Canyon Fuel Company, LLC
A Subsidiary of Wolverine Fuels, LLC

Skyline Mine
Gregg A. Galecki, Sr. Environmental Engineer
HC35, Box 380
Helper, Utah 84526
(435) 448-2636
Fax (435) 448-2632

September 11, 2020

C/007/0005
Received 9/15/20
Task #6191

Steve Christensen
Coal Program Supervisor
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84114-5801

RE: Electric Lake Discharge Line, Canyon Fuel Company, LLC, Skyline Mine, C/007/005,

Dear Mr. Christensen:

Attached is information to install a water discharge line extending from the mine into Electric Lake. Unfortunately timing is critical on this project as the plan is to drill and install the line this fall prior to winter weather conditions setting in, then mine into water discharge location once installed. Power, sumps, and pump will all be installed in-mine, with only minimal piping exposed at the surface prior the suface pipe being buried to the lake. The Water Quality permit allowing discharge into Electric Lake will go out for public comment in October with permit issuance in November. The mine will likely initiate discharges to Electric Lake soon after all permitting and structure is in place.

Sklyline acknowledges and appreciates the timely reviews your staff continues to provide. We hope your staff's schedule will allow an expedited review of this application. Please don't hesitate to contact me or Taylon Earl with any questions that may arise.

Attached to this cover letter are completed C1 and C2 forms, and information to be incorporated into the M&RP. The information is being submitted electronically. Two (2) hard copies will be sent upon Division approval.

If you have any questions, please call me at (435) 448-2636.

Sincerely,

Gregg A. Galecki

Gregg A. Galecki
Sr. Environmental Engineer, Skyline Mine
Canyon Fuel Company, LLC

APPLICATION FOR COAL PERMIT PROCESSING

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

Permittee: Canyon Fuel Company, LLC

Mine: Skyline Mine **Permit Number:** C/007/005

Title: Electric Lake Discharge Line

Description, Include reason for application and timing required to implement:

Modification to install a water discharge line from the Mine into Electric Lake.

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

- ☐ Yes ☒ No 1. Change in the size of the Per .5 increase, from 146.74 to 147.24 acres. ease.
- ☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# _____
- ☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
- ☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
- ☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
- ☐ Yes ☒ No 6. Does the application require or include public notice publication?
- ☐ Yes ☒ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
- ☐ Yes ☒ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
- ☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # _____
- ☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
  Explain: _____
- ☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
- ☐ Yes ☒ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
- ☐ Yes ☒ No 13. Does the application require or include collection and reporting of any baseline information?
- ☐ Yes ☒ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
- ☐ Yes ☒ No 15. Does the application require or include soil removal, storage or placement?
- ☐ Yes ☒ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
- ☒ Yes ☐ No 17. Does the application require or include construction, modification, or removal of surface facilities?
- ☐ Yes ☒ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
- ☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
- ☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
- ☒ Yes ☐ No 21. Have reclamation costs for bonding been provided?
- ☐ Yes ☒ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
- ☒ Yes ☐ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

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

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

DEWEY TANNER
Print Name

[signature] GM 9/11/20
Sign Name, Position, Date

Subscribed and sworn to before me this 11 day of Sept, 20 20

[signature: Melissa S Willden]
Notary Public

My commission Expires: 03-19, 20 23

Attest: State of Utah } ss:
County of Carbon

MELISSA S. WILLDEN
NOTARY PUBLIC • STATE OF UTAH
COMMISSION# 705119
COMM. EXP. 03-19-2023

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining

Form DOGM- C1 (Revised March 12, 2002)

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

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: Electric Lake Discharge Line

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

Add	Replace	Remove	DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐	☒	☐	Chapter 1, Pages 1-35, 1-37, 1-38
☐	☒	☐	Chapter 1, Plates 1.6-3, 1.6-3A
☐	☒	☐	Chapter 2, Section 2.1, page 2-4c2
☐	☒	☐	Chapter 2, Section 2.3, pages 2-34, 2-35, 2-35a, 2-35c, 2-36, 2-36a, 2-36b, 2-38
☐	☒	☐	Chapter 2, Section 2.4, pages2-43, 2-45,
☐	☒	☐	Chapter 2, Section 2.5, page 2-51a-2, 2-51a-3
☐	☒	☐	Chapter 2, Section 2.7, page2-63(b)
☐	☒	☐	Chapter 2, Section 2.8, Page 2-68
☐	☒	☐	Chapter 2, Section 2.11, page 2-120(m)
☐	☒	☐	Chapter 2, Section 2.12, page 2-128,
☐	☒	☐	Chapter 3, Section 3.2, page 3-31(d), and 3-72 (c)
☐	☒	☐	Chapter 3, Section 3.4, Page 3-83
☐	☒	☐	Chapter 4, Section 4.3, Bond: Total page, Demo Total, Demo - Well Abandonment45, Earthwork Total, Reveg Cost
☒	☐	☐	Chapter 4, Section 4.3, Bond: Electric Lake Discharge Line 18 (earthwork sheet)
☐	☒	☐	Chapter 4, Section 4.4 page 4-29
☐	☒	☐	Chapter 4, Section 4.6, page 4-34(b)
☐	☒	☐	Chapter 4, Section 4.7 page 4-50(a)
☐	☐	☐	Chapter 4, Section 4.9, pages 4-75, 4-81
☒	☐	☐	Appendix A-2, Alpine Ecological Vegetation report
☐	☒	☐	Appendix A-2, Alpine Ecological Soils report
☒	☐	☐	Appendix A-4, CONFIDENIAL, Archeology correspondence with USFS personnel
☐	☐	☐	
☐	☐	☐	
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☐	☐	☐	
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☐	☐	☐	
☐	☐	☐	

Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	Received by Oil, Gas & Mining
Submitted electronically. Hard copies will be shipped for incorporation following approval.	

Chapter 1

RECEIVED
AUG 0 3 2020
DIV OF OIL, GAS & MINING

The facilities to be constructed on the surface easements and rights-of-way are a part of the Skyline Mines and these areas of surface use are to be included in the permit area as shown on Drawing 1.6-1.

The Lawrence Reservoir (Drawing 1.6-1), proposed in 1938, was never developed. Efforts to pursue the project were discontinued and resulted in case file closure by the Utah State Engineer's Office on August 8, 1961. When Federal Coal Lease Utah 044076 was issued, the site area of the proposed Lawrence Reservoir was excluded from the leased premises. On March 27, 2001, the Lawrence Reservoir area was added to Federal Coal Lease Utah-044076 by the BLM. In a letter dated March17, 2003 and sent certified mail to Skyline Mine, the BLM approved longwall recovery of the 12 Left "A" panel that underlies a portion of the now-abandoned Lawrence Reservoir site. The BLM further determined that impacts related to subsiding this area had been adequately addressed in previous NEPA documents. The BLM approval also had 5 stipulations with which the operator will comply. Copies of the letters addressed to CFC from the BLM stating that the reservoir site is within Federal Coal Lease Utah-044076 and discussing the stipulations related to mining this portion of the lease are included as Exhibit 1.14-3.

In 2020, the Skyline water quality permit added outfall UPDES-005 to discharge water into Electric Lake. A discharge line with an associated pipeline was installed on the west side of Huntington Canyon immediately adjacent to USFS road 3124 as it exists State road SR-264, located in the NE ¼, NW ¼ Section 34 T13S, R6E. Disturbance includes an approximately 20-ft by 30-ft pad and an approximately 330-ft buried pipeline; total disturbance approximately 0.50 acres.

Due to the great volume of documents involved with the ownership, right-of-entry, etc. of the Skyline properties, photocopies of the agreements have not been included in this Notice. The relevant documents are presently maintained at the offices of Canyon Fuel Company, LLC , Midvale, Utah, and at the Skyline Mine's office. Copies of the agreements can be viewed by interested persons during normal business hours.

Canyon Fuel Company, LLC holds no interest under any real estate contracts covering surface lands or other realty to be affected by mining activities at the Skyline Mines. Also, there are no purchasers of record under real estate contracts with respect to the Skyline properties.

of Mine Workings Workings (Life of Mine)	Surface to 1,500' max	Surface to 2,300' max	Surface to 1,500' max

The anticipated number of total surface land acres to be affected (life of mines) is less than the combined total of the affected acreages for each of the three mines due to the overlapping of mining operations which is inherent to this multi-seam mining operation. The total surface acreage to be disturbed by surface facilities associated with underground mining is 136.45 acres.

The following information was based on projection for the next five years (2012-2016).

	Mine No. 1	Mine No. 2	Mine No. 3
Extent of Horizontal Workings	240 acres	375 acres	1,400 acres
Extent of Vertical Workings	Surface to 1,250'	Surface to 2,250'	Surface to 2,125'

Permit Area

The construction/installation of surface facilities at the mine site, loading area, conveyor belt route, well houses, water tank pad, waste rock disposal site, and South Fork Breakout, and Winter Quarters Ventilation Facility comprise the Permit Area. The permit area acreage listed adequately accommodate areas of disturbance.

PERMIT AREAS TO BE RECLAIMED

AREA	ACREAGE
Loadout	13.86
Portal Yard	42.55
Water tanks, water lines, and Well pads (water lines not reclaimed)	0.60
Conveyor Bench	14.18
Waste Rock Disposal Site and Road	32.48
South Fork Breakout	0.60
James Canyon Buried Power Line	0.30
James Canyon Buried Pipeline	1.60
James Canyon Water Wells and Road	2.95
Winter Quarters Ventilation Facility	7.93
Winter Quarters Road (not reclaimed)	4.90
Electric Lake Discharge Line	0.50
Swens Power line reclaimed	18.46(including 0.46 acres currently under public review)
Swens Canyon Pad	6.33 (cutting pond never built)
TOTAL	~~146.74~~147.24

