 45 ton tandem trailer coal haulers used in the Utah coal fields. GENWAL uses a loading site on the Utah Railway located at Mohrland, Utah, a loading facility on the Southern Pacific Railway in Wellington, Utah, and other independently owned loadouts within the Carbon/Emery county area.

The Forest Development Road from Huntington Creek to the truck turn around area was constructed under the definition of a class one road and will be maintained as a primary road, in compliance with the road use permit issued by the U. S. Forest Service, Manti-La Sal National Forest. The forest access road will remain as part of the post mining land use in accordance with the Forest Service Permit (Appendix 1-2). The Forest Service Access Road, upgraded under the definition of a class two road, is maintained as a primary road. The road connects the main pad area, the truck turn around area, and the Forest Service Parking/Turnaround to the Huntington Canyon Road (State Route 31). The road is designed, maintained and will be restored in accordance with the Forest Service road use permit.

The road from the lower pad area to the upper pad area was built under the definition of a class two road and is maintained as a primary road. It is designed (as shown on Plate 5-10),

maintained and restored in accordance with R645-301-527.120. The Ancillary road to the portal area was built under the definition of a class three road and was designed (as Shown on Plate 5-10), is maintained and restored in accordance with R645-527.130.

The Forest Service Development road has been designed and was approved by the USFS prior to construction. The design drawings are on file with the Manti-La Sal National Forest in Price, Utah. During the 1991 construction season GENWAL Resources Inc. improved and asphalted the Forest Service Development road and surface facilities area of the Crandall Canyon Mine (as shown on Plate 5-3). The improvement information covering the haul road and facilities area is addressed in Appendices 5-15, 5-16, and 5-17.

The Forest Service road (primary road) is utilized by coal haul trucks, mining equipment (on a limited basis), support vehicles, employees, and recreational users (public). The two roads located on the permit area, the portal pad road and the access road to the main pad, are utilized by both surface and underground mining equipment, support vehicles, and employee vehicles. The ancillary road to the portal area is utilized by service vehicles on a very limited basis. The ancillary road to the upper unused area has been reseeded.

The forest parking area past the mine site was preserved for recreational/forest service parking and with verbal approval for the short term storage or mine equipment being onloaded/offloaded or moved as a part of upgrading or retrofitting.

Because of the limited space available at the existing site, snow removal and storage is now a problem. Currently, under agreement with the Forest Service, limited snow storage is allowed in the Forest Service trailhead parking area. This practice is less than ideal however. Snow storage in this area limits the amount of available public parking. Snow melt and runoff from the snowpiles often makes the parking area muddy in the springtime and makes sediment control into nearby Crandall Creek more challenging. The expanded operations area should relieve congestion at the site and free up both the parking area and the Forest Service road and make snow storage in the parking area unnecessary. Snow storage will become available in the area of the existing loadout facilities once these facilities have been removed and the area cleaned up properly as part of the overall site expansion project. Snowmelt from this new storage area will be able to report directly to the sediment pond located nearby. There will be absolutely no snow storage in the sediment pond itself.

After construction of the surface expansion is completed, the Forest Development Road 50248 will be returned to double lane width through the permit area to the Forest Service trailhead parking area. This will be accomplished by the following:

a) The existing loadout facilities will be removed and cleaned up and the road will be widened, realigned, and repaved through this area.

b) The existing truckscales and exit ramp will be removed from the middle of the road and the roadway will be re-established and repaved in this area.

c) The existing oil storage shed will be rehabilitated and the roadway will be regraded and repaved in this area. This storage facility has been designed and constructed to adequately

contain the volume of the largest storage tank plus the additional volume of any direct precipitation which may accumulated within the containment area.

d) The existing roadway from the loadout up to the truck turnaround area will be widened by approximately 15 feet. This will result in an additional (third) lane which can be used by the trucks as a stacking lane as they wait to enter the loadout to be loaded. This will free up the existing road for unobstructed two-way, two lane traffic to facilitate public use of the road for Forest related activities.

e) The turn-around area will also be widened to allow the trucks to turn in a standard counter-clockwise direction and thereby eliminate the present practice of clockwise cross traffic turnarounds.

f) Construction of the high speed, high efficiency truck loadout will in and of itself help minimize the congested conditions which now exist within the mine site. Presently trucks are often forced to stop along the Forest Service road while waiting to be loaded. The expanded coal storage capabilities and the new high-speed truck loading facilities will allow the trucks to be loaded in a continuous, uninterrupted basis, thereby eliminating the major cause of tie-ups and congestion.

g) After the Forest Service road has been re-established, (i.e. realigned and repaved) the roadway will be striped to properly delineate the travelway through the mine site areas to the Forest Service Trailhead. The travel lanes will be clearly marked to help separate public traffic on the road from truck traffic associated with the coal operations. Signs will also be installed to direct the public to the trailhead and to instruct the public as to which areas within the minesite should be avoided in order to prevent conflicts with the ongoing operations. These direction signs will be readily visible to the motoring public and will conform to the Manual of Uniform Traffic Control Devices .

The plan view for roads may be found on Plate 5-3. The typical cross section for each road and their corresponding profile may be found on Plate 5-10.

The coal trucks exit to the east of the loadout facility and onto the USFS road (see Plate 5-3). Roads in the permit area are inspected in order to determine the maintenance required to minimize and correct erosion problems before they become extensive. Maintenance will be performed as required to control erosion. This maintenance will include maintaining the ditches, resurfacing when needed and maintaining proper drainage.

See Plates 5-3, 5-10, 5-19, and Appendix 1-2 for more sections and details of the roads within the permitted boundaries. If a road is damaged by a catastrophic event, such as a flood or earthquake, it will be repaired as soon as practical after the damage has occurred.

5.28 Handling and Disposal of Coal, Overburden, Excess Spoil and Coal Mine Waste

5.28.10 Coal Removal, Handling, and Storage

See Section 5.26 of this chapter. See Section 5.4 for removal and reclamation.

5.28.20 Overburden

See Section 5.28.30 for removal and reclamation.

5.28.30 Spoil, Mine Development Waste, and Noncoal Waste Removal, and Overburden

The Crandall Canyon Mine produces a run of mine product for final sale, this product does not contain any mine related rock or development waste. The method of mining used at the Crandall Canyon mine produces no development waste, however small amounts of rock waste are generated in unexpected roof falls and overcasts. This rock waste is not brought to the surface, but is disposed of on pillar lines or stored in areas that have been mined or where no second mining is to be done. The material disposed of on the pillar lines will be of the same nature that naturally caves in the pillaring process, therefore no leachate will be formed other than that associated with normal pillaring.

In no event will the disposal of this material interfere with future recovery of the coal resource without consent of the BLM or the managing agency of the coal resource. In the unlikely event either rock, development, and/or processing waste is encountered, and the volume exceeds the capacity that can be disposed of along pillar lines; GENWAL commits to disposing of the waste in a DOGM approved disposal facility. GENWAL will notify and consult with DOGM regarding disposal sites; all waste disposal will be done in accordance with MSHA regulations.

The waste generated by the normal underground mining activities will be brought outside the mine for disposal. No oil or grease will be intentionally disposed of underground. All solid waste brought to the surface will be disposed of in a trash container until the container becomes full, at which time the container will be transported to a State approved landfill for final disposal.

At the present time the landfills to be used will be the state approved Nielson landfill or American Kinfold landfill (M&P Enterprises, which are located next to the county landfill, approximately 1.5 miles north of Orangeville, Utah, and if another State approved landfill becomes available and is more cost effective, then this landfill will be utilized. The operator will notify the Division prior to any waste disposal in any landfill other than those mentioned. The location of the new landfill and a statement from the DOH indicating the landfill permit number, the permit term and any conditions that the DOH has concerning the disposal of noncoal waste will be submitted to the Division. In no event will liquids be disposed of in landfills that are not permitted to handle such

material. Scrap metal and used equipment will be removed from the mine unless safety considerations prevent removal.

Oil contaminated soil from the gas and oil storage area will be disposed of prior to reclamation or moving of the facility. If oil or gas spills occur outside the containment area, the spill will be contained, cleaned up and disposed of in a permitted facility. The contaminated material will be disposed of at a facility licensed to accept oil/gas contaminated soil or remediated onsite with appropriate approvals from the pertinent regulatory agencies.

Processing Waste

No processing waste is generated at the Crandall Canyon Mine. Only coal is removed from the mine, all of which is trucked off site and sold. Exploratory drill hole data and mining conditions indicate that no development or processing waste will be produced. However, in the unlikely event either rock, development and/or processing waste is encountered, and the volume of waste generated exceeds the capacity that can be disposed of along pillar lines, GENWAL commits to disposing of the waste in a DOGM approved disposal facility. GENWAL will notify and consult with DOGM regarding disposal sites. All disposal operations will be in compliance with Utah Coal Mining regulations R645-301-536 and R645-301-746.

Hazardous Wastes

In the unlikely event that hazardous or toxic material is encountered, GENWAL will notify the Division as well as the State Health Department; the hazardous or toxic material(s) will be disposed of at a facility permitted to accept the specific contaminants found.

Sediment Pond Waste

Sediment removed from the pond during the cleaning process will be hauled to an approved waste disposal facility. Prior to cleaning the sediment pond, representative sediment samples will be collected and analyzed for any acid- and/or toxic forming materials (as listed on page 5-39A). If the analytical results exceed the toxic limit, the waste material will be handled and disposed of in compliance with regulations applicable to acid- and/or toxic forming materials. GENWAL will notify DOGM if the analytical results of the samples show that acid or toxic forming materials are present.

Sanitary Waste

There are less than 10 regularly assigned employees on the surface per shift. These surface employees use the bathhouse for their sanitary waste needs. Waste from the underground bathhouse toilets and showers is pumped to a holding tank located underground. When required the holding tank is pumped and the materials are disposed of by a licensed contractor at a State Health approved disposal site (See Appendix 5-12). GENWAL will keep records of the sewage pumped from the tank by the contractor. The sanitary waste needs for the miners underground will be handled in accordance with MSHA regulations.

5.29 Management of Mine Openings

Five portals have been placed on the Star Point Sandstone in the Hiawatha coal seam. Four of the five portals are used while one of the portals is sealed. Three portals are used for intake ventilation, beltline, and return ventilation. The fourth portal opening is used for access to the underground bathhouse. Two identical fans located at the return portal will operate in parallel. One fan will discharge horizontally and the second vertically.

These portals existed during previous mining attempts and will be utilized during current mining operations. The highwall above the portals has been secured and canopies have been installed to maintain the portals at MSHA standards. During operation of the Crandall Canyon Mine, access to all mine openings are controlled by the operator during working and nonworking hours. Due to public access through the mine site, a security person is located at the mine during times of no work or when surface personnel are not present. Permanent sealing of underground openings is discussed in Section 5.42.71 of this chapter.

5.30 Operational Design and Plans

5.32 Sediment Control

The design of the sediment control structures is presented in Chapter 7, Section 7.42 of this document. The designs are intended to minimize the disturbance to the hydrologic balance by disturbuting the smallest practical area at any one time during the mining operation through progressive backfilling, grading, and prompt revegetation as required in R645-310-353.200, and to stabilizing the backfilled material to promote a reduction of the rate and volume of runoff in accordance with the regulations.

5.33 Impoundments

The only impoundment on the Crandall Canyon Mine site is the sedimentation pond. The design of the sediment control structures is presented in Chapter 7, Section 7.42 of this document. The sedimentation pond meets criteria of R645-301-533 as shown in Appendix 7-10, page 7.

EarthFax Engineering, Inc. previously conducted the sediment pond design and stability analysis (Chapter 7, Section 7.42 and Appendix 7-6) which determined that the old sediment pond was stable under static and seismic conditions. The redesigned pond, constructed in conjunction with the surface facility expansion, does meet the minimum regulatory requirement of 1v:5h combined upstream and downstream side slopes. Refer to Appendix 7-4 for additional detail on the sediment pond.

5.34 Roads

The primary roads associated with the Crandall Canyon Mine have been located on the most stable available surfaces. They have been surfaced with materials (gravel, road base, asphalt, etc.) approved by the Division as being sufficiently durable for the anticipated volume of traffic and weight and speed of vehicles using the road. All roads falling under DOGM regulations are built on cut material and, as a result, no embankments were used during road construction. The roads are routinely maintained to include repairs to the road surface, blading, filling potholes and adding replacement surface material when needed. Culverts and ditches have been installed and are maintained to sustain the life of the roads during the operational life of the mine. See Plate 7-5A for the location of culverts and Appendix 7-11 for the culvert designs. See Section 5.27 for further information on these roads.

The area not designated as a primary road is the upper pad. This area has been asphalted to the approval of the Division. The pad is utilized for parking, loading and unloading of supplies and equipment, storage for those supplies, a staging area for new and rebuilt underground equipment, and access to the primary road to the portal area. It is maintained to include repair to the pad surface, blading, filling potholes and adding replacement surface material when needed. Roads within the permit area used for mining operations will comply to R645-301-534.100 through R645-534.340.

After the new expansion facilities were completed, the existing loadout facility, including the truckscales, were dismantled and removed from the site. The oil storage shed will also be rehabilitated. The area was then regraded and repaved, allowing the Forest Service road to be re-established as a two lane road. In addition, the existing roadway heading up to the truck turnaround area was widened by approximately 15 feet. This resulted in an additional third lane which can be used by the trucks as a stacking lane as they wait to be loaded. This will free up the existing road for unobstructed two way, two lane traffic to better accommodate public, Forest related use of the road. The turn around area will also be widened to allow the trucks to turn in a standard counter-clockwise direction and thereby eliminate the present practice of clockwise cross traffic turn arounds.

The expanded coal storage capabilities and the new high-speed truck loading facilities now allow the trucks to be loaded in a continuous, uninterruped basis, thereby eliminating the major cause of tie-ups and congestion.

5.35 Spoil

There are no permanent refuse sites located on the property. All spoil is controlled and maintained as described in Section 5.28.30 and Section 7.54 of Chapter 7.

5.36 Coal Mine Waste

See Section 5.28 of this chapter.

5.37 Regraded Slopes

The following information supplied is incorporated within the currently approved mine plan and variances have been granted. If a slide should occur within the permit area, GENWAL will notify the regulatory authority and comply with the remedial measures required by the regulatory agency.

The applicant concurs, that 1:1 excavation slopes are not suitable in the superficial topsoil deposits and have included slope rounding of these slopes at 1.5:1. If the factor of safety of 0.72 was correct, most areas of the existing canyon would already have failed as the natural slope approaches 1:1 in the entire canyon. Any excavation slope greater than 1:1 (with exception of slope rounding) would be unrealistic and impose unnecessary impact far beyond the current limits. In many instances, a 1.5:1 excavation slope is not realistic as the topography of the canyon exceeds this value.

Careful monitoring of construction in critical areas will be necessary to identify and use the correct design profile (i.e. 1:1, 1/2:1, or 1/4:1 slopes). The stability of the recontoured slopes has been demonstrated by the interim reclamation in evidence at the property. A number of these slopes are in excess of the proposed 1.5 to 1 final reclamation contours and have been in place for over ten (10) years. GENWAL will continue to observe these slopes and in the event that a failure occurs or evidence of instability is noted, such as sloughing, tension fractures, etc., all appropriate regulatory authorities will be notified and an acceptable plan to modify the proposed final reclamation contours will be agreed upon at a minimum of five (5) years prior to cessation of mining.

The roads are used to access the portal and substation areas and operations area as shown on Plate 5-3. Cut slopes of 0.25h:1v for competent bedrock, 0.5h:1v for fractured bedrock and 1h:1v for shallow surficial deposits less than four feet deep overlaying bedrock are proposed for the portal access roads.

A slope stability investigation was submitted by Delta Geotechnical Consultants and is included as Appendix 5-19 with a safety factor of 0.72 for the shallow surficial deposits of the

proposed 1:1 cut slopes. Since the safety factor does not comply with UMC 817.162 (c) requirements, cut slopes with 1:1 slopes will be rounded to 1.5:1 in the shallow superficial material. Appendix 5-16 is a stability analysis of the storage pad (upper pad) at the Crandall Canyon Mine prepared by EarthFax Engineering, Inc. A reclamation slope stability analysis has been prepared by JME Consultants and is included in Appendix 5-21. This analysis shows that the minimum static safety factor of 1.3 for the reclamation fill slopes will be met.

5.40 Reclamation Plan

NOTE: See Appendix 5-22(A) for the stand-alone reclamation plan for the East Mountain Emergency Drillpads and Access Roads. See Plate 1-1 for the location of these drillpads and access roads.

5.41 General

When no longer needed for mining operations, all entry ways or other openings to the surface from the underground mine will be sealed and backfilled. The permanent closures will be constructed to prevent access to the mine workings by people, livestock, and wildlife. Potential surface drainage will also be kept from entering the sealed entries.

Prior to final sealing of any openings, the BLM will require an on site inspection and a submission of formal sealing methods for approval of the BLM. The formal sealing methods will be presented as a plan including cross sections demonstrating the measures taken to seal or manage mine openings will comply with R645-301-529.100. At the time that the mine closure plan is submitted to the BLM, a copy will be forwarded to the Division for concurrence and approval and for addition to the mine plan on file. A copy will also be placed at the Emery County Recorder's office.

A formal plan will be submitted to the BLM for approval prior to final sealing of any openings. As per their on site inspection and plan approval, the openings will be sealed. All surface equipment, as well as structures, including all concrete foundations, will be removed by the applicant after the permanent cessation of operations.

MW-1 Supply Well Abandonment

Upon permanent cessation of mining operations, the water supply well, MW-1, will be permanently abandoned in accordance with regulations promulgated by the Utah Division of Water

Rights. This will include filling of the well with a neat cement grout in accordance with the regulations.

Temporary Cessation

If operations are to be temporarily suspended for 30 days or longer, the applicant will submit a notice of intention to the Division. This notice will include a description of the extent and nature of existing surface and underground disturbance prior to temporary cessation. The statement will also cover the type of reclamation which will have been accomplished to date and also include the type of ongoing monitoring, number of opening closures, water treatment activities and other topographic rehabilitative efforts which have been or will be undertaken during this period. The applicant will maintain and secure the surface facilities and mine openings.