Legal Description of Permit Area

Township 12 South, Range 7 East, SLBM

Section 32:	Portion SE1/4SE1/4

Township 13 South, Range 6 East, SLBM

Section 1:	Portions of S1/2NW1/4, S1/2NE1/4
Section 13:	Portions of S1/2S1/2
Section 23:	Portions of E1/2E1/2, SW1/4SE1/4
Section 24:	Portions of N1/2
Section 25:	Portions of S1/2S1/2
Section 26:	Portions of NW1/4NE1/4, N1/2NW1/4, SW1/4NW1/4
Section 27:	Portions of the S1/2NE1/4, S1/2NW1/4
Section 34:	Portions of the NE1/4NW1/4
Section 35:	Portions of NE1/4, S1/2
Section 36:	Portions of N1/2NW1/4

Township 13 South, Range 7 East, SLBM

Section 4:	Portions of SW1/4NW1/4, NW1/4SW1/4
Section 5:	Portions of E1/2NE1/4
Section 6:	Portions of S1/2N1/2
Section 17:	Portions of S1/2S1/2
Section 18:	Portions of S1/2S1/2
Section 19:	Portions of N1/2N1/2

Township 14 South, Range 6 East, SLBM

Section 2:	Portions of W1/2NW1/4
Section 3:	Portions of SE1/4NE1/4

See Plate 1.6-3 for graphic illustration of Permit Area

Ch. 2, Sec. 2.1

Swens Canyon Ventilation Facility (SCVF)

In 2014 preliminary studies for permitting construction of the Swens Canyon Ventilation Facility and power line were initiated. An area of approximately 9.7 acres was proposed for addition into the permit area for the SCVF pad site. A power line corridor of approximately 50-foot by 3.05 miles, totaling 18.46 acres was proposed for addition into the permit area. The 18.46 acres includes approximately 0.46 acres currently not permitted. The public is currently being given the opportunity to comment on the construction of the power line as it is within 100-ffeet of two public roads; SR-264 and USFS road 0018, respectively. A Cultural Resource survey was conducted by Environmental Planning Group, LLC (EPG)covered areas of approximately 13 acres for the pad area and a 200-foot wide corridor for the power line respectively. A Class I cultural resource file search and Class III cultural resource inventory was conducted in the area. A total of five (5) isolated occurrences and three (3) new cultural resources sites were identified, documented, and evaluated for inclusion in the National Register of Historic Places (NRHP). None of the sites were recommended for eligibility in the NRHP. Therefore, the project will have no adverse effect on those sites. See Confidential File for EPG report (A CULTURAL RESOURCES INVENTORY FOR THE SKYLINE MINE EXPANSION AND TRANSMISSION LINE CONSTRUCTION PROJECT, CARBON AND EMERY COUNTIES, UTAH)

Electric Lake Discharge Line

In 2020 Water Quality permit outfall UPDES-005 was permitted to discharge mine water below the high-water mark of Electric Lake. Cultural resources were addressed with previous NEPA work for a logging operation conducted throughout the upper Huntington drainage in 2020. Correspondence from the USFS archeologist and SHPO concurrence are in Appendix A-4.

Chapter 2, Section 2.3

Water quality samples are collected from the 26 selected springs in the project area. A total of 13 spring were removed from the plan in 2020 following completion of mining in the North Lease and North of Graben areas of Mine #3. An evaluation of the sites is located in Appendix A-1, Volume 2.The samples are comprehensively analyzed each year for the parameters listed in Table 2.3.7-1 and Table 2.3.7-2. All water samples collected for use in this permit have been collected and analyzed according to methods in either the "Standard Methods for the Examination of Water and Wastewater" or the 40 CFR parts 136 and 434. A listing identifying the station types is shown on Table 2.3.7-3.

In addition to the collection of the outlined water quality data, water level data has been collected from each of the wells (if functional) as scheduled on Tables 2.3.7-1, 2.3.7-2,and 2.3.7-3, and noted on Plate 2.3.6-1. Water quality samples will be collected from the Waste Rock Disposal Site Well 92-91-03. Summary information on these observation wells is found on Table 2.3.7-4. Six (6) wells, W79-10-1A,79-14-2B 20-4-2, 99-28-1,79-22-2-1 and 79-22-2-2 have experienced casing failures, and have been properly abandoned. Well W79-10-1B failed with a blockage in 1st Quarter 2017, however close observation indicates it likely started to fail in late 2013 to early 2014. An analysis of Well W79-10-1B is available in Appendix A-1 Volume 2. There are no plans to replace these wells.

The amount of water discharged from each mine on each monitoring occasion will also be monitored at the mine mouth through the use of a totalizing flow meter or similar device. Significant changes in the source of water in the mine will be noted during the period of operation. Underground water pumped from each mine will be monitored for water quality. Mines #1,#2, #4 and and the majority of#5 (Flat Canyon lease)discharge is sampled at Station CS-14 prior to entering Eccles Creek. In 2020, clean-water system was incorporated into the UPDES permit to allow mine-water to be discharged into Electric Lake as Station CS-36. Mine #3 discharge from the North Lease is sampled at Station CS-12 prior to entering Eccles Creek and CS-24 in Winter Quarters Creek, respectively. ~~Mine #2 water is also discharged at JC-3.~~

Should the concentrations result in a discharge which exceeds the UPDES discharge permit limitations or indicates potential disturbance to the hydrologic balance, an attempt will be made to isolate the contributing source and an evaluation made of possible appropriate remedial action. The best alternative remedial action will be implemented as soon as practicable to ensure protection of ~~Eccles Creek~~the receiving creek water quality. A copy of pertinent sections of the current UPDES permit ~~(expires April 30,2020) is appended to this section as Exhibit 2.3-1~~is available on-line or at the Mine site. The permit is renewed every five (5) years.

As required, ground water quality data collected from the property area will be submitted to the Utah Division of Oil, Gas, and Mining in an electronic format through the Electronic Data Input web site (http://linux3.ogm.utah.gov/cgi-bin/apx-ogm.cgi. Such reports will be submitted within 90 days after completion of the quarterly monitoring program. An annual report which will include a summary of water quality data and water well level data for the previous year will be submitted within 90 days of the end of each year.

In 2002, several new sites were added to the monitoring program. Sites MC-1, MC-2, MC-3, MC-4, MC-5, and MC-6 are surface water sites on Mud Creek (Site MC-6 was added in November 2002 as agreed upon by the operator and the Division). These sites were identified as part of a study to determine the impacts of increase mine discharge on Mud and Eccles Creeks. EarthFax Engineering, Inc. was contracted to write and implement a work plan to evacuate the impacts in July 2002. A copy of the work plan is included in Volume 4 of this M&RP. The study calls for establishing and characterizing reference sites on Eccles and Mud Creeks to: 1)determine depth to ground water at the sites, 2) obtain historic flow data for the stream for comparative purposes, 3) gather and evacuate historic aerial photos of the streams, 4) collect additional water quality data, 5) evaluate bank stability indexes along with vegetation information, and conduct long-term monitoring at the selected sites. The initial field work for this project was completed in August 2002. Annual updates to the study have been submitted with the annual reports. This study concluded after the 2005 information was submitted based on the initial parameters of the study which indicated the study would last through one (1) year after discharge from the mine decreased to a sustained flow less than 5,000 gpm.

Samples obtained at the MC-sites were monitored for total flow, TDS, TSS, and total phosphorous. In addition a stream stability cross-section and reach survey was conducted approximately 75 yards downstream of the MC-6 monitoring location. The results of these analyses were reported with the other mine water quality monitoring reports while the study was being conducted (2002-2005).

Sites MD-1, ~~JC-1, JC-3,~~ and ELD-1 were also added to the monitoring site list. MD-1 is a composite sample of the all the water discharged from Skyline Mine to Eccles Creek. JC-1 and ~~JC-3~~ CS-36 are samples of the water discharged from the ~~two~~ James Canyon groundwater and mine dewatering wells. ELD-1 reports the total flow-only from both JC-1 and ~~JC-3~~CS-36. ELD-1 previously reported flows from JC-3, but due to poor water quality at JC-3 the permit expired. MD-1 and ELD-1 are monitored for total flow and the results are reported to the Division on a monthly basis. Quarterly, MD-1 and~~,~~ JC-1, ~~and JC-3~~ are also monitored for TSS~~,~~ and TDS~~, and total phosphorous~~. Total phosphorous was taken off the analysis for MD-1 in 2016 to coincide with the UPDES permit. ~~Since JC-3 is a PacifiCorp UPDES site, it is monitored each month for flow, TSS, TDS, oil and grease, and total iron.~~

Springs and streams in the North Lease and North of Graben areas of Mine #3 were eliminated from monitoring following completion of mining. CS-20 and CS24 will continue to be monitored as long as the UPDES 004 (Winter Quarters portal) discharge is in place. Location of these samples sites are illustrated on Drawing 2.3.6-1.

Skyline Mine has also obtained numerous water samples from within the mine for age-dating purposes. Samples have been analyzed for both stable and unstable isotopes; the majority being analyzed for tritium and carbon 14 content. The analyses results of these samples is discussed in detail in the July 2002 Addendum to the PHC. The results of repeated tritium sampling and analysis in a few location in the mine, specifically those in the 9 and 10 Left panel areas that began in August 2001, suggest that the majority of the water is not younger than 50 years. Only a few carbon 14 samples have been obtained from these should be accessible for the next several years. The results of the analyses will be monitored for changes in ages that may indicate changes in the source of the mine water inflows. These samples will be obtained as outlined in Table 2.3.7-1.

Samples of water discharging from springs 8-253 (Flat Canyon area), 2-413 (James Canyon), S24-1 (Sulfur Spring in Huntington Canyon), and S15-3 (Upper Huntington Creek) will be collected during the 2nd Quarter(April - June) and 4th Quarter(October - December) monitoring period and analyzed for tritium content. Additional tritium samples will be obtained from EL-1 (inflow to Electric Lake above JC-1 and JC-3 discharge) and EL-2 (outflow from Electric Lake) during the 2nd, 3rd, and 4th Quarter water monitoring periods. These samples will be collected for a period of three years beginning in the spring of 2004. The purpose of collecting these tritium samples, along with the tritium samples from JC-1, is to monitor the change in tritium content, if any, in the local aquifers and Electric Lake during spring, summer, and fall and over the three year period.