GENWAL will implement the temporary cessation regulations as follows:

(a) GENWAL shall effectively support and maintain all surface access openings to underground operations, and secure surface facilities in areas in which there are no current operations, but operations are to be resumed under an approved permit. Temporary abandonment shall not relieve GENWAL of its obligation to comply with any provisions of the approved permit.

(b) Before temporary cessation of mining and reclamation operations for a period of thirty days or more, or as soon as it is down that a temporary cessation will extend beyond thirty days, GENWAL shall submit to the Division a notice of intention to cease or abandon operations. This notice shall include a statement of the exact number of surface acres and the horizontal and vertical extent of subsurface strata which have been in the permit area prior to cessation or abandonment, the extent and kind of reclamation of surface area which will have been accomplished, and identification of the backfilling, regrading, revegetation, environmental monitoring, underground opening closures, and water treatment activities that will continue during the temporary cessation.

(c) Each mine entry which is temporarily inactive but has a further projected useful service under the approved permit application, shall be protected by barricades or other covering devices, fenced and posted with signs to prevent access into the entry and to identify the hazardous nature of the opening. These devices shall be periodically inspected and maintained in good operating condition by GENWAL.

(d) Each exploration hole, other drill hole, bore hole, shaft, well or other exposed underground opening which has been identified in the approved permit application for use to return underground workings, or to be used to monitor ground water conditions, shall be temporarily sealed until required for actual use.

5.42 Narratives, Maps, and Plans

5.42.10 Timetable

All reclamation, other than areas handled in interim reclamation, will commence with removal of the surface structures, redistribution of the cut and fill materials and final grading of disturbed surface areas. Within 30 days following completion of final grading (which should be in August), topsoil from the stockpile will be redistributed. Nutrients and soil amendments, if shown to be required by soil tests, shall be applied to the redistributed topsoil before the end of October. Seeding, transplanting and mulching will then proceed when moisture conditions are optimal for planting and seeding. Seeding will commence as soon as the seedbed is finished in the late fall. Tree planting will be done in conjunction with seeding or in the following spring, as soon as one can work the soil.

A reclamation sequence for the mine yard, including the proposed culvert expansion project, is described in Appendix 5-22.

Timetable-Reclamation Activities: First available season following cessation of mining

Normal Access- May 15,

Begin demolition- May 15
Structure removal- May 15 to June 30
Seal portals- Sept 1 to Sept 30
Asphalt Removal- June 15 to June 30
Earthwork/recontouring- May 15 to September 30
Topsoil redistribution- August 30 to Oct 15
Drainage Construction- Sept 1 to Sept 30
Hydroseeding- Sept 15 to Oct 30
Seeding/Planting- Oct 1 to Oct 30

Final Reclamation- (cessation of mining)

Year 1	May	June	July	Aug.	Sept.	Oct.
Struct. remove	———					
Portal Seals					——	
Asphalt remove		—				
Earthwork/recontour		———	———	———	———	
Topsoil redistribution/final grade					———	
Drainage Construction					——	
Seeding/Mulching						———
Planting						——

Year 2 through 10

Vegetation Monitoring July 1 to August 30
Hydrologic Monitoring June 1 to Oct 30 (4 times)

5.42.20 through 5.42.32 Final Surface Configuration

All areas affected by surface operations will be graded and restored to approximate original contour. All final grading will be done along the contour to minimize erosion and instability unless this operation becomes hazardous to the equipment operators. Backfilling and grading will proceed so as to eliminate the cut slopes and highwalls. Refer to Plates 5-16, 5-17, and 5-17A. The proposed culvert expansion project will supply all backfill material needed to achieve approximate original contour and to reclaim existing highwalls.

A reclamation map showing post construction interim reclamation area, Plate 7-5, and final reclamation, Plates 5-16, 5-17, and 5-17A, accompanies this document. Slope rounding on Plate 5-3 has been revised to meet the required slope of 1.5:1 at the specified reclaimed cross sections.

Interim Reclamation

All surface areas disturbed during construction and which are not needed for mining operations were revegetated in the fall of the year following completion of the construction. This revegetation was performed as described in Chapter 3 of this document.

Disturbed areas within the mine plan area that contribute water directly to the sediment pond have undergone interim reclamation. The goal of this reclamation was to achieve vegetative cover that will minimize erosion thus reducing the amount of soil material entering the sediment pond. To achieve this goal, a standard of 80% vegetative cover was met. Ocular estimates of cover are made each fall (early September) to determine if supplemental seeding is warranted.

A reclamation map showing post construction interim reclamation areas and final reclamation accompanies this chapter as Plate 5-17. The correct number of acres to be revegetated in final reclamation is 8.73 acres.

5.42.40 Bond Release

Before seeking bond release, GENWAL will provide a description of all temporary structures to be removed and reclaimed. No permanent sedimentation ponds, impoundments, and treatment

facilities that meet the requirements of the R645 rules for permanent structures will remain after final reclamation, Phase 2.

5.42.50 Timetable and Plans, Removal of Sedimentation Pond

The sediment pond will remain after the mining operations and through phase 1 reclamation until adequate revegetation has been established to control erosion. Reclaimed disturbed area drainages will be routed to the pond and diversions will be maintained to preserve the integrity of the pond until requirements of R645-301-763.100 have been met. These diversions can be found on Plate 5-16 and 7-5.

Upon approval of phase 1 revegetation, the sediment pond will be cleaned out and the material disposed of in the approved method. The sediment which accumulates in the sediment pond as a result of runoff from the reclaimed area should only be topsoil that has eroded from the reclaimed site (care will be taken not to mix the pond liner with this topsoil). This topsoil will be excavated, stockpiled and allowed to dry. Once the topsoil has been dried the sediment pond will be removed and the area regraded to remove any capability to impound water. Topsoil will be redistributed over the reclaimed sediment pond site and the area reseeded.

Removal of the sediment pond was included during final reclamation to comply with the direct request of the Price Office of the U.S. Forest Service.

5.42.60 Roads

The Forest Service Development Road from Huntington Creek to the Forest Service turn around will remain as part of the post mining land use in accordance with the Forest Service permit shown in Appendix 1-2. During reclamation, the Forest Service access road will be altered to comply with the special use permit. GENWAL has and maintains a "reclamation" bond with the Forest Service which covers the costs for the proposed post-mining road configuration.

As stipulated in the existing Forest Service special use permit (8/26/89) covering the road, during final reclamation the width of the road surface within the permit area will be reduced from a 27 foot subgrade and 22 foot running surface to a 20 foot subgrade and 14 foot running surface. Asphalt and subgrade removed from the permit area as part of this road narrowing will be taken to a RCRA-approved disposal site.

Based on recent correspondence, the Forest Service now indicates that it prefers to have the asphalt totally removed from the road surface upon final reclamation. GENWAL commits to reclaiming the road through the minesite to the specifications stated in the Road Use Permit.

All other roads used for the operation of the Crandall Canyon Mine, within the permit boundaries, will be reclaimed in accordance with R645-301-542.610 through R645-301-542.640.

5.42.70 Final Abandonment of Mine Openings and Disposal Areas

The old truck loadout was dismantled once the new loadout facility became operational. The loadout structures were removed and the excess coal around the area was cleaned up and hauled to the new coal stockpile area. This area will provide a place to store material as well as snow and salt in the winter time.

After the new loadout facilities was constructed, the existing loadout area was removed and the area rehabilitated and cleaned up. These rehabilitation measures include the following:

a) The existing loadout facilities will be dismantled and removed from the site, including the coal bin, crushers, scalehouse and loading chute.

b) The existing truck scale will be removed from the middle of the road and the roadway will be regraded and repaved.

c) The existing oil shed will be rehabilitated and the roadway will be regraded and repaved in this area.

d) The existing coal pile/storage area will be totally cleaned up. All coal and coal products will be removed. The area will then be swept and vacuumed.

e) The hillside below the coal storage area will be dressed up. The mine discharge waterlines will be relocated in a more orderly fashion. Coal products will be vacuumed from the hillside.

5.42.71 Closure and Management of Mine Openings

When no longer needed for mining operations, all entry ways or other openings to the surface from the underground mine will be sealed and backfilled. Prior to the sealing of the mine openings, all combustible material will be removed from the underground bathhouse. All structures that will interfere with sealing of the mine openings will also be removed. The permanent closures will be constructed to prevent access to the mine workings by people, livestock, and wildlife. Potential surface drainage will also be kept from entering the sealed entries.

All combustible material will be removed from underground and hauled to a state approved land fill. The portals will be backfilled with soil and two rows of solid concrete blocks placed across each entry and then backfilled to the surface and recontoured as shown on Plate 5-17. The block stoppings will be placed as far from the surface as is necessary to obtain a competent top and bottom.

5.42.72 through 5.42.742 Excess Waste

All waste material generated from the removal of the structures will be removed from the property and sold as scrap or disposed of in a state approved land fill. See Section 5.28 of this chapter for more detail on excess waste and spoil.

5.42.80 Estimate of Reclamation Costs

Estimate of reclamation costs are included under Appendix 5-20.

5.53 Backfilling and Grading

Backfilling and regrading of disturbed lands has been designed to restore all disturbed areas affected by surface operations to the approximate original contour of the land. This is made possible by the fill material required by the 1997 facility expansion project. Reclamation of affected areas, including revegetation is outlined in Chapter 3, Section 3.41.

During reclamation, the subsoils or backfill material will be laid down in 12" to 18" lifts and compacted through repeated travel by heavy equipment. This method has been utilized by a number of mines in the area and appears to give excellent compaction prior to topsoiling. In areas with slopes of less than 30%, the subsoil will be ripped to a depth of 18" prior to topsoil placement. In areas having average slopes of more than 30% the subsoil will be ripped to a depth of 12", where practical. Topsoil will then be redistributed in a manner that achieves an approximate, uniform stable thickness and other specifications stated in Chapter 2, Section 2.42 of this document.

Removal or Reduction of Cut Slopes and Highwalls

Prior to backfilling and grading of the highwall area above the portals and the cutslopes above the old coal loadout area and the pocket cuts at the south portals, existing shotcrete, wire mesh, clips, and other related material will be removed and disposed of in an appropriate manner. All noncombustible material generated from the removal of shotcrete will be disposed of underground (within the mine) prior to the sealing of the portals. All other waste generated will be removed and disposed of in an appropriate State permitted land fill.

Backfilling and grading will proceed so as to eliminate the cut slope, pocket cuts and highwall. Refer to Plate 5-3 for the highwall location. The cut slope above the coal stockpile area will be backfilled to match the approximate original contour with fill material from the Expansion Area pad. The Forest Service Trailhead Access Road will be left in place, but the surface will be modified to meet design specifications, as directed, by the Forest Service (see Appendix 1-2). See Plate 5-17 for the Forest Service road location.

The stability of the reclaimed highwall and cutslopes has a safety factor greater than 1.3 and is shown in Appendix 5-21.

No highwalls or remnants will remain after reclamation.

Terracing and Erosion Control

No terracing will be done. All final grading and surface preparation of overburden completed prior to the redistribution of the topsoil will be done along the contour to minimize erosion in areas with slopes less than 30%. In areas with slopes greater than 30% the grading, preparation and placement in a direction other than generally parallel to the contour will be used.
Revised 4/05/2003

Refuse Piles

There are no refuse piles at the Crandall Canyon mine site.

Surface Coal Mining

There will be no surface coal mining at the Crandall Canyon Mine.

5.60 Performance Standards

All mining and reclamation operations at the Crandall Canyon Mine will be conducted in accordance with the R645 rules and this permit.

CHAPTER 7
FIGURES

(Note: Figures follow Chapter 7 text)

3. Diverting runoff using protected channels or pipes through disturbed areas so as not to cause additional erosion;

4. Using 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;

5. Treating with chemicals/paving;

6. For the purposes of UNDERGROUND COAL MINING AND RECLAMATION ACTIVITIES, treating mine drainage in underground sumps.

7.42.20 Siltation Structures

7.42.21 General Requirements

Additional contributions of suspended solids and sediment to stream flow or runoff outside the permit area will be prevented to the extent possible using the best technology currently available.

Alternate Sediment Control Areas and Small Area Exemptions

There are eight ASCA sites associated with this property. All ASCA's are maintained to minimize additional contributions of suspended solids and sediment to stream flow or runoff outside the permit area. Details on the ASCA's are included in Appendix 7-4.

As a result of the Crandall Canyon Mine disaster of August 6, 2007, the mine has been de-activated and the portals have been sealed. Mine water inflow has built up to the extent that water is now discharging from the portals and is discharged through a 12" pipe into Crandall Creek under UPDES permit UT0024368. The mine is presently discharging approximately 400-500 gallons per minute, with the flow fluctuating with barametric pressure and seasons. In early 2009 the iron concentrations in the water began to exceed UPDES limits. Because there is no way to treat the water underground the company is proposing to treat the water with an aeration system located on the surface in the "old loadout" area, immediately below the portal bench. The existing water discharge pipeline would be re-routed so that the mine water would discharge at the upper end of the area. The water would then run across a series of low riffles to spread the flow out over as much area as possible and provide maximum contact with oxygen in the air. The treated water would then be collected at the lower end of the area, routed through a culvert under the road, and would then be discharged into Crandall Creek at the currently approved UPDES outfall monitoring point.

It should be noted that the "old loadout area" is located primarily within a large notch that was blasted out of the solid Star Point Sandstone when the facility was originally constructed in the early 1980's. The area will first be cleaned of all coal materials to reveal the under-lying granular borrow

base. The area will then be leveled in a north-south direction (transverse to the water flow) and smooth-graded in the west-east direction (along the direction of flow). The area will then be surfaced with a water-proof treatment (i.e., concrete, asphalt, impervious liner, etc.) to make certain that the water flow across the treatment pad does not saturate the underlying fill material. Because the floor of the treatment pad will be at a lower elevation than the adjacent roadway, the aeration waterflow will be contained at all times within a lined treatment basin. This will ensure that the adjacent fill under the roadway stays dry and retains its full stability.

The existing mine-water discharge pipeline, which comes down the bank from the portals, will be equipped with a Tee and valve assembly. From this tee a new distribution line will be installed to carry the discharge water to the upper (western) end of the treatment area. This distribution pipeline will be suspended either from off the existing concrete wall (left over from the old loadout facility) or suspended from rock anchors affixed to the solid ledgerock. The distribution line will be valved at the tee so that water can be turned into the treatment area, or can be directed back into the existing discharge line. This ability to bypass the treatment facility will be advantageous at time when the facility needs to be taken off-line for construction, maintenance or adjustments.

A suitably constructed barricade would be constructed around the treatment facility along the outer edge of the treatment basin (between the treatment basin and the road) which will prevent any disturbed area drainage from entering the treatment facility area, and similarly will prevent any of the mine discharge water from spreading over the adjacent disturbed area and reporting to the sediment pond. See Plate 5-3 for the location of the facility. This treatment area is also designated as ASCA 12 in the Sedimentation and Drainage Control Plan found in Appendix 7-4 and Plate 7-5. See Figure 7-13 for a schematic representation of the aeration facility, as well and the mine-water discharge piping and French drain collection system at the portals.

The discharge water will flow down-gradient over the treatment basin from the upper (western) end down to the lower (eastern) end. Along the way it will pass over and around a series of low-lying baffle structures placed at right angles to the flow pattern. As currently envisioned, these structures could be precast concrete parking curbs (wheel stops) measuring approximately 4" high x 6" wide x 8' long. The purpose of these curb structures is to slow down the flow velocity and spread it out over as much surface area as possible. This will maximize the amount of exposure of the water to the air to enhance the aeration precipitation of the iron. The curbs can be individually adjusted to maximize the spread the waterflow

Between the curbs will be a 2"-3"layer of sorted gravel which will help trap the iron precipitate particles to prevent them from continuing on downstream to the UPDES outfall. The gravel material will also provide a better surface area for the iron sulfides to adhere. This gravel may consist of a crushed limestone to help chemically in the iron removal process. It will also be possible to add a chemical flocculant and/or coagulant to the water at the upstream end to aid in the iron removal process. This gravel/crushed rock layer will be removed and replaced as necessary as it becomes overloaded with iron precipitates.

At the lower end of the treatment basin, the water will be collected into a buried pipeline. This pipeline will cross underneath the road and will connect into the existing discharge line. In this

manner the treated water end up reporting to the Crandall Canyon drainage (by way of the main bypass culvert) at the existing approved UPDES outfall point.

There is every reason to believe that water will permanently discharge from the Crandall Mine portals. The iron level of the mine water historically was very low, and began rising only after the water began to build up and impound within the mine workings following the mine collapse of 2007. There is a possibility that the iron is the result of dissolved pyrites in the coal, and that after the pyrites have been leached out, the iron level will drop back down to its pre-existing compliance levels. Until then, the treatment will have to continue, but if the situation stabilizes the aeration treatment can later be discontinued. Therefore, it is not known at this time if the iron treatment facility will be a temporary structure or if it will be needed on a long-term (i.e., permanent) basis. This question will be addressed in more detail in the Reclamation Plan, Appendix 5-22.

7.42.22 Sedimentation Pond

Design

The sedimentation pond located in Crandall Canyon has been redesigned to control the additional storm runoff from the pad extension and from the designated undisturbed drainage areas above the pad extension associated with the proposed culvert expansion. The topography and watershed boundaries are shown on Plate 7-5 and 7-5C. Cross sections of the pond design are shown on Plate 7-3.

Runoff- and Sediment-Control Facilities

Results of analyses to determine the required size and hydraulics of the sedimentation pond are included in Appendix 7-4. Details of the sedimentation pond required for compliance with 30 CFR 77.216-1 and 30 CFR 77.216-2 are contained in Appendix 7-8. Permanent disposal of the sediment removed during cleanout will be in accordance with Section 535.

Prior to any discharges through the decant system on the sedimentation pond, a sample will be collected to determine total suspended solids, settleable solids, total dissolved solids, oil and grease, total iron, total manganese concentrations, and pH. The sample will be collected by opening the gate valve on the dewatering device, allowing water to flow from the pond through the primary spillway for a sufficient time to collect a sample of the water, and then immediately shutting the gate valve to prevent further dewatering. This sample will then be submitted to a laboratory for analyses of the indicated parameters.