Surface-water will be monitored in the vicinity of the Winter Quarters Ventilation Facility (WQFV) by two (2) stream sites located both up- and downstream of the site, CS-20 and CS-24, respectively. The stream sites will monitor the surface- water ensuring neither the shaft or slope is compromising the surface water system. Groundwater Well 08-1-5 screened from 297-317 feet below the surface and will monitor the water elevation below the coal seam. No springs exist on the south facing slope where the WQVF pad is located. Spring WQ1-1 is located on the north-facing slope, is approximately 1/4-mile east of the WQVF pad and monitors near surface groundwater south and east of the WQVF site.

Skyline began discharging mine-water from UPDES-004, the outfall of the WQVF pond in 2020, per the Utah State Water Quality permit. While discharging mine-water, CS-20 and CS-24 will be monitored monthly documenting flow, field parameters, and limited solute analysis as outlined on Table 2.3.7-1 in addition to quarterly monitoring. Data will be uploaded to the DOGM database in the month following date of collection.

Discharge of mine-water into Electric Lake was permitted in 2020 as UPDES-005. While discharging mine-water quarterly water monitoring samples will be collected at CS-36 as outlined on Table 2.3.7-1.

Both surface-water and groundwater monitoring sites were added in Woods Canyon as mining was extended to the east in Section 36, T12S, R6E. CS-25 will monitor stream flow downstream of all mining activity. Shallow ground water along Woods Canyon Creek will be monitored by piezometers WC-1, WC-3, WC-5, WC-7 and WC-9. The shallow ground water wells were discontinued after the 2016 field season as mining was completed in 2015 (See Plate 2.3.6-1a for historic WC- locations). Spring WQ36-1 will monitor groundwater within the Blackhawk formation above active mining areas.

Mines #4 and #5 Flat Canyon Area Monitoring

The monitoring site selection criteria has remained relatively consistent throughout the years with representative sites being selected from the baseline data. With the addition of the Flat Canyon lease, initial seep and spring data was collected beginning in 1997 in preparation of the Flat Canyon EIS. Baseline sampling in the Mine #4 and #5- Flat Canyon lease area resumed in 2006 and continued through 2016. The number of sites were refined based on proposed mining by adding some stream sites upstream of mining and selecting spring sites representative of the geologic units in areas proposed for undermining.

In the Mine #4 and #5 - Flat Canyon lease area the groundwater monitoring will include the addition of nine (9) springs in the near-surface active zone. Spring SW32-277 is located in the Price River formation, SW33-268, SW4-429, and SW5-590 are in the Castlegate Sandstone, and SW21-104, SW28-110, SW28-111, SW4-169, SW4-174 are in the Blackhawk Formation,

Table 2.3.7-1
Comprehensive Water Quality Analytical Schedule
(Surface and Ground Water Stations)

	1st Quarter							2nd[2] / 3rd[3] / 4th Quarters															
Sample Site	Lab Analysis*[a]	Field parameters only*[1]	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P	TDS,TSS	O & G	Lab Analysis*[a]	Qtrly Field parameters* only[1]	Quarterly Flow	Monthly Flow	Flow Monitoring (HCWMP)[4, 5],	Water Level Monitoring (HCWMP)	Monthly Seasonal Flow	Manual Quarterly Water Level	Dissolved Oxygen	TDS,TSS, T-P	TDS,TSS	O & G	Carbon 14	Tritium	Deuterium	Oxygen 18
Streams																							
CS-3								X											X				
CS-6**	X			X			X	X								X			X				
CS-7 (F-5)									X			X											
CS-8									X			X											
CS-9								X															
CS-10 (C-1)									X			X											
CS-11								X											X				
CS-12	X							X															
CS-13	X							X															
CS-14***	X							X															
CS-16 (C-3)								X				X							X				
CS-17 (C-2)								X				X											
CS-18 (C-4)								X															
CS-20****								X			X							X	X				
CS-22										X													
CS-23										X													
CS-24****								X			X					X		X	X				
CS-27								X															
CS-28																		X	X				
CS-29 (C-6)								X															
CS-30 (C-8)								X															
CS-31								X				X											
CS-32										X													
CS-33										X													
CS-34										X													
CS-35										X													
CS-36	X							X															
MD-1			X	X		X					X							X					
SRD-1			X								X												
F-10									X			X											
UP&L-10								X															
VC-6	X			X			X	X								X			X				
VC-9	X			X			X	X								X			X				
VC-10		X							X														
VC-11										X													
VC-12										X													

Table 2.3.7-1
Comprehensive Water Quality Analytical Schedule
(Surface and Ground Water Stations) (continued)

Sample Site	1st Quarter							2nd[2] / 3rd[3] / 4th Quarters															
	Lab Analysis*[a]	Field parameters only*[1]	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P		O & G	Lab Analysis*[a]	Qtrly Field parameters* only[1]	Quarterly Flow	Monthly Flow	Flow Monitoring (HCWMP)[4,5]	Water Level Monitoring (HCWMP)	Monthly Seasonal Flow	Manual Quarterly Water Level	Dissolved Oxygen	TDS,TSS, T-P	TDS,TSS	O & G	Carbon 14	Tritium	Deuterium	Oxygen 18
Streams (cont.)																							
WRDS #1								X											X				
WRDS #2								X											X				
WRDS #3								X											X				
WRDS #4								X											X				
EL-1																					X		
EL-2																					X		
Springs																							
S13-2									X														
S14-4									X														
S15-3									X												X		
S17-2								X															
S22-5									X														
S22-11									X														
S23-4									X														
S24-1 Sulfur Spring									X												X		
S24-12									X														
S26-13									X														
S34-12									X														
S35-8									X														
S36-12									X														
SW21-104								X															
SW28-110								X															
SW28-111									X														
SW4-169									X														
SW4-173								X															
SW4-429								X															
SW5-590								X															
SW32-277								X															
SW-33-268								X															
2-413									X												X		
3-290									X														
8-253																					X		
WQ1-1									X														
WQ1-39								X															
WQ3-6								X															
WQ3-26								X															
WQ3-41								X															
WQ3-43								X															
WQ4-12								X															
WQ36-1								X															

Table 2.3.7-1
Comprehensive Water Quality Analytical Schedule
(Surface and Ground Water Stations) (continued)

	1st Quarter							2nd[2] / 3rd[3] / 4th Quarters															
Sample Site	Lab Analysis*[a]	Field parameters only*[1]	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P		O & G	Lab Analysis*[a]	Qtrly Field parameters* only[1]	Quarterly Flow	Monthly Flow	Flow Monitoring (HCWMP)[4,5]	Water Level Monitoring (HCWMP)	Monthly Seasonal Flow	Manual Quarterly Water Level	Dissolved Oxygen	TDS,TSS, T-P	TDS,TSS	O & G	Carbon 14	Tritium	Deuterium	Oxygen 18
Wells																							
JC-1 (S)			X						X		X						X			X	X	X	X
JC-2 (S)													X		X								
JC-3 (S)(REMOVE)			X						X		X						X						
ELD-1			X								X												
W79-26-1 (B)															X								
W2-1(98-2-1)(S)													X		X								
W99-4-1 (S)													X		X								
W20-28-1 (S)													X		X								
92-91-03								X															
08-1-5 (S)															X								
15-21-2 (S)													X		X								
16-24-1 (S)															X								
17-21-1 (B)													X		X								
17-34-1B													X		X								
17-34-1S													X		X								
18-28-1B													X		X								
18-32-1B													X		X								
18-32-1S													X		X								
18-5-1S													X		X								
19-5-1B													X		X								
P17-4-1 (E&W)															X								
P17-33-1 (E&W)															X								
P17-34-1 (N&S)															X								
Sustained in-mine flow >200 GPM for 60 days								X													X		

* Field Measurements and Laborotory Analyses are defined in Table 2.3.7-2

[a]Field parameters will be taken in conjunction with samples collected for Lab Analyses

[1]Sites with at least two (2) years of laboratory analysis data will be sampled once every five (5) years for the currently approved laboratory parameters in Table 2.3.7-2 beginning in 2010. If field parameter monitoring indicates any trending changes, regular laboratory analysis may be resumed until trend is adequately characterized.

[2]2nd Quarter sampling may extend to July 15 in years when spring snow conditions do not allow access before June.

[3] Baseline Lab Analysis will be conducted every five (5) years beginning in 2010 in the 3rd quarter. (ie. Years 2010, 2015, 2020, etc.) (JC-1 and In-mine shall include Microscopic Particulate Analysis (MPA))

(HCWMP)[4] - Sites are incorporated as part of the Huntington Canyon Water Monitoring Program (HCWMP)
(HCWMP)[5] - Stream transducers may be pulled during winter months due to ice.

** Flow measurements discontinued at CS-6 in 12/2009, lower Eccles flow documented with VC-9
*** CS-14 represents mine in-flows and discharges from Mines #1, #2, and #4 (the SW districts of the Mine.
**** CS-24 and CS-20 will be sampled monthly for TDS, TSS, and Flow only when UPDES 004 is discharging

Table 2.3.7-3
MONITORING STATION IDENTIFICATION

ECCLES CANON/MUD/FISH CREEK DRAINAGES

STREAM STATIONS 11 Stations

CS-3	CS-6	CS-9	CS-11	CS-20	CS-24
VC-6	VC-9	VC-10	VC-11	VC-12	

HUNTINGTON CANYON

STREAM STATIONS 21 Stations

CS-7 (F-5)	CS-8	CS-10	CS-16	CS-17	CS-18
CS-22	CS-23	UPL-10	F-10	EL-1	EL-2
CS-27	CS-28	CS-29	CS-30	CS-31	CS-32
CS-33	CS-34	CS-35			