After receipt of analytical results from the laboratory, if the pH and concentrations of total suspended solids, settleable solids, total dissolved solids, oil and grease, total iron, and total manganese are within the acceptable limits, water will be discharged from the pond through the dewatering device. If the parameters of concern are not within the acceptable limits, no water will be discharged through the device.

During discharge of water to Crandall Creek from the sedimentation pond, samples of the water will be collected at the discharge point at the beginning and end of the discharge time. These samples will be sent to a laboratory following the discharge period for analyses of total suspended solids, settleable solids, total dissolved solids, total iron, total manganese, oil and grease, and pH. Analytical results will be submitted to the Division with the subsequent quarterly report.

The emergency spillway discharges onto the boulder-covered slope adjacent to the sedimentation pond. Boulders that cover this slope were blasted from the cut above the pond during construction of the mine-access road. Due to the large size of the boulders, laboratory size-fraction analyses could not be conducted. However, the boulders are visually estimated to range in size up to at least 10 feet in diameter. It is further estimated that approximately 80 percent of the coarse rock on the slope is finer than 8 feet in diameter, 30 percent is finer than 5 feet in diameter, and 10 percent is finer than 3 feet in diameter.

The blasted rock has an approximate thickness of 15 to 20 feet at the top of the slope and 5 to 6 feet at the bottom of the slope. The soil that underlies the rock is a silty sand. Size-fraction analyses presented by Delta Geotechnical Consultants (1982) indicate that this soil is 70 percent sand and 30 percent silt and clay (the latter being minus 200 mesh).

The emergency spillway is lined with riprap and a filter blanket to reduce erosion potential. A concrete cutoff has also been installed immediately downstream of the inlet. The concrete cutoff ensures that the emergency spillway will not erode during a discharge event. Grading of the riprap, filter blanket, and embankment materials are shown in Figure 7-10. The spillway will discharge directly onto the boulder-covered slope. Due to the extreme thickness of the boulders and cobbles on the slope, additional erosion protection below the emergency-spillway outflow will not be required.

All new fill required to modify the embankment will be placed in 6-inch lifts. This new fill will be compacted in place by repeated passes of a front-end loader or equivalent prior to placing the next lift. Compaction will continue until the density of the material is at least 90 percent of Proctor density (as determined by sandcone density tests in the field).

As included in the original design, the interior of the pond will be lined with a 12-inch thick local, compacted clay to reduce seepage from the pond and, thereby, increase the stability of The embankment. The clay liner will be placed in 6-inch lifts and compacted during placement by at

least four passes of a front end loader or equivalent. The initial layer will be disk-harrowed into the bottom of the pond prior to completion.

After pond cleanout, the thickness of the clay liner will be sampled by means of a bucket auger at 8 locations. Three holes will be placed along the ingress/egress route and five additional holes will be randomly selected from the remaining pond area. If any of the holes penetrate less than 10 inches of clay, additional clay will be compacted into the deficient areas of the pond.

Flow conditions in Crandall Creek adjacent to the sedimentation pond were examined to determine if flood flows may erode the downstream toe (see Appendix 7-5). As noted, the peak flow from the 100-year, 24-hour precipitation event will encroach 0.6 foot above the toe of the embankment. Thus, a riprap protective layer (with a median rock diameter of 12.5 inches) was placed along the lower 2.0 feet of the embankment as shown in Plate 7-4. Placement of this riprap will serve an incidental purpose of increasing the stability of the dam by placing additional weight on the downstream toe (Figure 7-10).

Following construction of the sedimentation pond as designed herein, all disturbed areas associated with pond construction (with the exception of the interior of the pond) will be revegetated with the temporary seed mixture. This mixture was developed in consultation with Lynn Kunzler of the Division and Walt Nowak of the U.S. Forest Service. This mixture provides rapid growth species, sod-forming species, and species that are compatible with other plants.

Seeding will be done in the late fall, just prior to the first heavy snowfall of the year (Plummer et al., 1968). Seeding will be accomplished by hydroseeder. Mulch will be placed after seeding. The mulch, which consists of two tons of straw or grass hay per acre of disturbed area, will be spread over the area to be planted by hydromulcher.

Following seeding, the revegetated outslopes of the pond will be inspected during normal pond inspections to determine the effectiveness of the seeding. Straw-bale dikes will be added as necessary to control excessive gullying on the dam face. These dikes will be installed as noted by Figure 7-11.

7.42.30 Diversions

Diversion UD-1 is a 42" culvert placed along the western edge of the site at the location shown on Plate 7-5 to divert water from a 95-acre undisturbed watershed around the yard area. Analyses and design information associated with this and other diversions associated with the site are contained in Appendix 7-4. (Table 10)

Two additional diversions were designed to convey water from undisturbed areas away from the disturbed site. One (UD-2) was constructed in the northwest portion of the site along the proposed substation pad. UD-2 is an open ditch diversion. UD-3 is a 24" culvert diversion located in the northeastern portion of the site to convey water away from the portal area. Design details are presented in Tables 8 and 10 respectively in Appendix 7-4.

As a result of the Crandall Canyon Mine disaster of August 6, 2007, the mine has been de-activated and the portals have been sealed. During the process of constructing the seals much of the

UD-3 culvert diversion structure was damaged beyond repair. Upon further evaluation it was determined that the undisturbed drainage from WSUD-3 above the portals could be diverted into the existing surface drainage ditches rather than try to re-establish it back across the portals as it had been previously. The drainage from WSUD-3 is now proposed to report to disturbed drainage ditch DD-8, then to culvert C-1, then to ditch DD-5, then culvert C-12, and ultimately into the sediment pond. As shown in Tables 3, 5, 6 and 7 of Appendix 7-4, all ditches and culverts are presently sized to adequately handle the additional runoff from the undisturbed area. Also, as shown in Table 11 of Appendix 7-4, the sediment pond is also adequately sized to handle this additional contribution.

The existing culverts in the mine yard were examined to determine their adequacy with respect to passing the peak flow. Details of these designs are provided in Appendix 7-4.

Similarly, ditches within the disturbed area are designed to pass the peak flow from the 10-year, 6-hour storm. Typical cross sections and design calculations are contained in Appendix 7-4 for these ditches. Ditches have been evaluated for adequacy in passing the 10 year-24 hour storm and found to be of adequate size (see Appendix 7-4).

A berm was placed around the (un-used) power substation area to prevent runoff water that accumulates thereon from flowing across the remainder of the site. A small channel on the substation pad collects water from the pad and adjacent undisturbed areas. A stilling basin was placed at the downstream end of this diversion to trap sediment prior to discharging into UD-1.

Expansion Area Surface Water Drainage and Sediment Control

Water on the extended mining pad associated with the proposed culvert expansion comes from two sources. The pad itself and two watershed areas located in undisturbed terrain to the south of the proposed pad. Runoff from the pad and watersheds is collected and controlled by the use of drainage ditches and culverts. All runoff diverted through the drainage ditches and culverts go into a sediment pond. The watersheds are shown on Plate 7-5. The location of drainage ditches and culverts can be also be found on Plate 7-5.

All diversion ditches have been designed to have a triangular channel with a minimum depth of one foot and side slopes of 1H:1V. During the periods of peak flow at least 3" of the channel depth will be freeboard. The calculations associated with drainage ditch design can be found in Appendix 7-4.

7.42.40 Road Drainage

All of GENWAL's roads have been designed, located and constructed as required by the regulations R645-301-742.410 through R645-301-742-423.5.

7.43 Impoundment

There are no permanent impoundments associated with the GENWAL facilities. Temporary impoundments of water collected for runoff control will occur in the sediment pond. The physical design of the sediment pond are certified designs as required in R645-301-512 and are presented in Section 5.33 and Appendix 7-4 of this application. The sediment

pond does not meet the criteria for MSHA regulations. The hydrologic design for the sediment pond is presented in Section 7.42.20 and Appendix 7-4. On cessation and reclamation of mining and disposal activities, the sediment pond will be removed.

7.44 Discharge Structures

The sediment pond is equipped with a decant, a riser pipe (cmp) principle overflow and a rip-rapped open-channel emergency spillway. Sediment pond details are covered under Section 7.42.20 and in Appendix 7-4.

7.45 Disposal of Excess Spoil

No significant excess spoil will be developed by the underground mine. In the event spoil is generated during the mining operations, this will be transported to an approved disposal site. The handling of these materials will comply with R645-301-745.

7.46 Coal Mine Waste

The disposal and placement of any refuse materials will be conducted in accordance with the plans presented in Chapter 5 of this application.

7.47 Disposal of Noncoal Mine Waste

Garbage

Solid waste generated from mining activities, such as garbage and paper products, is disposed of in large trash "dumpsters" located near the portal. A contract garbage hauling service, empties the contents of the dumpsters on a weekly basis and hauls the garbage to an approved dump or landfill.

Unusable Equipment

All salvageable mining equipment is sold to local scrap dealers: items such as broken bolts, worn out engine parts, and items which might be recycled. Any machinery or large parts are placed in a stockpile near the material storage area for periodic salvage by local scrap dealers. No mining equipment will be merely abandoned.

Petroleum Products

Oil and grease wastes are collected in tanks and returned to distributors for refining or used as heating fuel. In case of spills, a spill control plan has been developed and is located at the mine site.

7.48 Casing and Sealing of Wells

Following completion of reclamation, the monitoring wells for the mine site will be plugged and abandoned in accordance with R645-301-631 and R645-301-748. This will prevent the potential for disturbance to the hydrologic balance.

7.50 Performance Standards

All coal mining and reclamation operations will be conducted to minimize disturbance to the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area and support approved postmining land uses in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302. For the purpose of SURFACE COAL MINING AND RECLAMATION ACTIVITIES, operations will be conducted to assure the protection or replacement of water rights in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302.

The following sections, 7.51 through 7.55 provide a commitment to meet the requirements of the applicable laws. Specific plans for accomplishing compliance are provided under the applicable, referenced sections of this Mining and Reclamation Plan.

7.51 Water Quality Standards and Effluent Limitations

Discharges of water from areas disturbed by coal mining and reclamation operations will be made in compliance with all Utah and federal water quality laws and regulations and with effluent limitations for coal mining promulgated by the U.S. Environmental Protection Agency set forth in 40 CFR Part 434.

7.52 Sediment Control Measures

Sediment control measures will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-760. Refer to sections 7.32, 7.42 and 7.60 of this plan.

7.52.10 Siltation Structures

Siltation structures and diversions will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-763. Refer to sections 7.32, 7.42 and 7.63 in this plan.

7.52.20 Road Drainage

Roads will be located, designed, constructed, reconstructed, used, maintained and reclaimed according to R645-301-732.400, R645-301-742-400, and R645-301-762. Refer to sections 7.32, 7.40 and 7.62 in this plan.

7.52.21 Erosion Control or Prevention

Control or prevent erosion, siltation and the air pollution attendant to erosion by vegetating or otherwise stabilizing all exposed surfaces in accordance with current, prudent engineering practices.

7.52.22 Suspended Solids

Control or prevent additional contributions of suspended solids to steam flow or runoff outside the permit area.

7.52.23 Effluent Standards

Neither cause nor contribute to, directly or indirectly, the violation of effluent standards given under R645-301-751. Refer to section 7.51 in this plan.

7.52.24 Surface and Groundwater Systems

Minimize the diminution to, or degradation of, the quality or quantity of surface and groundwater systems.

7.52.25 Normal Water Flow

Refrain from significantly altering the normal flow of water in streambeds or drainage channels.

7.53 Impoundments and Discharge Structures

Impoundments and discharge structures will be located, maintained, constructed and reclaimed to comply with R645-301-733, R645-301-734, R645-301-743 and R645-301-745 and R645-301-760. Refer to sections 7.33, 7.34, 7.43, 7.45 and 7.60 in this plan.

7.54 Disposal of Excess Spoil, Coal Mine Waste and Noncoal Mine Waste

Disposal areas for excess spoil, coal mine waste and noncoal mine waste will be located, maintained, constructed and reclaimed to comply with R645-301-735, R645-301-736, R645-301-745, R645-301-746, R645-301-747 and R645-301-760. Refer to sections 7.35, 7.36, 7.45, 7.46 7.47 and 7.60 in this plan.

7.55 Casing and Sealing of Wells

All wells will be managed to comply with R645-301-748 and R645-301-765. Water monitoring wells will be managed on a temporary basis according to R645-301-738. Refer to sections 7.38, 7.48, and 7.65 in this plan.

7.60 Reclamation

Sealing of Mine Openings

The Applicant has drilled from the Hiawatha seam upwards to the Blind Canyon seam as described in Chapter 6. The drilling occurred in areas that pillar extraction will occur and no provisions were made to seal the bore hole.

Temporary sealing of the portals, if needed, will be accomplished by the construction of protective barricades or other covering devices, fenced and posted with signs indicating the hazardous nature of the opening. Permanent closure plans will include sealing the portals as per the request of the U.S.G.S. (See Section 5.29).

Upon cessation of mining operations all drift openings to the surface from underground will be backfilled, regraded and reseed as per Section 5.40 of this plan. Prior to final sealing of any openings, the U.S.G.S. will require an on site inspection and a submission of formal sealing methods for approval. The formal sealing methods will be presented as a plan including cross sections demonstrating the measures taken to seal or manage mine openings will comply with R645-301-529.

Removal of Surface Structures

All waste material generated from the removal of the structures will be removed from the property and sold as scrap or disposed of in the appropriate approved state land fill. The only structures to remain after the mining operation will be the sedimentation system and all necessary diversions required to insure routing of disturbed area drainage to the pond and diversions to maintain the integrity of the pond until the requirements are met. The diversion ditch is shown on Plate 5-16.

Upon cessation of mining operations, the water supply well (MW-1) will be permanently abandoned in accordance with regulations promulgated by the Utah Division of Water Rights. This will include filling of the well with a neat cement grout in accordance with the regulations.

Disposition of Dams, Ponds and Diversions

Upon final cessation of mining the area will be reclaimed. Upon completion of the reclamation earthwork the sediment pond will be cleaned out and the material disposed of in the approved method. Once it is determined that the pond is no longer required for sediment control of the reclaimed area and Phase I reclamation has been deemed complete, the pond will be cleaned out again. The pond will only be reclaimed after vegetation has been established on the site and Phase I reclamation has been approved. The material in the pond should only be topsoil that has eroded from the reclaimed site, (care will be taken not to mix the pond liner with this topsoil). This topsoil will be stockpiled and allowed to dry at the edge of the pond. Once the topsoil has been dried, the sediment pond will be reclaimed and the topsoil spread on top of the pond area.

Recontouring

All areas affected by surface operations will be graded and restored to approximate original contour that is compatible with natural surroundings and postmining land use. For approximate

contours prior to GENWAL's surface disturbance refer to the topography south of the road on Plate 5-20. The final regraded contours can be found on Plate 5-17.

Removal or Reduction of Cut Slopes & Highwalls

Backfilling and grading will proceed so as to eliminate the cutslopes and highwalls. This can be done by recontouring as per Section 5.40 of this Plan. The portals will be backfilled with soil and two rows of solid concrete blocks placed across each entry and then backfilled to the surface and recontoured as shown on Plate 5-17. The cut slope above the coal stockpile will be backfilled with material from the culvert expansion project.

Terracing and Erosion Control

No terracing will be done. All final grading, preparation of overburden before replacement of topsoil will be done along the contour to minimize erosion and instability unless this operation becomes hazardous to equipment operators in which case the grading, preparation and placement in a direction other than generally parallel to the contour will be used.

Final Reclamation

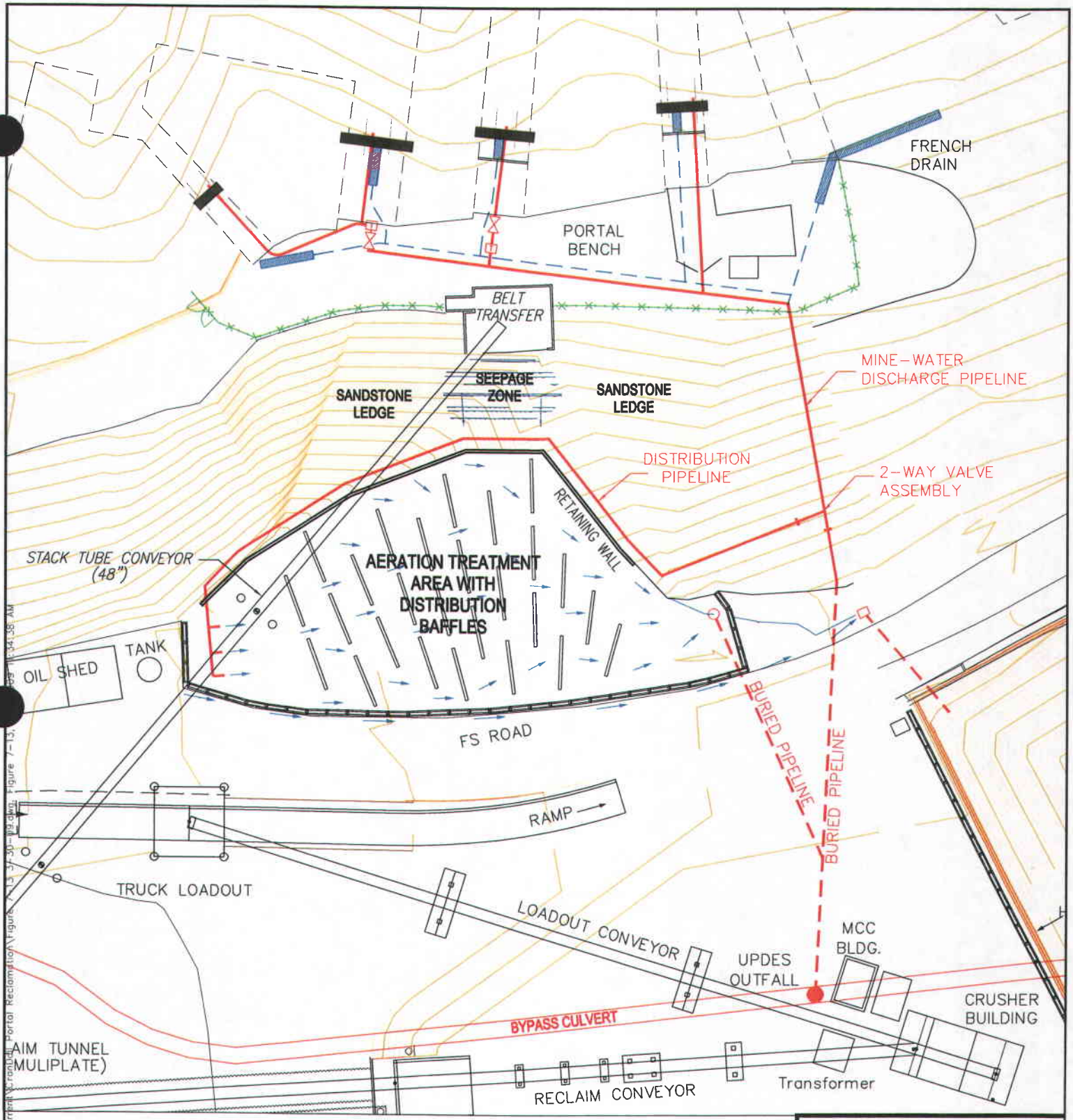
All areas affected by surface operations will be graded and restored to approximate original contour. All final grading will be done along the contour to minimize erosion and instability unless this operation becomes hazardous to the equipment operators. Backfilling and grading will proceed so as to eliminate the cut slopes and highwalls. Refer to Plates 5-16 and 5-17. Backfilling and grading will be done according to the reclamation timetable as originally submitted.