MINE DISCHARGE STATIONS 5 Stations

CS-12 (Mine #3) CS-14 (Mines #1, #2, #4) MD-1 (Composite CS-12 & CS-14)

SRD-1 (Total Mine Site Discharge to Eccles Creek/Scofield reservoir)* CS-36 (Electric Lake)

FRENCH DRAIN STATIONS 1 Station

CS-13

WASTE ROCK DISPOSAL SITE

STREAM STATIONS 4 Stations

WRDS #1 WRDS #2 WRDS #3 WRDS #4

GROUNDWATER STATIONS

SPRINGS 26 Stations

S13-2	S14-4	S15-3	S17-2	S22-5	S22-11	S23-4
S24-1 Sulfur	S24-12	S36-13	S34-12	S35-8	S36-12	2-413
3-290	8-253	SW21-104	SW28-110	SW28-111	SW4-169	SW4-173
SQ4-429	SW5-590	S26-13	SW32-277	SW33-268		

WELLS (MONITORING)** 25 Well Stations

	92-91-03	W79-26-1 (B)	W2-1 (98-2-1) (S)		W99-4-1 (S)
JC-1 (S)	JC-2 (S)	JC-3 (S)	W20-28-1 (S)	W08-1-5 (S)	15-21-2 (S)
W16-24-1 (S)	W17-21-1 (B)	W17-34-1B	W17-34-1S	W18-28-1B	W18-32-1B
W18-32-1S	W18-5-1S	W19-5-1B	P17-4-1(E & W)	P17-33-1(E&W)	P17-34-1(N&S)

ELD-1 (Total of JC-1 and JC-3)

WELLS, CULINARY -Referenced but not monitored

W13-1 W13-2 W17-1 W17-3 W24-1

NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES)

001 Portal Area 002 Loadout 003 Waste Rock Area 004 Winter Quarters JC-3 James Cyn

* Sites are monitored for total flow only and the results are reported to the Division on a monthly basis

** See Table 2.3.7-4 for well detail

*** (S) or (B) has been added to pre-existing wells representing screened formation(i.e. Star Point or Blackhawk)

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gpm. The increase in discharge rate is related to increased ground water inflow to the Mine #2 area of the Skyline Mine. A flow of 10,500 gpm in Eccles Creek due to the increased mine discharge is approximately 42 times the minimum measured base flow (approximately 250 gpm) of Eccles Creek. The increased flow to Mud Creek of the 10,500 gpm of mine water discharge represents an increase of approximately 10.5 times the minimum measured base flow (approximately 1,000 gpm measured in 1981) at the USGS flow gaging station located below the confluence of Mud and Winter Quarters Creeks. The average daily flow of Mud Creek at the USGS gaging station from 1979 to 2001 is approximately 2,700 gpm. The mine discharge rate of 10,500 gpm is about 4 times average daily flow of Mud Creek. The discharge to Eccles Creek diminished after July 2003 when the JC-3 well was completed by PacifiCorp. The JC-3 well was completed in the 10 Left area of the mine and pumps mine water to Electric Lake. The rate of discharge from JC-3 has varied between approximately 1,500 and 5,100 gpm. The rate of discharge to Eccles Creek after July 2003 has subsequently varied between 900 gpm and 6,000 gpm, dependant upon the operation of JC-3 and allowing of portions of the mine to flood. The anticipated changes to mine inflow volumes is discussed in greater detail in the July 2002 Addendum to the PHC, Appendix F and K.

In 2020 Skyline started encountering ground water inflows into the Mine #5 area. A clean-water system was developed to supply high quality water from the Mine into Electric Lake. A discharge line was extended from the mine to the Lake. The Water Quality permit identifies the outfall site as UPDES-005 in the Skyline Mine permit. The discharge line, associated pump and pipeline are designed to have a maximum pumping capacity of 10,000 gpm. An evaluation of the receiving section of the lake by R.B.White PLLC, indicates the increased flow can be adequately accommodated raising the water level in the receiving portion of the lake by only a few tenths of a foot. (Appendix A-5). Mine water sent through UPDES-005 to Electric Lake reduces the amount of mine water discharge sent to Eccles Creek.

An ongoing study of the effects of the increased flows on Eccles and Mud Creeks was initiated in the winter of 2001. EarthFax Engineering, Inc. was contracted with to establish six monitoring stations on Mud Creek and three on Eccles Creeks. The flow, water chemistry, stream channel morphology, vegetation are monitored at these sites for any significant changes that could be related to the increase in mine water discharge. Initial results of the study indicate that no significant effects have been noted at the monitoring sites due to increased discharges. However, the study will continue until the mine discharge volumes return to pre-

Stations will be located both above and below the rock waste disposal site in each of the drainages. (See Drawing 2.3.6-1.)

2. When flow is present, these stations will be monitored, when accessible, at the same frequency and for the same constituents as the stations in Eccles Creek. The data will be tabulated and reported in the same manner as the Skyline water quality data.

3. The data from these stations will be evaluated for non-point source contribution from ground water aquifers. This procedure offers the best potential for detection of ground water contamination.