If possible, the topsoil will be redistributed in the late fall (late September or early October) just prior to the seeding to keep the seedbed free of weeds and annual grasses. Should weeds and annual grasses become established before seeding, they will be removed prior to seeding, refer to Chapters 2 and 3 for additional information.

Typical cross sections and topographic maps which adequately represent the existing land configuration of the area affected by surface operations are shown on Plates 3-7, 3-8 and 3-9 for existing ground as well as Plate 5-20 for premining topography and the geotextile-covered area. Postmining reclamation cross sections and surface topography will be as near to premining as is possible and practical, as noted on Plate 5-17.

A reclamation map showing post construction interim reclamation areas and final reclamation accompanies this document as Plates 7-16 and 5-17. Slope rounding on Plate 5-3 has been revised to meet the required slope of 1.5:1 at the specified reclaimed cross sections. Two distinct areas showing post construction interim reclamation and final reclamation can be found on Plates 7-5.

Reclamation hydrology is discussed in Appendix 7-4.



UTAH REGISTERED PROFESSIONAL ENGINEER #6449561 David W. Hibbs 4/2/09

I CERTIFY THIS MAP TO BE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

MINE-WATER DISCHARGE TREATMENT FACILITY

Crandall Canyon Mines

Crandall Canyon
P.O. BOX 910
EAST CARBON, UTAH

MSHA ID #42-01715

DRAWN BY: PJ	SCALE: 1" = 50'
APPROVED BY: DS	DATE: 2 APRIL 2009
FIGURE:	FIGURE 7-13a

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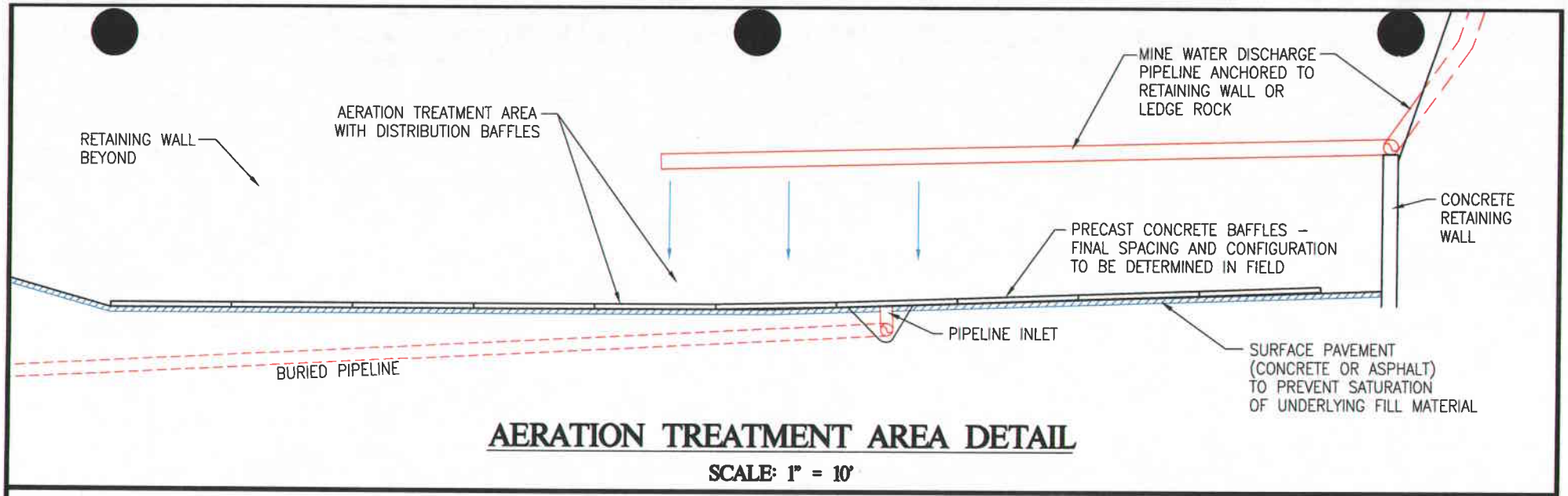
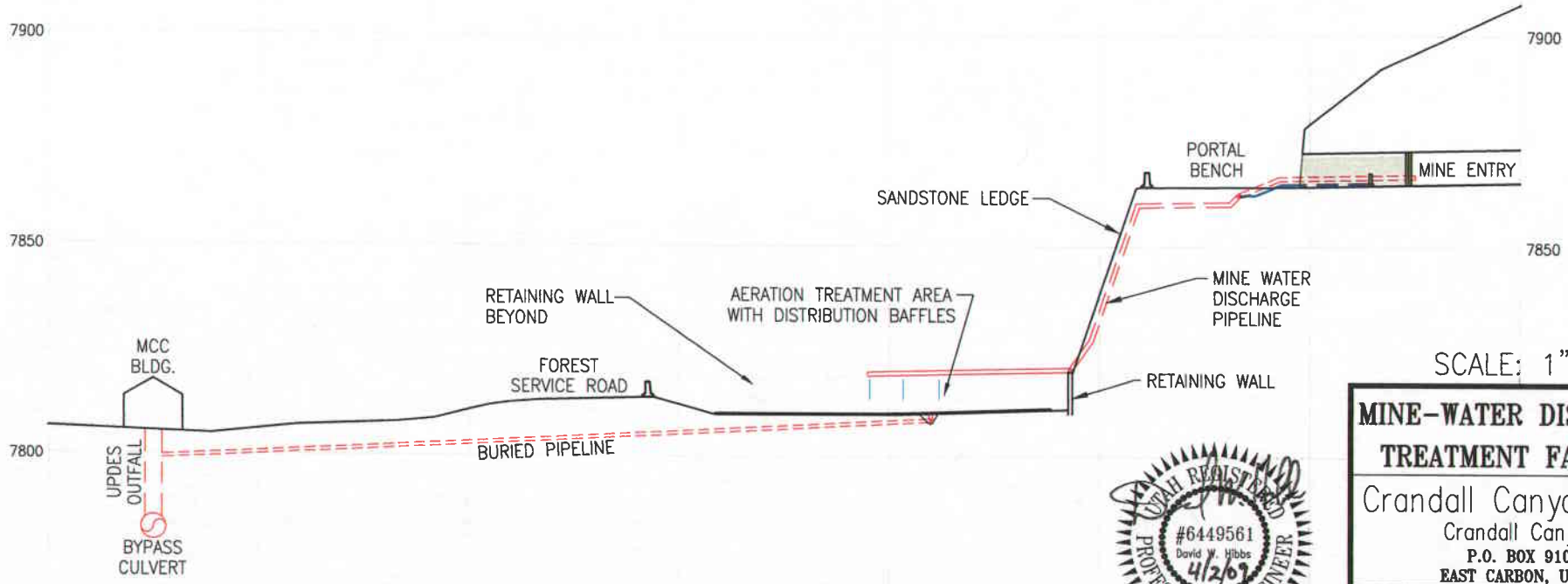


AERATION TREATMENT AREA DETAIL

SCALE: 1" = 10'



SOUTH-TO-NORTH SCHEMATIC SECTION

SCALE: 1" = 40'

SCALE: 1" = 40'

UTAH REGISTERED PROFESSIONAL ENGINEER #6449561 David W. Hibbs 4/2/09

I CERTIFY THIS MAP TO BE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

MINE-WATER DISCHARGE TREATMENT FACILITY

Crandall Canyon Mines
Crandall Canyon
P.O. BOX 910
EAST CARBON, UTAH

MSHA ID #42-01715

DRAWN BY	PJ	SCALE	AS SHOWN
APPROVED BY	DS	DATE	2 APRIL 2009
SHEET			Figure 7-13b

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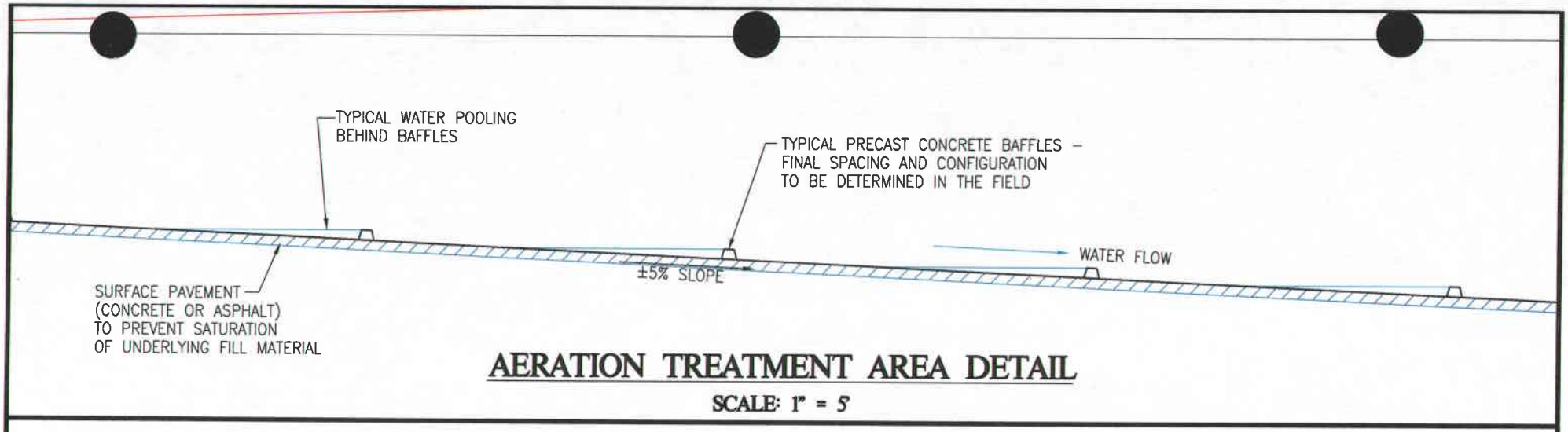

AERATION TREATMENT AREA DETAIL

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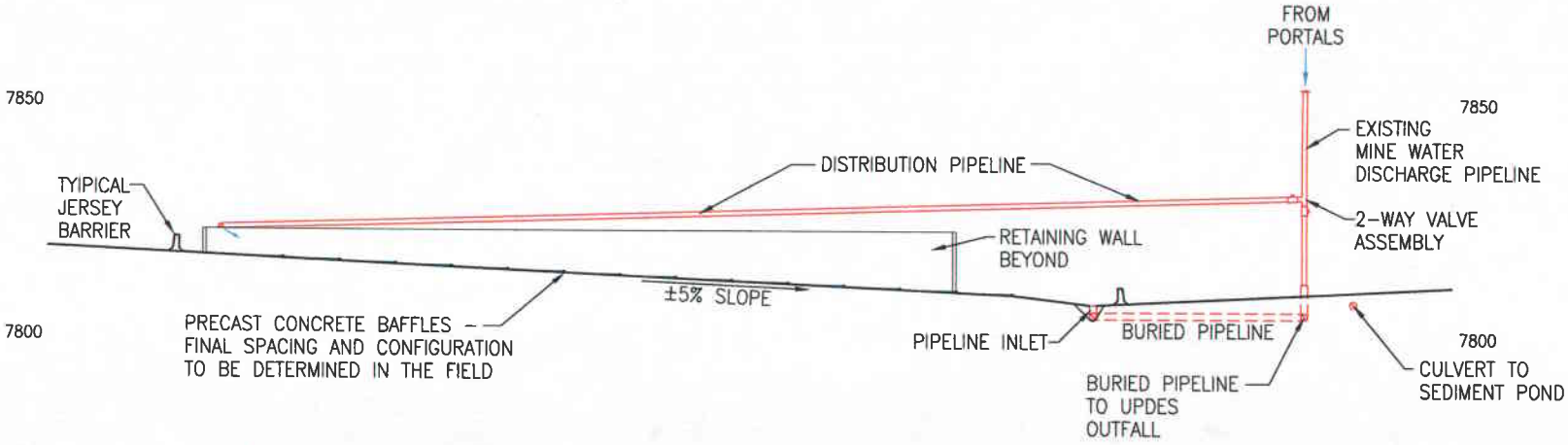

WEST-TO-EAST AERATION TREATMENT AREA SECTION

SCALE: 1" = 40'

UTAH REGISTERED
#6449561
David W. Hibbs
4/2/09
PROFESSIONAL ENGINEER

I CERTIFY THIS MAP TO BE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

MINE–WATER DISCHARGE TREATMENT FACILITY

Crandall Canyon Mines
Crandall Canyon
P.O. BOX 910
EAST CARBON, UTAH

MSHA ID #42-01715

DRAWN BY	PJ	SCALE	AS SHOWN
APPROVED BY	DS	DATE	2 APRIL 2009
SHEET			Figure 7-13c

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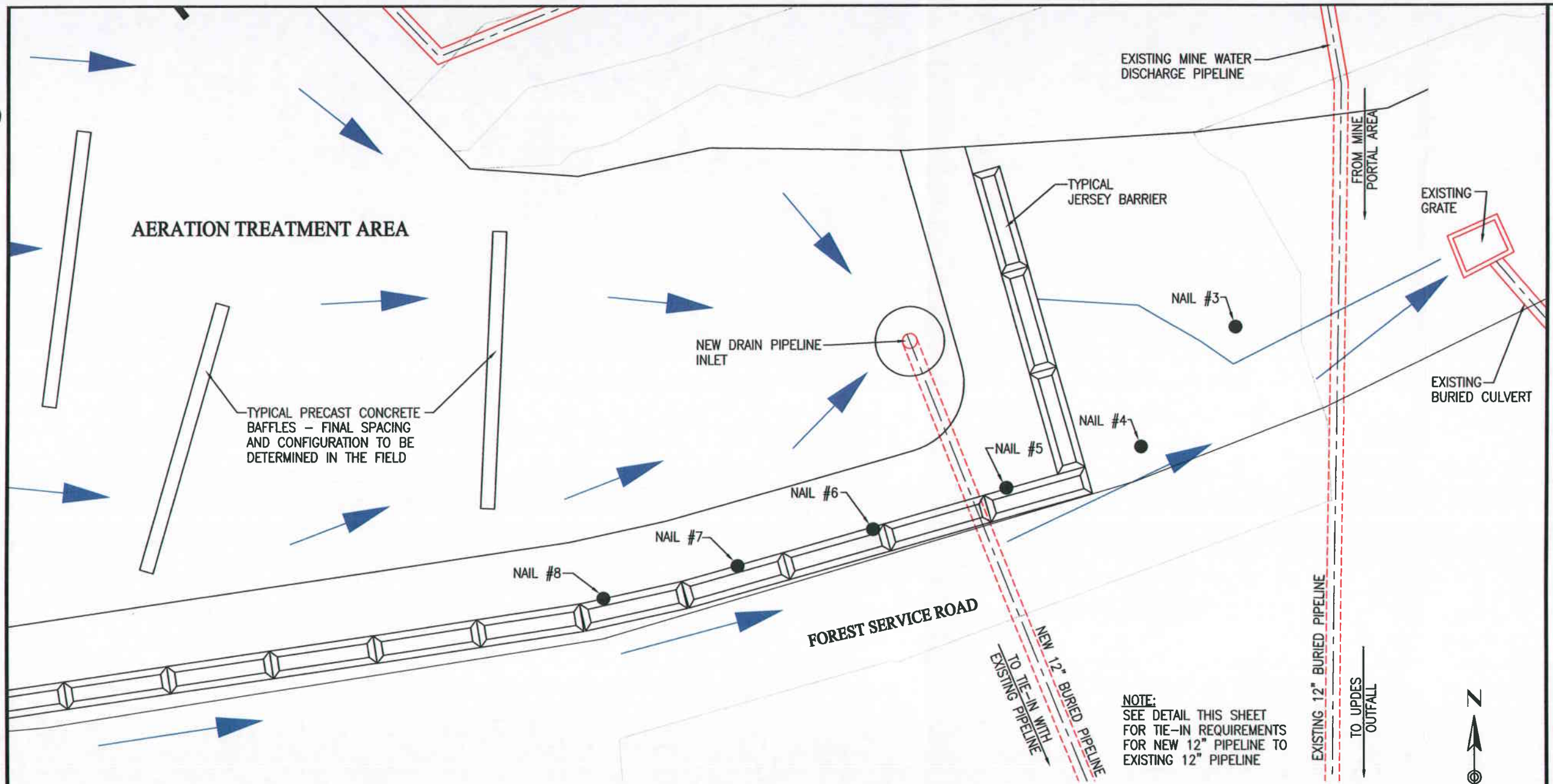
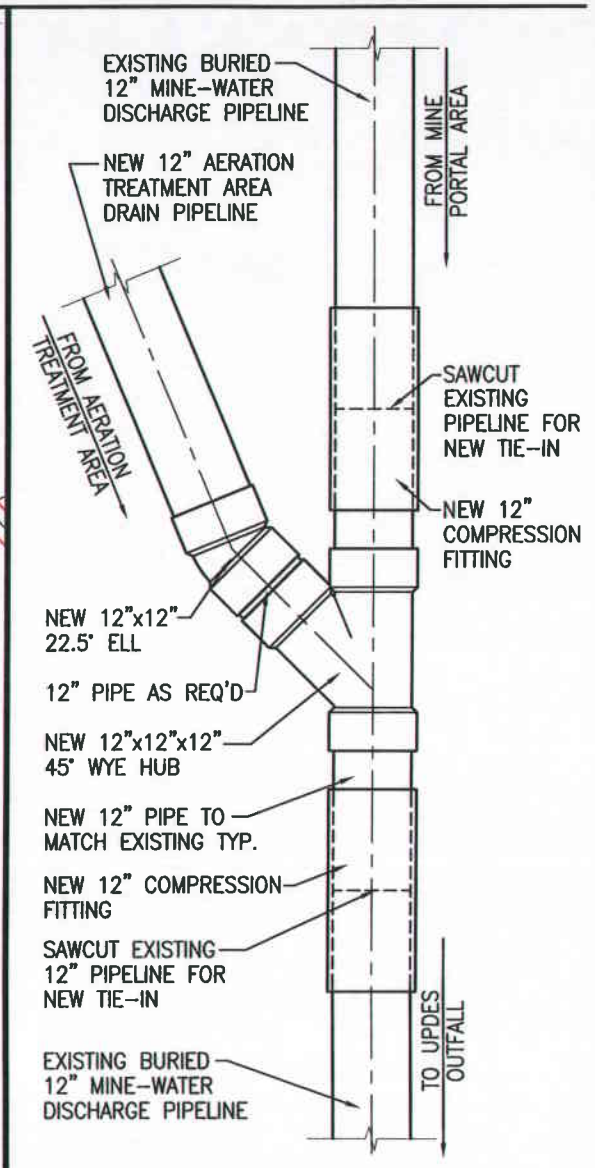


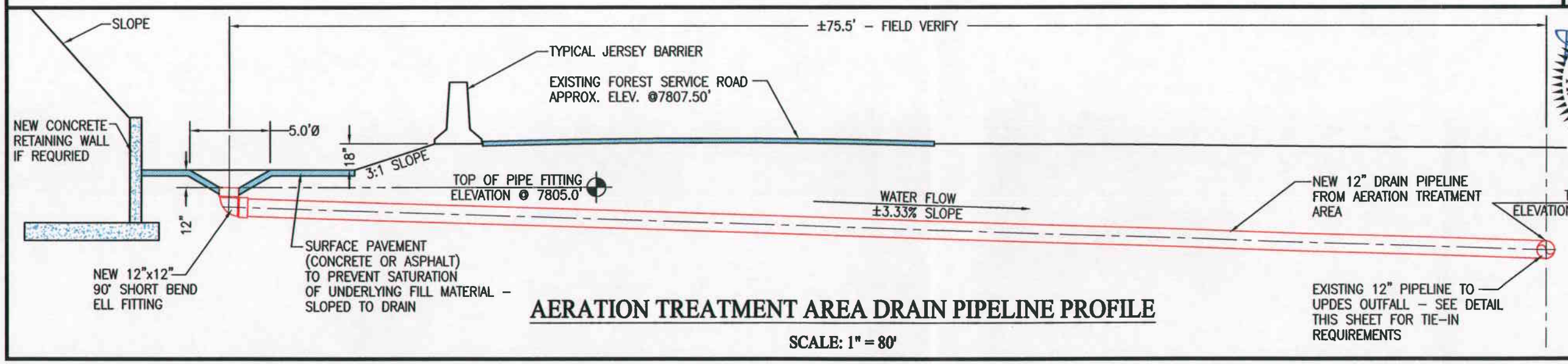
AERATION TREATMENT AREA DRAIN PIPELINE LOCATION PLAN

SCALE: 1" = 100'



AERATION TREATMENT AREA DRAIN PIPELINE TIE-IN TO MINE-WATER DISCHARGE PIPELINE

SCALE: 1" = 30'



AERATION TREATMENT AREA DRAIN PIPELINE PROFILE

SCALE: 1" = 80'

UTAH REGISTERED #6449561 David W. Hibbs 4/4/09 PROFESSIONAL ENGINEER

MINE-WATER DISCHARGE TREATMENT FACILITY

Crandall Canyon Mines
Crandall Canyon
P.O. BOX 1077
PRICE, UTAH

MSHA ID #42-01715

DRAWN BY	PJ	SCALE	AS NOTED
APPROVED BY	DS	DATE	3 APRIL 2009
SHEET			Figure 7-13d

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APPENDIX 7-4

CRANDALL CANYON MINE
SEDIMENTATION AND DRAINAGE CONTROL PLAN

PREPARED BY: *DAN W. GUY, P.E.*
BLACKHAWK ENGINEERING, INC.
1056 WEST 2060 NORTH
HELPER, UT. 84526

REVISED: *MARCH 2009*

CRANDALL CANYON MINE
SEDIMENTATION AND DRAINAGE CONTROL PLAN

TABLE OF CONTENTS

Figures:

1. Introduction

The Sedimentation and Drainage Control Plan for the Crandall Canyon Mine has been designed according to the State of Utah R645- Coal Mining Rules, November 1, 1996. All design criteria and construction will be certified by a Utah Registered Professional Engineer.

This plan has been divided into the following three sections:

1) Design of Drainage Control Structures for the Proposed Construction
2) Design of Sediment Control Structures
3) Design of Drainage Control Structures for Reclamation

The general surface water control plan for this project will consist of the following:

(a) The proposed pad expansion will necessitate modifications of a number of existing hydrologic structures on the site. In an effort to clarify the new plan, the entire sedimentation and drainage control plan has been re-evaluated for the site and presented in this Appendix.

(b) The general plan for the pad expansion is to divert undisturbed drainage from Crandall Canyon above the minesite through a 6' diameter CMP culvert beneath the expansion area and discharge below the disturbed area. As a result of the expansion, existing culverts C-2, C-8, C-10 and Ditch DD-9 will be removed. 2 new ditches (DD-12 & DD-13) and 3 new culverts (Main Canyon, C-11 and C-11A) will be added to provide for drainage control for the expanded facility. The existing sediment pond will also be expanded to contain additional runoff from the expansion area. All other existing drainage controls will remain unchanged. All minesite drainage controls are shown on Plate 7-5 "Drainage Map".

(c) *The main canyon culvert is sized to safely pass the runoff from a 100 year - 6 hour precipitation event. All other undisturbed diversions, disturbed ditches and culverts are sized to safely convey runoff from a 10 year - 24 hour precipitation event. The sediment pond is sized to contain runoff from a 10 year - 24 hour precipitation event, as required.*

(d) *The cresent-shaped area below the portals will be utilized as a water treatment facility for the mine water discharging from the mine and seeping from the slope below the portals. The plan is to divert all mine water into this area, where it will be channeled through a series of baffles for aeration to reduce the iron content. Once treated, the mine water will flow into the main canyon culvert at the UPDES #002 discharge location. Calculations show a minimum 12" pipeline at a minimum grade of 3 % is more than adequate to carry the expected maximum discharge of 800 gpm or 1.78 cfs. A larger pipeline may be used. This system will be isolated from the rest of the minesite drainage by topography and jersey-barriers, and since it will no longer flow to the sediment pond, it will be treated as an ASCA. The ASCA location and drainage plans are shown on Plate 7-5.*

(e) *When the Crandall Canyon Mine Portals were sealed as a result of the 2007 disaster, it was decided to re-route the culvert system of UD-3, which diverts undisturbed drainage area WSUD-3. Culvert UD-3 now reports to Disturbed Ditch DD-8, Culvert C-1, Disturbed Ditch DD-5, Culvert C-12 and ultimately into the Sediment Pond. Calculations show that all affected ditches and culverts are adequately sized to handle the increased flow from WSUD-3 (See Tables 3, 5, 6, and 7). The Sediment Pond is also adequate to handle this additional flow (See Table 11).*

DESIGN OF DRAINAGE CONTROL STRUCTURES

Design Parameters:

Tables:

Design Parameters:

2.1 Precipitation

The precipitation-frequency values for the area were taken from the existing plan which lists Miller, et.al. (1973) as the sources.

Frequency - Duration	*Precipitation*
10 year-6 hour	*1.55"*
10 year-24 hour	*2.50"*
25 year-6 hour	*1.90"*
100 year-6 hour	*2.40"*
100 year-24 hour	*3.70"*

2.2 Flow

Peak flows, flow depths, areas and velocities were calculated using the computer program "Office of Surface Mining Watershed Model", Storm Version 6.21 by Gary E. McIntosh. All flow is based on the SCS - TR55 Method for Type II storms.

Time of concentration of storm events was calculated for each drainage area using the following formula:

$$t_L = \frac{L^{0.8}\,(S+1)^{0.7}}{1900\,Y^{0.5}}$$

where:

t_C	=	*Time of Concentration (hrs.)*
t_L	=	*Lag Time (hrs.)* $= 0.6\,t_C$
L	=	*Hydraulic Length of Watershed (ft.)*
Y	=	*Average Land Slope (%)*
S	=	$\frac{1000}{CN} - 10$

2.3 Velocity

Flow velocities for each ditch structure were calculated using the Storm computer program with Manning's Formula:

$$V = \frac{1.49}{n} R^{2/3} S^{1/3}$$

where:

V	=	*Velocity (fps)*
R	=	*Hydraulic Radius (ft.)*
S	=	*Slope (ft. per ft.)*
n	=	*Manning's n; Table 3.1, p. 159,*

"Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner & Haan, 1983.

Note: The following Manning's n were used in the calculations:

Structure	*Manning's n*
Culverts (cmp)	*0.020*
Unlined Disturbed Area Ditches	*0.035*

2.4 Drainage Areas

All drainage areas were planimetered directly from Plate 7-5, Drainage Map, and Plate 7-5C, Watershed Boundaries.

2.5 Slopes, Lengths

All slopes and lengths were measured directly from the topography on Plate 7-5, Drainage Map, and Plate 7-5C, Watershed Boundaries.

2.6 Runoff

Runoff was calculated using the SCS Formula for Type II Storms; using the Storm Version 6.21 computer program:

$$Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S}$$

where:

CN	=	*Runoff Curve Number*
Q	=	*Runoff in inches*
P	=	*Precipitation in inches*
S	=	$\frac{1000}{CN} - 10$

2.7 Runoff Curve Numbers

Two curve numbers were utilized for the undisturbed areas. Average curve numbers for the north facing and south facing slopes were determined from curves presented in Figure 7-3 (Chapter 7), using measured cover densities as reported in Chapter 3 and the northern half of lease area SL 062648, assuming a hydrologic soil group of C. Curve numbers of 60 and 69 were obtained for the north facing and south facing undisturbed areas, respectively, using Chart A for Oak-Aspen and ground cover densities of 45 and 26 for north facing and south facing areas, respectively. The above referenced Figure 7-3 (Chapter 7) is included in this Appendix as Figure 9.

Runoff curve numbers for reclaimed, disturbed and paved areas were selected based on comparison with Table 2.20 (p. 82, Barfield, et al, 1983) and numbers previously approved in the M.R.P. A conservative number of 75 was used for reclaimed areas within the disturbed boundary. Curve numbers of 90 and 95 were used for all disturbed areas and paved areas, respectively. See Plates 7-5 and 7-5C for referenced areas.

The following is a summary of runoff curve numbers used in these calculations:

Watershed	*Runoff CN*
Undisturbed (North Facing):	*60*
Undisturbed (South Facing):	*69*
Reclaimed:	*75*
Disturbed:	*90*
Paved:	*95*

2.8 Culvert Sizing

Minimum culvert sizing is based on the following Manning's Equation; using the Haestad Methods, Flowmaster I, Version 3.42 computer program:

$$D = \left(\frac{2.16 \; Q \; n}{\sqrt{S}} \right)^{0.35}$$

where: D = *Required Diameter (feet)*
Q = *QP = Peak Discharge (cfs)*
n = *Roughness Factor (0.020 for cmp)*
S = *Slope (ft. Per ft.)*

Using the above formula, minimum required culvert sizes were calculated for each applicable area. Culverts were then selected above the required minimum, and these sizes were checked for adequacy against the Culvert Nomograph included as Figure 1 of this report.

2.9 Culverts

As indicated in Section 1, the proposed pad expansion will necessitate modifications of a number of existing hydrologic structures on the site, including culverts. As a result of the expansion, existing culverts C-2, C-8 and C-10 will be removed. Two new culverts (Main Canyon, C-11) were added to provide drainage control for the expanded facility during phase I of the surface expansion. One more (C-11A) will be added during the phase II south portal construction. All other existing culverts on the site will remain unchanged.

Culverts have been sized according to the calculations previously described, and are summarized on the following tables. The culverts are shown on Plate 7-5, Drainage Map.

All undisturbed diversions are labeled with a UD number (i.e. UD-1). One of these diversions is a culvert (UD-1), and is clearly marked on Plate 7-5. Contributing watersheds for undisturbed diversions are labeled with a WSUD number, (i.e. WSUD-1) as shown on Plates 7-5 and 7-5C. All undisturbed diversion culverts will be fitted with trash racks to minimize plugging by rocks or other debris.

The proposed Main Canyon culvert is sized to carry runoff from a 100 year - 6 hour precipitation event for the Crandall Canyon area above the minesite. A 6' diameter C.M.P. culvert is proposed to carry the Crandall Canyon runoff beneath the expanded pad area and discharge below the minesite. Calculations in Table 10 show the proposed 6' diameter culvert to be more than adequate to carry the expected peak flow. The culvert will be equipped with an inlet headwall and trash rack and a properly sized outlet apron and energy dissipator for erosion protection. Runoff characteristics, flow and culvert design are presented in this Appendix.

The remaining undisturbed culverts on the site (UD-1 and UD-3) are existing. These culverts are adequate for the required 10 year - 6 hour precipitation event, as shown on Table 10 of this Appendix.

Culverts carrying disturbed drainage are designed with a C number (i.e. C-1). Contributing watersheds for disturbed area culverts (and ditches) are designated with a WSDD number (i.e. WSDD-1) shown on Plate 7-5. All disturbed area drainage culverts have been designed to carry the runoff from a 10 year - 24 hour precipitation event. All calculations and design criteria are included in this Appendix.

Existing culverts C-2, C-8 and C-10 will be removed during the pad extension, and therefore are not included in this Appendix. These culverts are shown on Plate 7-5C, dated 03/21/91.

All culverts will be inspected regularly, and cleaned as necessary to provide for passage of design flows. Inlets and outlets shall also be maintained to prevent plugging, undue restriction of water flow and erosion. Culvert outlets will be rip-rapped where necessary to protect from erosion.

One culvert, UD-1, is considered a permanent diversion, and will remain in place after reclamation. This culvert is sized to carry runoff in-excess of a 100 year - 6 hour storm. Justification for leaving it in place is provided in the Reclamation Hydrology Section 4.1, of this Appendix.

All other culverts are considered temporary, and will be removed upon final reclamation, with the exception of the lower 300' of the Main Canyon Culvert. This portion of the culvert will be left in place until the sediment pond is removed during Phase II Reclamation. The remaining portion of the culvert will be removed at that time.

2.10 Ditches

The proposed pad expansion will necessitate modifications to hydrologic structures, including ditches. As a result of the expansion, existing ditch DD-9 will be eliminated. Two new ditches (DD-12 and DD-13) will be added to provide drainage control for the expanded facility. All other existing ditches on the site will remain unchanged.

Undisturbed diversions are designated with a UD number (i.e. UD-2). There is only one undisturbed diversion ditch - (UD-2). This ditch is existing. Contributing watersheds for the undisturbed diversion are labelled with a WSUD number (i.e. WSUD-2), and are shown on Plate 7-5C.

Disturbed diversions (ditches) are designated with a DD number (i.e. DD-1). Contributing watersheds for disturbed diversions are labelled with a WSDD number (i.e. WSDD-1) as shown on Plates 7-5 and 7-5C. All disturbed diversions carry runoff which ultimately goes to the sediment pond.

All ditches are designed to carry the expected runoff from respective watersheds from a 10 year - 6 hour precipitation event, with a minimum freeboard of 0.3'. Ditches were assumed to be unlined with a Manning's No. of 0.035. All ditches have been conservatively evaluated for size using the computer program "Office of Surface Mining Watershed Model," Storm, Version 6.21, by Gary E. McIntosh, to calculate peak flows, which were then routed into triangular shaped channels with 1:1 side slopes. This evaluation shows conditions which are not uncommon at minesites and which tend to maximize required flow depths. All ditches are designed with the steeper (1:1) side slopes to allow for maintenance by road grading or other equipment. Actual side slopes may vary in the field; however, as long as the ditch has the required depth and cross-sectional area to carry the flow with required

freeboard, the ditch is adequate.

Ditches with flow velocities of 5 fps or greater will be lined with properly sized rip-rap or other controls to protect from erosion.

All ditch slopes and lengths were taken from Plate 7-5, "Drainage Map".

A typical ditch section, as well as a summary of flow depths and sizes is provided in Figure 3 of this Appendix.

All ditches will be inspected regularly, constructed and maintained to the minimum dimensions to provide adequate capacity for the design flow. All ditches are temporary and will be removed during final reclamation.
Note: Ditches were also evaluated for adequacy to carry runoff from the 10 year - 24 hour precipitation event.

2.11 Main Canyon Culvert

The proposed main canyon culvert will be placed to closely approximate the existing stream alignment. In an effort to protect the natural channel, the area will be covered with a filter fabric (geotextile material). An underdrain will then be installed on the fabric, consisting of an 18" perforated drain pipe surrounded by a bed of clean 2" drain drainrock. The underdrain will be covered by a second layer of fabric which in turn will be covered with a layer of marker material used to facilitate visibility during final reclamation. A layer of bedding material will then be placed over the marker material. The proposed 72" cmp culvert will then be installed on the bedding material and backfilled and compacted throughout the length of the mine site - approximately 1500'.

The culvert has been sized to safely carry the runoff from a 100 year - 6 hour precipitation event for all of Crandall Canyon above the minesite. The 100 year - 6 hour flow has been calculated at 222.79 cfs, as shown on Table 3. This flow can be carried by a 3.75' minimum diameter culvert, as calculated by the Manning's Equation and shown in Table 10; therefore, the proposed 6' diameter culvert is more than adequate.

There have been some questions raised as to previous main canyon flow calculations which showed the expected runoff from the 100 year - 6 hour storm to be as high as 431 cfs. It appears this number was generated by using a computer program called "Peak", using slightly different parameters than those used in this report.

The runoff numbers in this Appendix were calculated using the "Office of Surface Mining Watershed Model", Storm Version 6.21, by Gary E. McIntosh. All flows were based on the SCS-TR55 Method for Type II storms. This program has been supplied to the operators by the Division, and results have been consistently accepted

by the agencies.

In an effort to make the runoff values more conservative, yet realistic, for design purposes, some parameters, such as concentration time and SCS Upland Curve numbers were placed on the conservative side in the program. Based on these numbers, a very conservative flow of 222.79 cfs was obtained. It should be noted that this flow agrees closely with a previous calculation using the equation of Thomas and Lindskov (1983), which estimates the 100 year - 6 hour flow for the main canyon at 272 cfs.

Summary: It is obvious that the final number on the main channel flow is entirely dependent upon which computer program or method is used. Since the OSM Storm program has been used throughout calculations for this plan, and since it is a widely accepted method, the more conservative figure of 222.79 cfs has been used in design calculations for this plan.

2.12 Main Canyon Culvert Inlet Structure

The culvert inlet will be protected by an inlet section and trash rack, along with a rip-rapped headwall. An additional trash rack will be installed upstream of the inlet at a location convenient for maintenance and cleanout, as shown on Figure 10. Based on the Culvert Nomograph, Figure 1, the expected flow will enter the culvert at slightly over 1 diameter of head; therefore, additional headwall protection will be provided for a minimum of 5' above and around the inlet structure. Headwall protection will be of 18" D_{50} rip-rap, as shown on Figure 10.

A small side drainage enters Crandall Creek just west of the bypass culvert inlet. As the drainage calculations took into consideration the runoff from this side canyon, the bypass culvert and inlet riprap are adequately sized to handle drainage from this side canyon. The riprap has been extended up this drainage for a short distance (see Map 5-3) in order to protect the culvert inlet.

2.13 Main Canyon Culvert - Outlet Structure

The outlet of the 6' diameter main canyon culvert has been designed to flow into a rip-rap apron to protect against scouring and for energy dissipation. The rip-rap apron is designed to fit the natural channel configuration as closely as possible, and will allow runoff to re-enter the natural channel at a reduced velocity which is no greater than natural flow conditions. Runoff from the 100 year - 6 hour precipitation event in the canyon above the minesite has been calculated at 222.79 cfs.

The rip-rap apron design is based on Figure 7-26, Design of Outlet Protection - Maximum Tailwater Condition, "Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner and Haan, 1983. Based on the figure, the apron should be a minimum of 22' in length, widening from 6' to 15', with a 0% slope. The proposed length has been increased to 30', with an 18' width, to ensure adequate time for velocity reduction. The slope is kept at 0%. Rip-rap size is conservatively placed at 30" D_{50}. Rip-rap will be placed to a depth of 1.5 D_{50} and will be embedded in a 12" layer of 2" drain rock filter. Rip-rap will also be placed on 1:1 side slopes to the height of the culvert (6') at the culvert outlet tapering to 3' at the outlet of the apron. This rip rap apron has been sized and designed to adequately dissipate energy from flow velocities of a 100 year, 24 hour precipitation event and resist dislodgement. The drain rock filter bed will also serve to secure the rip rap boulders firmly in place, to add an additional element of stability, and prevent scouring underneath the boulder bed.

The natural channel below the proposed outlet has been measured from field surveys to have a bottom width of approximately 17' at the proposed apron outlet, with side slopes approximately 1:1. When the flow is routed from the culvert across the apron to the natural channel, the velocity is reduced from 21.70 fps at the culvert outlet to 10.83 fps at the outlet of the apron. Refer to 72" Culvert Outlet Rip-Rap Apron Flow Velocity Calculations in Section 4.6. Based on actual field measurements, the natural channel flow velocity would be approximately 11.02 fps at this location with the same flow of 222.79 cfs. Therefore, the velocity of the stream flow exiting the rip rap apron will be less than the velocity in the naturally existing stream bed, at that location, under similar conditions.

TABLE 1
WATERSHED SUMMARY

Watershed	Type	CN	Acres	Drains To		Final
Crandall	Undisturbed	69	3480.00	Main Culvert	-	Crandall Creek
WSUD-1	Undisturbed	69	84.88	Culvert UD-1	-	Crandall Creek
WSUD-2	Undisturbed	69	1.39	Ditch UD-2	-	Culvert UD-1
WSUD-3	Undisturbed	69	8.66	Culvert UD-3	-	Sediment Pond
WSDD-1	Undisturbed	69	0.14	Ditch DD-1	-	Sediment Pond
WSDD-1	Reclaimed	75	0.08	Ditch DD-1	-	Sediment Pond
WSDD-2	Reclaimed	75	0.15	Ditch DD-1	-	Sediment Pond
WSDD-3	Undisturbed	69	0.13	Ditch DD-3	-	Sediment Pond
WSDD-3	Reclaimed	75	0.15	Ditch DD-3	-	Sediment Pond
WSDD-3	Disturbed	90	0.26	Ditch DD-3	-	Sediment Pond
WSDD-3	Paved	95	0.33	Ditch DD-3	-	Sediment Pond
WSDD-4	Paved Road	95	0.11	Ditch DD-4	-	Sediment Pond
WSDD-4	Disturbed	90	0.08	Ditch DD-4	-	Sediment Pond
WSDD-5	Undisturbed	69	0.12	Ditch DD-5	-	Sediment Pond
WSDD-5	Reclaimed	75	0.33	Ditch DD-5	-	Sediment Pond
WSDD-5	Paved Road	95	0.33	Ditch DD-5	-	Sediment Pond
WSDD-7	Undisturbed	69	0.18	Ditch DD-7	-	Sediment Pond
WSDD-7	Disturbed	90	0.17	Ditch DD-7	-	Sediment Pond
WSDD-7	Paved Road	95	0.09	Ditch DD-7	-	Sediment Pond
WSDD-8	Undisturbed	69	3.59	Ditch DD-8	-	Sediment Pond
WSDD-8	Reclaimed	75	0.15	Ditch DD-8	-	Sediment Pond
WSDD-8	Disturbed	90	0.37	Ditch DD-8	-	Sediment Pond
WSDD-8	Paved Road	95	0.25	Ditch DD-8	-	Sediment Pond
WSDD-10	Undisturbed	69	0.07	Culvert C-4	-	Sediment Pond
WSDD-10	Reclaimed	75	0.12	Culvert C-4	-	Sediment Pond
WSDD-10	Disturbed	90	0.61	Culvert C-4	-	Sediment Pond
WSDD-10	Paved Road	95	0.27	Culvert C-4	-	Sediment Pond
WSDD-11	Undisturbed	69	2.09	Ditch DD-11	-	Sediment Pond
WSDD-11	Reclaimed	75	0.15	Ditch DD-11	-	Sediment Pond
WSDD-11	Disturbed	90	0.04	Ditch DD-11	-	Sediment Pond
WSDD-12	Undisturbed	60	8.82	Ditch DD-12	-	Sediment Pond
WSDD-12	Disturbed	90	2.29	Ditch DD-12	-	Sediment Pond
WSDD-13	Undisturbed	60	17.72	Ditch DD-13	-	Sediment Pond
WSDD-13	Disturbed	90	3.70	Ditch DD-13	-	Sediment Pond
WSDD-13	Paved	95	0.27	Ditch DD-13	-	Sediment Pond
WSDD-14	Disturbed	90	0.89	Sediment Pond	-	Sediment Pond
WSDD-14	Undisturbed	60	0.78	Sediment Pond	-	Sediment Pond
WSDD-14	Paved	95	0.02	Sediment Pond	-	Sediment Pond
WSDD-15	Paved	95	0.09	Ditch DD-7	-	Sediment Pond

TABLE 2
WATERSHED PARAMETERS

Watershed	Type	CN	Acres	Hyd. Length(ft.)	Land Slope(%)	Elev.Change(ft.)
Crandall	Und.	69	3480.00	16,500	17.58	2900
WSUD-1	Und.	69	84.88	3,100	53.55	1660
WSUD-2	Und.	69	1.39	320	78.13	250
WSUD-3	Und.	69	8.66	1300	70.77	920
WSDD-1	Und.	69	0.14	100	40.00	40
WSDD-1	Recl.	75	0.08	120	25.00	30
WSDD-2	Recl.	75	0.15	200	25.00	50
WSDD-3	Und.	69	0.13	80	50.00	40
WSDD-3	Recl.	75	0.15	100	48.00	48
WSDD-3	Dist.	90	0.26	125	56.00	70
WSDD-3	Paved	95	0.33	100	3.00	3
WSDD-4	Paved	95	0.11	250	8.33	20
WSDD-4	Dist.	90	0.08	100	10.00	10
WSDD-5	Und.	69	0.12	60	50.00	30
WSDD-5	Recl.	75	0.33	80	50.00	40
WSDD-5	Paved	95	0.33	300	8.33	25
WSDD-7	Und.	69	0.18	100	78.00	78
WSDD-7	Dist.	90	0.17	120	66.67	80
WSDD-8	Und.	69	3.59	700	65.71	460
WSDD-8	Recl.	75	0.15	80	62.50	50
WSDD-8	Dist.	90	0.37	60	65.71	39
WSDD-8	Paved	95	0.25	560	5.36	30
WSDD-10	Und.	69	0.07	45	62.22	28
WSDD-10	Recl.	75	0.12	50	72.00	36
WSDD-10	Dist.	90	0.61	120	62.50	75
WSDD-10	Paved	95	0.27	335	5.37	18
WSDD-11	Und.	69	2.09	570	64.91	370
WSDD-11	Recl.	75	0.15	30	66.67	20
WSDD-11	Dist.	90	0.04	35	66.67	23
WSDD-12	Und.	60	8.82	1600	42.50	680
WSDD-12	Dist.	90	2.29	80	72.73	58
WSDD-13	Und.	60	17.72	2100	53.81	1130
WSDD-13	Dist.	90	3.70	650	9.09	59
WSDD-13	Paved	95	0.27	40	4.00	2
WSDD-14	Dist.	90	0.89	140	16.11	23
WSDD-14	Und.	60	0.78	380	64.41	245
WSDD-14	Paved	95	0.02	30	3.00	1
WSDD-15	Paved	95	0.09	150	3.33	5

TABLE 3
RUNOFF SUMMARY
UNDISTURBED DIVERSIONS

Diversion	*Main Culvert*	*UD-1*	*UD-2*	*UD-3*
Watershed	*Crandall Canyon*	*WSUD-1*	*WSUD-2*	*WSUD-3*
Area (Acres)	*3480.0*	*84.88*	*1.39*	*8.66*
Runoff CN	*69*	*69*	*69*	*69*
10 year/6 hour Rainfall (in.)	*1.55*	*1.55*	*1.55*	*1.55*
Peak Flow 10/6 (cfs)	*N/A*	*1.91*	*0.04*	*0.23*
25 year/6 hour Rainfall (in.)	*1.90*	*1.90*	*1.90*	*1.90*
Peak Flow 25/6 (cfs)	*N/A*	*3.68*	*0.08*	*0.43*
100 year/6 hour Rainfall (in.)	*2.40*	*2.40*	*2.40*	*2.40*
Peak Flow 100/6 (cfs)	*222.79*	*6.81*	*0.21*	*0.89*
10 year/24 hour Rainfall (in.)	*N/A*	*2.50*	*2.50*	*2.50*
Runoff Volume 10/24 (ac.ft.)	*N/A*	*2.98*	*0.05*	*0.30*

TABLE 4
RUNOFF SUMMARY
DRAINAGE TO SEDIMENT POND

Watershed	Type	10 year/24 hour Volume-ac.ft.	10 year/24 hour Peak Flow-cfs	10 year/6 hour Peak Flow-cfs	25 year/6 hour Peak Flow-cfs
WSDD-1	Undisturbed	0.02	0.10	0.04	0.06
WSDD-1	Reclaimed	0.01	0.04	0.01	0.01
WSDD-2	Reclaimed	0.01	0.06	0.01	0.03
WSDD-3	Undisturbed	0.00	0.03	0.00	0.01
WSDD-3	Reclaimed	0.01	0.05	0.01	0.02
WSDD-3	Disturbed	0.03	0.18	0.08	0.12
WSDD-3	Paved	0.05	0.32	0.17	0.22
WSDD-4	Paved	0.02	0.12	0.07	0.09
WSDD-4	Disturbed	0.01	0.08	0.04	0.05
WSDD-5	Undisturbed	0.00	0.03	0.00	0.01
WSDD-5	Reclaimed	0.02	0.10	0.02	0.04
WSDD-5	Paved	0.05	0.39	0.21	0.27
WSDD-7	Undisturbed	0.01	0.05	0.00	0.01
WSDD-7	Disturbed	0.02	0.12	0.05	0.07
WSDD-8	Undisturbed	0.43	2.15	0.33	0.63
WSDD-8	Reclaimed	0.01	0.05	0.01	0.02
WSDD-8	Disturbed	0.05	0.23	0.10	0.14
WSDD-8	Paved	0.04	0.37	0.20	0.26
WSDD-10	Undisturbed	0.00	0.03	0.00	0.01
WSDD-10	Reclaimed	0.01	0.03	0.01	0.01
WSDD-10	Disturbed	0.08	0.42	0.19	0.27
WSDD-10	Paved	0.04	0.35	0.19	0.24
WSDD-11	Undisturbed	0.07	0.47	0.06	0.12
WSDD-11	Reclaimed	0.01	0.04	0.01	0.02
WSDD-11	Disturbed	0.01	0.06	0.03	0.04
WSDD-12	Undisturbed	0.13	0.25	0.04	0.16
WSDD-12	Disturbed	0.29	3.33	1.51	2.10
WSDD-13	Undisturbed	0.26	0.49	0.07	0.30
WSDD-13	Disturbed	0.47	5.39	2.44	3.39
WSDD-13	Paved	0.04	0.20	0.11	0.14
WSDD-14	Disturbed	0.11	0.78	0.35	0.49
WSDD-14	Undisturbed	0.01	0.03	0.00	0.02
WSDD-14	Paved	0.02	0.07	0.04	0.05
WSDD-15	Paved	0.02	0.11	0.06	0.08
Totals		2.36	16.53	6.46	9.50

TABLE 5
RUNOFF CONTROL STRUCTURE
WATERSHED SUMMARY

Structure	Type	Contributing Watersheds
Main Culvert	Culvert	Crandall Canyon Above Mine
UD-1	Culvert	WSUD-1
UD-2	Culvert	WSUD-2
UD-3	Culvert	WSUD-3
DD-1	Ditch	WSDD-1, WSDD-2
DD-3	Ditch	WSDD-1, WSDD-2, WSDD-3
DD-4	Ditch	WSDD-1, WSDD-2, WSDD-3, WSDD-4, WSDD-8, WSDD-12
DD-5	Ditch	WSDD-1, WSDD-2, WSDD-3, WSDD-4, WSDD-5, WSDD-8, WSDD-12
DD-7	Ditch	WSDD-7, WSDD-11
DD-8	Ditch	WSDD-8, WSUD-3
DD-11	Ditch	WSDD-11
DD-12	Ditch	WSDD-12
DD-13	Ditch	WSDD-13
DD-14	Sheet Flow	WSDD-14
C-1	Culvert	WSDD-1, WSDD-2, WSDD-3, WSDD-8
C-3	Culvert	WSDD-7, WSDD-11, WSDD-15
C-4	Culvert	WSDD-10
C-5	Culvert	WSDD-11
C-6	Culvert	WSUD-2
C-7	Culvert	WSDD-1, WSDD-2, WSDD-3
C-9	Culvert	WSDD-4, WSDD-12
C-11	Culvert	WSDD-12
C-11A	Culvert	WSDD-12
C-12	Culvert	WSDD-1, 2, 3, 4, 5, 8, 12
C-13	Culvert	WSDD-13
C-14	Slot Culvert	WSDD-4
C-15	Slot Culvert	WSDD-15
C-16	Culvert	WSDD-13
C-17	Culvert	WSDD-13
Sediment Pond	Pond	WSDD-1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13, 14

TABLE 6
RUNOFF CONTROL STRUCTURE
FLOW SUMMARY

Structure	Type	10 year/6 hour Peak Flow-cfs	10 year/24 hour Peak Flow-cfs	25 year/6 hour Peak Flow-cfs	100 year/6 hour Peak Flow-cfs
Main Culvert	Culvert	-	-	-	222.79
UD-1	Culvert	1.91	-	3.68	6.81
UD-2	Ditch	0.04	-	0.08	0.21
UD-3	Culvert	0.23	-	0.43	0.89
DD-1	Ditch	0.06	0.20	0.10	-
DD-3	Ditch	0.32	0.78	0.47	-
DD-4	Ditch	2.39	5.96	3.49	-
DD-5	Ditch	2.85	7.88	4.24	-
DD-7	Ditch	0.21	0.85	0.34	-
DD-8	Ditch	0.64	2.80	1.05	-
DD-11	Ditch	0.10	0.57	0.18	-
DD-12	Ditch	1.55	3.58	2.26	-
DD-13	Ditch	2.62	6.08	3.83	-
DD-14	Sht Flw	0.39	0.88	0.56	-
C-1	Culvert	0.96	3.58	1.52	-
C-3	Culvert	0.21	0.85	0.34	-
C-4	Culvert	3.01	6.79	4.02	-
C-5	Culvert	0.10	0.57	0.18	-
C-6	Culvert	0.04	-	0.08	-
C-7	Culvert	0.32	0.78	0.47	-
C-9	Culvert	0.11	0.20	0.14	-
C-11	Culvert	1.55	3.58	2.26	-
C-11A	Culvert	1.55	3.58	2.26	-
C-12	Culvert	2.85	7.36	3.92	-
C-13	Culvert	2.62	6.08	3.83	-
C-14	Slot Cul.	0.11	0.20	0.14	-
C-15	Slot Cul.	0.06	0.11	0.08	-
C-16	Culvert	2.62	6.08	3.83	-
C-17	Culvert	2.62	6.08	3.83	-
Sediment Pond	Pond	6.46	16.53	9.50	-

TABLE 7
DISTURBED DITCH DESIGN SUMMARY

Ditch	DD-1	DD-3	DD-4	DD-5	DD-7	DD-8	DD-11
Slope (%)	30.77	3.00	11.91	4.50	3.33	3.59	3.00
Length (ft.)	130	75	168	628	142	557	173
Manning's No.	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Side Slope (H:V)	1:1	1:1	1:1	1:1	1:1	1:1	1:1
*Bottom Width (ft.)	0	0	0	0	0	0	0
Peak Flow 10/6 (cfs)	0.06	0.32	2.39	2.85	0.21	0.64	0.10
Peak Flow 10/24 (cfs)	0.20	0.78	5.96	7.88	0.85	2.80	0.57
Flow Depth (ft.) 10/6	0.14	0.40	0.66	0.84	0.33	0.50	0.26
Flow Depth (ft.) 10/24	0.22	0.56	0.92	1.23	0.57	0.87	0.50
Flow Area (ft^2)10/6	0.02	0.16	0.43	0.71	0.11	0.25	0.07
Flow Area (ft^2)10/24	0.05	0.31	0.85	1.52	0.32	0.76	0.25
Velocity (fps)10/6	3.15	2.00	5.55	4.02	1.87	2.55	1.50
Velocity (fps) 10/24	4.26	2.50	6.97	5.19	2.66	3.68	2.31
Rip-Rap Req'd (Y/N)	N	N	Y	N	N	N	N
Rip-Rap D_{50}	-	-	6"	-	-	-	-

* All ditches are triangular.
Note: Slope/Lengths from Plate 7-5.

TABLE 7 (Continued)
DISTURBED DITCH DESIGN SUMMARY

Ditch	DD-12	DD-13 (MIN.)	DD-13 (MAX.)
Slope (%)	3.29	1.79	50.00
Length (ft.)	50	280	80
Manning's No.	0.035	0.035	0.035
Side Slope (H:V)	1:1	1:1	2:1
Bottom Width (ft.)	0	0	2
Peak Flow 10/6 (cfs)	1.55	2.62	2.62
Peak Flow 10/24 (cfs)	3.58	6.08	6.08
Flow Depth (ft.) 10/6	0.71	0.97	0.15
Flow Depth (ft.) 10/24	0.97	1.33	0.24
Flow Area (ft^2) 10/6	0.50	0.94	0.34
Flow Area (ft^2) 10/24	0.94	1.77	0.60
Velocity (fps) 10/6	3.07	2.79	7.66
Velocity (fps) 10/24	3.79	3.44	10.12
Rip-Rap Req'd (Y/N)	N	N	Y
Rip-Rap D_{50}	-	-	9"

** All ditches are triangular.*
Note: Slope/Lengths from Plate 7-5.
Note: DD-12 is shortened due to construction of the south portal access ramp/fan pad.

TABLE 8
UNDISTURBED DITCH DESIGN SUMMARY

Ditch	*UD-2*
Slope (%)	*12.5*
Length (ft.)	*400*
Manning's No.	*0.035*
Side Slope (H:V)	*1:1*
Bottom Width (ft.)	*0*
Peak Flow-10/6 (cfs)	*0.04*
Flow Depth (ft.)	*0.14*
Flow Area (ft^2)	*0.02*
Velocity (fps)	*2.03*
Lined (Y/N)	*N*
Rip-Rap Req'd (Y/N)	*N*

Note: Slope/Lengths from Plate 7-5.

TABLE 9
DISTURBED CULVERT DESIGN SUMMARY

Culvert	C-1	C-3	C-4	C-5	C-6	C-7	C-9	C-11	C-11A	C-12	C-13	C-14	C-15	C-16	C-17
Slope (%)	16.67	8.00	25.07	57.14	17.20	3.00	3.50	3.50	1.50	4.50	3.00	1.00	1.00	25.00	20.00
Length (ft.)	60	360	69	120	12	80	18	30	60	330	100	40	30	40	60
Manning's No.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Peak Flow 10/6 (cfs)	0.96	0.21	3.01	0.10	0.04	0.32	0.11	1.55	1.55	2.85	2.62	0.11	0.06	2.62	2.62
Peak Flow 10/24 (cfs)	3.58	0.85	6.79	0.57	N/A	0.78	0.20	3.58	3.58	7.36	6.08	0.20	0.11	6.08	6.08
Min. Diam. Req'd (ft.) 10/6	0.42	0.28	0.60	0.14	0.13	0.39	0.25	0.68	0.80	0.82	0.85	0.32	0.25	0.57	0.60
Min. Diam. Req'd (ft.) 10/24	0.69	0.46	0.82	0.28	N/A	0.54	0.32	0.93	1.09	1.16	1.17	0.40	0.32	0.79	0.82
Diam. Installed (ft.)	1.50	2.00	2.00	1.00	1.00	1.00	1.00	1.50	1.50	2.00	2.00	1.00	1.00	1.67	1.50
Velocity (fps) 10/6	6.80	3.53	10.54	6.13	3.11	2.71	2.20	4.27	3.10	5.46	4.59	1.38	1.18	10.17	9.35
Velocity (fps) 10/24	9.44	5.01	12.91	9.47	N/A	3.39	2.56	5.26	3.83	6.92	5.67	1.60	1.38	12.55	11.54
Rip-Rap D_{50}	12"	-	12"	6"	-	-	-	-	-	6"	-	-	-	12"	12"

Note: Slope/Lengths from Plate 7-5.
Source: (Haestad Methods, Flowmaster I, Version 3.42)

TABLE 10
UNDISTURBED CULVERT DESIGN SUMMARY

Culvert	**Main Canyon*	*UD-1*	*UD-3*
Slope (%)	*8.00*	*23.33*	*11.96*
Length (ft.)	*1500*	*270*	*460*
Manning's No.	*0.02*	*0.02*	*0.02*
Peak Flow 100/6 (cfs)	*222.79*	-	-
Peak Flow 10/6 (cfs)	-	*1.91*	*0.23*
Min. Diam. Req'd (ft.)	*3.75*	*0.52*	*0.26*
Diam. Installed (ft.)	*6.00*	*3.50*	*2.00*
Velocity (fps)	*20.14*	*9.16*	*4.20*

* *Culvert to be installed under expansion plan.*
All other undisturbed culverts are existing.

Note: Slope/Lengths from Plate 7-5.
Source: (Haestad Methods, Flowmaster I, Version 3.43)

DESIGN OF SEDIMENT CONTROL STRUCTURES

Design Specifications:

Tables:

Figures:

3.1 Design Specification for Expanded Sediment Pond

The sedimentation pond located in Crandall Canyon has been redesigned and reconstructed to control the additional storm runoff from the pad extension and from the undisturbed drainage areas above the pad extension. The "As-Constructed" topography and cross sections of the pond design are shown on Plate 7-3.

The pond has been sized to meet the requirements of R645-301-742.221.33 (DOGM), which stipulates that sedimentation ponds be capable of containing or treating the 10-year 24-hour precipitation event. According to Miller, et al (1973), the 10-year, 24-hour design storm for Crandall Canyon is 2.5 inches. The design storm calculations for the sedimentation pond are presented in Table 4 of this Appendix. These calculations include the proposed pad extension, the additional watersheds above the pad extension, the existing pad and reclaimed areas, and the undisturbed watersheds above the existing pad.

As required by R645-301-742.223, the 25 year-6 hour precipitation event was routed through the sedimentation pond to determine the adequacy of the spillway. Overflow from the pond is discharged to Crandall Creek. Total precipitation from the 25 year-6 hour storm is 1.9 inches (Miller, et al, 1973). The 25 year-6 hour flow is calculated at 9.07 cfs. Based on the calculations, the primary spillway is more than adequate to carry the expected runoff from a 25 year-6 hour event.

3.2 Sediment Yield

The Universal Soil Equation (USLE) was used to estimate sediment yield from all drainage areas contributing to the pond. All soil loss from this area was assumed to be delivered to, and deposited in the sedimentation pond.

Erosion rate (A) in tons-per-acre-per-year is determined using the USLE as follows:

$$A = (R)\ (K)\ (LS)\ (CP)$$

Where the variables R, K, LS, and CP are defined as follows:

Variable "R" is the rainfall factor which can be estimated from $R = 27P^{2.2}$*; where P is the 2-year, 6-hour precipitation value. P for the Crandall Canyon area is estimated at 1.00" based on Figure 5.4, page 315, Barfield, et.al. 1983. Therefore, the estimated value of "R" for this area is 27.00.*

Variable "K" is the soil erodibility factor. For disturbed areas, the "K" value is taken as 0.06 as determined from soils samples and shown on the soil erodibility chart, Figure 4. K is estimated to be 0.15 for undisturbed and reclaimed areas, based on soils data and the soil erodibility chart, Figure 5.

Variable "LS" is the length-slope factor. This figure was determined by calculating a weighted average slope length and percentage for the undisturbed, reclaimed and disturbed areas, respectively. The slope length and percentage were then substituted into the following equation to determine the LS Factor:

$$(\frac{\pi}{72.6})^{m}(\frac{430\ x^2 + 30\ x + 0.}{6.613}$$

where:

π	=	*Field slope length in feet;*
^{m}	=	*0.5 if S is 5% or greater;*
x	=	*sin* θ*;*
θ	=	*Angle of slope in degrees.*

Variable "CP" is the control practice factor, which can be divided into a cover and practice factor. Values were determined from Appendix 5A, Barfield, et.al., 1983.

Site	CP Factor
Disturbed Areas	1.20
Reclaimed Areas	0.100
Undisturbed Areas	0.003

The sediment volume is based on a density of 100 pounds per cubic foot of sediment.

SEDIMENT YIELD CALCULATIONS - USLE

Drainage	R	K	Acres	Slope Length Feet	%	LS	CP	A*	Yield**
Undisturbed	27.00	0.15	42.25	1700	53	79.60	0.003	00.967	0.019
Reclaimed	27.00	0.15	1.22	90	52	17.81	0.10	07.213	0.004
Disturbed	27.00	0.06	8.92	350	26	11.69	1.200	22.725	0.093

Total Sediment 1 year (ac.ft.) 0.116

Total Sediment 3 years (ac. ft.). 0.348

* *A = tons/acre-year*
** *Yield = acre-ft/year*

3.3 Sediment Pond Volume

The volumes shown in Table 11 are from the volumes calculated from the precipitation, runoff and sediment yield for a 10 year-24 hour precipitation event. The volumes were calculated based on the disturbed areas (and contributing undisturbed areas) runoff values, developed using the design parameters described in this section.

The sediment pond has been reconstructed, and the sediment pond volumes on Table 11, Table 12 and Figure 6 all represent the "As-Constructed" pond.

Expanded Area Pond Requirement

3 Year Sediment Storage

TABLE 11
SEDIMENT POND DESIGN

1. *Use 2.50" for 10 year-24 hour event.*

2. *Runoff Volume (from Table 4, 10 yr/24 hr) =* 2.360 ac. ft.

3. *Sediment Storage Volume*

   USLE 0.116 ac.ft./yr. x 3 yrs. = 0.348 ac. ft.

4. *Direct Precipitation into Pond*

   0.441 acres x 2.50" / 12 in./ft. = 0.092 ac. ft.

5. *Total Required Pond Volume*

   2.360 + 0.348 + 0.092 = 2.800 ac. ft.

6.* *Peak Flow (25 yr. - 6 hr. event) =* 9.500 cfs

7. *Pond Design Volume @ Principle Spillway =*
   (See Table 12) 3.572 ac. ft.

* *Peak Flow values from Table 4.*

TABLE 12
SEDIMENT POND
STAGE / VOLUME DATA

Elev.	Area	Volume	Acc. Volume (ac.ft.)	Remarks
7766	1756.67	.0000	.0000	Bottom of Pond
7767	3706.92	2731.80	0.063	
7768	5119.14	4413.03	0.164	
7769	5857.00	5488.07	0.290	Sediment Cleanout Level
7770	6949.54	6403.32	0.437	Maximum Sediment Level
7771	7806.54	7378.14	0.606	
7772	8894.51	8350.53	0.798	
7773	9905.02	9399.77	1.014	
7774	11055.91	10480.47	1.254	
7775	12153.06	11604.49	1.520	
7776	13120.22	12636.64	1.810	
7777	14084.05	13602.14	2.123	
7778	15043.33	14563.69	2.457	
7779	15984.66	15514.00	2.813	
7780	16934.94	16459.15	3.191	
7780.81	17669.26	14014.70	3.513	Principal Spillway
7781	17868.13	3376.05	3.591	
7781.81	18661.53	15028.20	3.936	Emergency Spillway
7782	18848.42	3430.08	4.012	
7783	19886.14	19367.28	4.457	
7784	21113.55	20499.85	4.927	
7785	22110.39	21611.97	5.423	Top of Embankment

TABLE 13
SEDIMENT POND
STAGE / DISCHARGE DATA

Head (ft.)	Q (cfs) Weir Controlled	Q (cfs) Orfice Controlled	Q (cfs) Pipe Flow Controlled
0.0	-	-	-
0.2	1.69	6.77	17.14
0.4	4.77	9.57	17.32
0.6	8.76	11.72	17.50
0.8	13.49	13.53	17.68
1.0	18.85	15.13	17.86

Note: 1- 25 year-6 hour flow = 9.500 cfs.

2- Flow will be weir controlled at a head of 0.64' over riser inlet.

Weir Controlled

$Q = CLH^{1.5}$; where : $C = 3.0$, L = Circumference of Riser = 6.2832'

Orifice Controlled

$Q = C'a\,(2gH)^{0.5}$; where : $C = 0.6$, a = Area of Riser = 3.1416 ft^2, $g = 32.2\ ft/sec^2$

Pipe Flow Controlled

$$Q = \frac{a\,(2gH')0.5}{(1+Ke+Kb+KcL)^{0.5}}$$; where

a = Area of Pipe = 1.77 ft^2

H' = Head = H + 9.1 (At outlet of Riser)

$Ke = 1.0$

$Kb = 0.5$

$Kc = 0.043$

$L = 90'$

3.4 Sediment Pond Summary

a) The sedimentation pond has been designed to contain the disturbed area (and contributing undisturbed area) runoff from a 10 year-24 hour precipitation event, along with 3 years of sediment storage capacity. Runoff to the pond will be directed by various ditches and culverts as described in the plan.

b) The required volume for the sediment pond is calculated at 2.800 acre feet, including 3 years of sediment storage. The existing sediment pond size will be a volume of approximately 3.988 acre feet (at the principle spillway), which is more than adequate. Existing decant and spillway design will not be modified for the pond expansion.

c) The pond will meet a theoretical detention time of 24 hours. It is equipped with a decant, a culvert principle spillway and an open-channel emergency spillway. Any discharge from the pond will be in accordance with the approved UPDES Permit.

d) The pond inlets will be protected from erosion, and the spillway will discharge into the main Crandall Canyon drainage.

e) The pond is temporary, and will be removed upon final reclamation of the property.

f) The pond expansion will be constructed according to the regulations and under supervision of a Registered, Professional Engineer.

g) The pond volume has been increased at the request of the Forest Service to provide a greater level of protection for forest resources located down stream from the minesite. The enlarged pond capacity (3.572 acre ft.) is over-designed by nearly 30% to contain the 10 year-24 hour design evert.

Storm Event	Pond Volume Required	Pond Capacity Provided
10 yr./24 hr.	2.800 acre ft.	128%

3.5 Alternate Sediment Control Areas (ASCA's)

ASCA-2 (consisting of 0.34 acre) exists at the northwest corner of the site. This area was initially constructed as a substation pad but was never utilized as such. A 12-inch CMP culvert was installed to act as a discharge into UD-1. A silt fence and strawbale dike have been placed to trap the sediment and prevent erosion. (Refer to Plates 7-5)

ASCA-5, ASCA-6, ASCA-7 and ASCA-11 consist of the topsoil stockpiles #1, #2, #3, and #4 respectfully. These stockpiles are located on the north and south side of the access road as shown on Plate 2-3. Disturbed areas associated with the topsoil stockpiles are 0.20 acres, 0.22 acres, 0.62 acres and 0.65 acres for ASCA-5, ASCA-6, ASCA-7, and ASCA-11, respectively. All topsoil stockpiles have been protected from erosion by a combination of dikes, silt-fencing, berms, and a vegetative cover. (Refer to Plate 2-3)

ASCA-9 (0.15 acres) is the outslope of the sediment pond; ASCA-10 (0.02 acres) is the headwall of the inlet of the main by-pass culvert. The drainage from these areas can not be directed to the sediment pond and are too close to the creek to construct separate sediment ponds. Therefore GENWAL has used alternate sediment control methods such as silt fences, straw bale dikes and vegetation. (Refer to Plate 7-5)

A new ASCA (ASCA-12) is the mine water treatment area and slope below the portals. This area is isolated from the rest of the mine site drainage, and does not flow to the sediment pond. The ASCA is approximately 0.51 acres, including the slope and treatment area. Sediment control will be accomplished by isolation from the surrounding disturbed areas. The ASCA is shown on Plate 7-5.

Note: ASCA's 1, 3, 4 and 8 have been eliminated through previous permitting actions.

DESIGN OF DRAINAGE CONTROL STRUCTURES FOR RECLAMATION

Reclamation Hydrology:

Tables:

Figures:

Reclamation Hydrology

4.1 General (Phase I)

During Phase I of reclamation, all disturbed area culverts and ditches will be removed except as shown on Plate 5-16. Undisturbed diversion UD-2 will also be removed, and the drainage from that area will be directed to the sediment pond. Undisturbed diversion UD-1 will remain in place as a permanent structure for the following reasons:

(1) The diversion is necessary to continue to divert runoff from the reclaimed site, the U.S. Forest Service turnaround area and beneath the U.S. Forest Service Road;

(2) The 10 year-24 hour storm runoff from WSUD-1 is approximately 2.98 acre feet, which combined with runoff from the reclaimed site, exceeds the holding capacity of the sediment pond;

(3) The existing diversion is a 42" full-round C.M.P. pipe, which is well in excess of the size required to carry runoff from a 100 year-6 hour storm event for the area (See Table 10).

The main canyon 72" culvert will also be removed during Phase I reclamation, except for the lower approximately 300', which will be left in place to divert undisturbed and treated runoff beneath the sediment pond. Once the main canyon culvert is removed, Crandall Creek will be directed back to the original drainage channel through the area. Silt fences will be installed on both sides of the restored channel to treat runoff from the reclaimed pad areas, as shown on Plate 5-16.

The U.S. Forest Service Road will be left as a permanent feature. A berm and ditch (RD-1) will be established along the road. This ditch will direct all runoff from areas above the road to the sediment pond. The sediment pond will remain in place until Phase II of reclamation.

Watersheds are shown on Plates 7-5 and 7-5C. Reclamation drainage details are shown on Plates 5-16 and 5-17.

4.2 General (Phase II)

Once the criteria for Phase II Bond Release are met, the sediment pond will be removed and, the area recontoured and reseeded according to the plan. The remaining 300' of the main canyon 72" culvert will also be removed at this time. At the discretion of the U.S. Forest Service, the berm along the road can also be removed at this time, or left in place. If the berm if left in place, reclaimed ditch RD-1 will be extended through the reclaimed pond area to the main channel.

4.3 Reclamation - Disturbed Drainage Control

Drainage from all contributing watersheds above the U.S. Forest Service Road, except WSUD-1, will be collected in a reclamation ditch (RD-1) and diverted into the sediment pond during Phase I reclamation. Drainage from the reclaimed areas and contributing watersheds below the road, will be treated through silt fences along the restored natural main channel, during Phase I reclamation.

Approximately 300' of the main canyon culvert will remain in place beneath the sediment pond area during Phase I.

Upon Phase II reclamation, the sediment pond will be removed and the area restored. The remaining portion of the main canyon culvert will also be removed at this time. Silt fences along the previously reclaimed channel section may also be removed during Phase II; however, additional silt fences will be installed along the 300' section of culvert removal channel restoration.

4.4 Restored Channels

Upon final reclamation, the main canyon drainage will be returned to the natural channel. During construction, this channel is to be covered by filter fabric and an underdrain system. The culvert will then be placed over the protected channel. Upon removal of the culvert, filter fabric will also be removed, exposing the natural channel. Construction in this manner will have a temporary effect on the riparian vegetation; however, this can readily be restored upon reclamation. Flow characteristics, bedding and other natural features of the natural channel will not be changed appreciably; therefore, no actual channel reconstruction or reclamation (beyond revegetation) is proposed.

No other channels are proposed to be restored within the reclaimed minesite.

4.5 Sediment Pond

The sediment pond will remain in place during Phase I reclamation. The pond will be removed during Phase II and all drainage will be returned to the Main Crandall Canyon channel at that time.

Calculations show the sediment pond to be adequately sized to contain the runoff from contributing watersheds from a 10 year-24 hour precipitation event, along with a minimum of 3 years of sediment storage. The principle and emergency spillways are each capable of passing the runoff from a 25 year-6 hour event, as required.

TABLE 14

RECLAMATION - PHASE I
RUNOFF SUMMARY
DRAINAGE TO SEDIMENT POND

Watershed	*10 year/24 hour Volume-ac.ft.*	*10 year/ 6 hour Peak Flow-cfs*	*25 year/6 hour Peak Flow-cfs*
WSUD-2	*0.05*	*0.04*	*0.08*
WSUD-3	*0.30*	*0.23*	*0.43*
WSDD-1	*0.03*	*0.05*	*0.07*
WSDD-2	*0.01*	*0.01*	*0.03*
WSDD-3	*0.09*	*0.26*	*0.37*
WSDD-4	*0.03*	*0.11*	*0.14*
WSDD-5	*0.07*	*0.23*	*0.32*
WSDD-7	*0.05*	*0.11*	*0.16*
WSDD-8	*0.23*	*0.41*	*0.62*
WSDD-10	*0.13*	*0.39*	*0.53*
WSDD-11	*0.09*	*0.10*	*0.18*
WSDD-14	*0.13*	*0.39*	*0.56*
Totals	*1.21*	*2.33*	*3.49*

Note: *Volumes and flows are totals from respective watersheds on Tables 3 and 4 of this report.*

TABLE 15

RECLAMATION - PHASE I
RUNOFF CONTROL STRUCTURE
WATERSHED SUMMARY

Structure	*Type*	*Contributing Watersheds*
Main Channel	*Silt Fence*	*WSDD-12, WSDD-13*
UD-1	*Culvert*	*WSUD-1*
RD-1	*Ditch*	*WSUD-2, WSUD-3, WSDD-1 thru WSDD-11*
Sediment Pond	*Pond*	*WSUD-2, WSUD-3, WSDD-1 thru WSDD-11 and WSDD-14*

TABLE 16

RECLAMATION - PHASE I
RUNOFF CONTROL STRUCTURE
FLOW SUMMARY

Structure	*Type*	*10 year/6 hour Peak Flow (cfs)*	*25 year/6 hour Peak Flow (cfs)*	*100 year/6 hour Peak Flow (cfs)*
Main Channel	*Silt Fence*	*3.73*	*5.44*	-
UD-1	*Culvert*	*1.91*	*3.68*	*6.81*
RD-1	*Ditch*	*1.94*	*2.93*	-
Sediment Pond	*Pond*	*2.33*	*3.49*	-

TABLE 17

RECLAMATION - PHASE 1
RECLAIMED DITCH/CULVERT DESIGN SUMMARY

Ditch	*RD-1*
Slope (%)	*10.10*
Length (ft.)	*990*
Manning's No.	*0.035*
Side Slope (H:V)	*1.5:1*
Bottom Width (ft.)	*0*
Peak Flow 10/6 (cfs)	*1.94*
Flow Depth (ft.)	*0.52*
Flow Area (ft^2)	*0.40*
Velocity (fps)	*4.85*
Lined (Y/N)	*N*
Rip Rap Req'd (Y/N)	*N*

Note: Slope / Length from Plate 5-16

DITCH FLOW CALCULATIONS

Title of run: DITCH DD-5 (10/6)

Solving for.....=	Depth Normal

Triangle

Flow depth (ft).....=	0.84
First Side slope.....=	1.0
Second Side slope.....=	1.0
Slope of diversion.....=	0.0450
Manning"s n.....=	0.035
CFS.....=	2.85
Cross section area (sqft)..=	0.71
Hydrualic radius.....=	0.30
fps.....=	4.02
Froude number.....=	1.30

Title of run: DITCH DD-5 (10/24)

Solving for.....=	Depth Normal

Triangle

Flow depth (ft).....=	1.23
First Side slope.....=	1.0
Second Side slope.....=	1.0
Slope of diversion.....=	0.0450
Manning"s n.....=	0.035
CFS.....=	7.88
Cross section area (sqft)..=	1.52
Hydrualic radius.....=	0.44
fps.....=	5.19
Froude number.....=	1.39

Title of run: DD-8 (10/6)

Solving for	Depth Normal

Triangle

Flow depth (ft)	0.50
First Side slope	1.0
Second Side slope	1.0
Slope of diversion	0.0359
Manning"s n	0.035
CFS	0.64
Cross section area (sqft)	0.25
Hydrualic radius	0.18
fps	2.55
Froude number	1.07

Title of run: DD-8 (10/24)

Solving for.....=	Depth Normal

Triangle

Flow depth (ft).....=	0.87
First Side slope.....=	1.0
Second Side slope.....=	1.0
Slope of diversion.....=	0.0359
Manning"s n.....=	0.035
CFS.....=	2.80
Cross section area (sqft)..=	0.76
Hydrualic radius.....=	0.31
fps.....=	3.68
Froude number.....=	1.17

CULVERT FLOW CALCULATIONS

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: GENWAL MINE

Comment: CULVERT C-1 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.1667 ft/ft
Manning's n.....	0.020
Discharge.....	0.96 cfs

Computed Results:

Full Flow Diameter.....	0.42 ft
Full Flow Depth.....	0.42 ft
Velocity.....	6.80 fps
Flow Area.....	0.14 sf
Critical Depth....	0.42 ft
Critical Slope....	0.1518 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	0.96 cfs
QMAX @.94D.....	1.03 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: GENWAL MINE

Comment: CULVERT C-1 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.1667 ft/ft
Manning's n.....	0.020
Discharge.....	3.58 cfs

Computed Results:

Full Flow Diameter.....	0.69 ft
Full Flow Depth.....	0.69 ft
Velocity.....	9.44 fps
Flow Area.....	0.38 sf
Critical Depth....	0.69 ft
Critical Slope....	0.1537 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	3.58 cfs
QMAX @.94D.....	3.85 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: GENWAL MINE

Comment: CULVERT C-12 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0450 ft/ft
Manning's n.....	0.020
Discharge.....	2.85 cfs

Computed Results:

Full Flow Diameter.....	0.82 ft
Full Flow Depth.....	0.82 ft
Velocity.....	5.46 fps
Flow Area.....	0.52 sf
Critical Depth....	0.74 ft
Critical Slope....	0.0395 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	2.85 cfs
QMAX @.94D.....	3.07 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: GENWAL MINE

Comment: CULVERT C-12 (10/24)

Solve For Full Flow Diameter

Given Input Data:

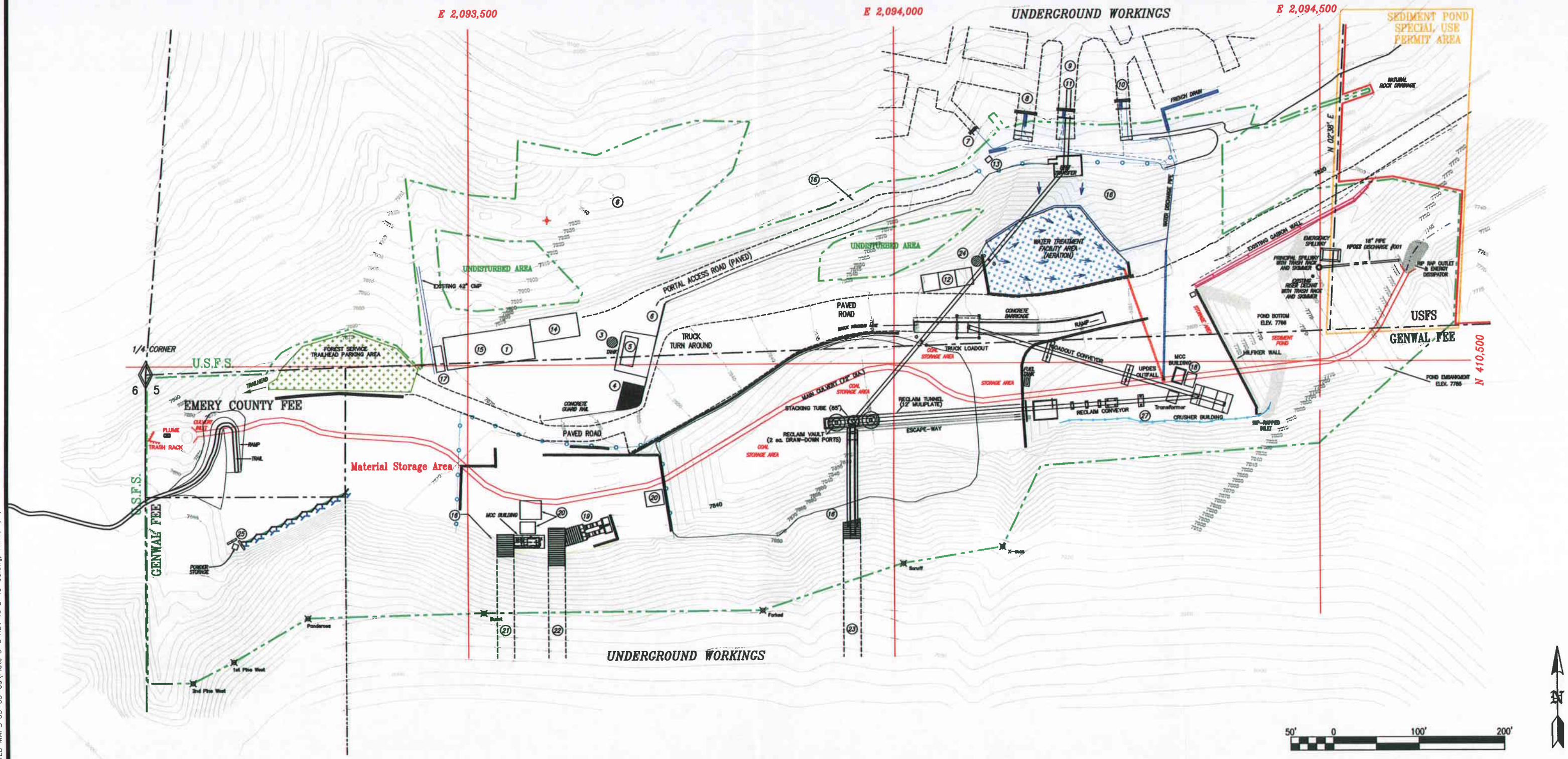
Slope.....	0.0450 ft/ft
Manning's n.....	0.020
Discharge.....	7.36 cfs

Computed Results:

Full Flow Diameter.....	1.16 ft
Full Flow Depth.....	1.16 ft
Velocity.....	6.92 fps
Flow Area.....	1.06 sf
Critical Depth....	1.07 ft
Critical Slope....	0.0391 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	7.36 cfs
QMAX @.94D.....	7.92 cfs
Froude Number.....	FULL

PLATE 5-3

SURFACE FACILITY MAP



LEGEND:

- SEDIMENT POND (SPECIAL USE PERMIT AREA)
- EXTENT OF DISTURBANCE
- 10' CONTOUR
- JERSEY BARRIERS
- RE-ESTABLISHED USFS ROAD (DOUBLE-LANE)
- SAFETY BARRIERS
- FENCING

FACILITY LEGEND:

1. Shop
2. Ventilation Fan
3. Rockdust Silo
4. Concrete Dumpster Pad
5. Power Center
6. Power Pole
7. Offices & Bathhouse (u'grd)
8. Intake Portal
9. Belt Portal
10. Fan Portal
11. Mine Belt
12. Oil Storage
13. Visual Disconnect
14. New Warehouse and Office Building
15. 4500 Gallon Cullinary Water Tank
16. Shotcrete
17. Parts Shed
18. Portable Shed
19. Ventilation Fan
20. Material Storage Sheds
21. Intake Portal
22. Return Portal
23. Belt Portal
24. Mag Tank
25. Powder Storage
26. Cap Storage
27. Concrete Ditch

UTAH REGISTERED #6449561 David W. Hibbs PROFESSIONAL ENGINEER 1/4/10

GENWAL™ RESOURCES, INC.
P.O. Box 1077, 794 North "C" Canyon Rd, Price Utah
Telephone: (435) 888-4000

CRANDALL CANYON MINE
SURFACE FACILITIES

REV: 16	ACAD: 5-3
DATE: 2-13-09	BY: PJJ
SCALE: AS SHOWN	PLATE #: 5-3

G:\Current Drawings\MRP Maps\Crandall Canyon\INCOPORATED MAPS 03-05-08\Plate 5-3 REV 16 2-13-09.dwg, 11x17, 4/3/2009 10:45:41 AM

PLATE 7-5

DRAINAGE MAP

E 2,093,500 E 2,094,000 E 2,094,500

N 410,500

1/4 CORNER

6 5

U.S.F.S. GENWAL FEE

WSUD-1 WSUD-2 WSUD-3 WSDD-8 WSDD-11

WSDD-12 WSDD-1 WSDD-2 WSDD-3 WSDD-4 WSDD-5 WSDD-7 WSDD-10 WSDD-13 WSDD-14 WSDD-15

UD-1 UD-2 UD-9

DD-1 DD-3 DD-4 DD-5 DD-6 DD-7 DD-8 DD-11 DD-12 DD-13

C-1 C-3 C-4 C-5 C-6 C-7 C-9 C-11 C-12 C-13 C-14 C-15 C-16 C-17

(ASCA 2) (ASCA 9) (ASCA 10) (ASCA 12)

SILT FENCE

STRAWBALE DIKE

SILT FENCE

C-8 12" CULVERT

UNDISTURBED AREA .30 ACRES

UNDISTURBED AREA .18 ACRES

FOREST SERVICE TRAILHEAD PARKING AREA

FLUME

TRASH RACK

MINE OPERATION AREA (UPPER PAD)

MAIN CULVERT (72" DIA.)

(Slotted Culvert)

(Slotted Culvert)

MINE WATER DISCHARGE 12" WATERLINE

MINE WATER TREATMENT DISCHARGE PIPE

De-Commissioned

MINE WATER DISCHARGE 12" WATERLINE (BURIED)

12" PIPE UPDES DISCHARGE #002 MINE WATER DISCHARGE

36" RISER

WashDown Pipe

RIP-RAPPED INLET

EMERGENCY SPILLWAY

UPDES DISCHARGE #001

PRINCIPAL SPILLWAY WITH TRASH RACK AND SKIMMER

RIP RAP OUTLET & ENERGY DISSIPATOR

SEDIMENT POND

LOWER PAD

USFS GENWAL FEE

LEGEND:

- POTENTIAL EXTENT OF DISTURBANCE
- 10' CONTOUR
- JERSEY BARRIERS
- WATERSHED BOUNDARY
- UNDISTURBED/DISTURBED WATERSHED (WSUD-1 WSDD-10)
- DIVERSION DITCH (DD-4)
- CULVERT (Solid--Above Grd/Dashed--Buried) (C-8)
- 6" DIAMETER CULVERT
- ASCA AREA:

N

CONTOUR INTERVAL = 10'

UTAH REGISTERED #154168 DAN W. GUY 3/25/09 PROFESSIONAL ENGINEER

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CRANDALL CANYON MINE DRAINAGE MAP

REV: 13	ACAD: 7-5
DATE: JUNE 2006	BY: BLACKHAWK
SCALE: 1" = 100'	PLATE #: 7-5