The Upper O'Connor seam required a breakout to improve ventilation. The breakout is on a south facing slope in a side canyon of the South Fork of Eccles Creek (see map no. 3.2.11-1). A new road was built across this canyon to gain access to the breakout area. The conyon flows water in all but the driest of years. During construction, the creek was sampled above and below the site of a daily basis. The samples were tested for total suspended solids and settleable solids as n aid to regulating construction activities and in implementing control measures. Construction related solids fluctuations were encountered throughout this phase of the project.

In 2020 Skyline began discharging mine-water through the WQVF pond as permitted under the UPDES permit. In addition to two (2) Earthfax reports (March 2010 and Evaluation of Geomorphic Conditions April,2017 both in Appendix A-1) documenting the well-armored nature of the stream, Skyline was required to photo-document sites WQ-1 through WQ-4 monthly while mine-water is discharging to document any potential erosional features. Photos, with any added text observations, will be submitted electronically in the month following the documentation.

Later in 2020 Skyline also installed a discharge line and pipeline to take ground water encountered in Mine #5 of the Mine and discharge the water into Electric Lake as permitted under the UPDES permit as UPDES-005. R.B.White Engineering provided a report (Appendix A-5) demonstrating Electric Lake can adequately receive the mine water discharge.

The volume of water discharged from the mine increased significantly in August 2002 after large volumes of ground water were encountered within the mine. The mine was concerned about what effects the increased flows might have on Eccles and Mud Creeks. EarthFax Engineering, Inc. was contracted to perform a stream bank stability analysis on the streams using flows ranging between 5,000 and 30,000 gpm. The initial results of the report indicated that the stream banks would be stable at flows up to 30,000 gpm for short periods of time, but would compromise culverts at road crossings. Further study was requested by the Division and EarthFax was again contracted to continue the study of the effects on Mud and Eccles Creeks of sustained increased discharges from the Skyline Mine. The

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The 15,000 gpm is based on inflows experienced in Mine #2 where a maximum inflow was approximately 8,000 gpm. Being further down-dip the Star Point Sandstone increased inflows are anticipated. Prudent engineering suggested a doubling of the highest inflows thus far encountered were appropriate. It is noteworthy that mine-water discharges from the Mine #2 area have declined substantially from more than 8,000 gpm in early 2003 to less than 2,000 gpm in 2016. Although there are other contributing factors such as flooding much of the workings, the lowering likely reflects a local lowering in the hydraulic head of the Star Point Sandstone groundwater system (Petersen Hydrologic, 2016). The U.S.D.A. Forest Service (2002) suggests that the mechanics of the Star Point Sandstone groundwater systems are not well understood. Within the Star Point Sandstone, groundwater flow occurs primarily where the sandstone bedrock is significantly fractured or faulted. In areas of unfractured Star Point Sandstone, discharge from the bedrock as springs is rare, and major springs are only associated with fault systems (Bills, 2000). This is evident in the JC-1 and JC-2 wells where JC-1 is a smaller well yet pumps significantly more water from a fractured zone, while JC-2 completed in the unfractured Star Point Sandstone produce only a fraction of the water. However, the 13+ years of pumping from this groundwater system has had minimal effect on the local potentiometric gradient (illustrated on Plate 2.3.4-2), suggesting additional pumping from this system in Mine #4 will not depressurize the system sufficiently to change the confined aquifer characteristics significantly. Refer to Section 2.3.7 (Water Monitoring Program) for added in-mine and Star Point Sandstone water monitoring commitments.

As experienced in Mines #2 and #4, many of the same fault-zones encountered in Mine #2 are further down dip in Mine #5 and continue to often act as a conduit for water from the inactive Star Point Sandstone. Beginning in late 2020, Skyline modified the water quality permit to allow high-quality mine water to be discharged into Electric Lake. The pumping system will be designed to pump up to 10,000 gpm, which will likely represent multiple ground water inflows as mining progresses. Previous experience indicates water encountered from the Star Point Sandstone is of adequate quality to be discharged into Electric Lake. Preliminary testing of the fault water encountered indicates the water ranges from to 6,500-7,500 years old, illustrating the waters not in direct contact with waters encountered at the surface. Recovery testing of wells in the Star Point Sandstone, when JC-1 is not pumping, indicates the almost 20 years of pumping has had little impact depleting the Star Point Sandstone reservoir as the surrounding monitoring wells quickly return to the pre-pumping potentiometric surface. It is anticipated that faults which likely supply a majority of water reporting in Mine #2 will decrease if significant inflows are encountered in Mine #5 in the same fault zone. Surface- and near-surface groundwater monitoring has not noted any impacts to overlying Blackhawk formation hydrology.

Water pumped from the inactive Star Point Sandstone should not impact the water quantity and water quality in streams and groundwaters discharging from springs and seeps from the shallow active-zone _groundwater systems in the Blackhawk Formation. Appendix P details the characterization of the Star Point Sandstone as an inactive aquifer that has not been in communication with surface waters for thousands of years. This is documented with the radiocarbon dating of in-mine waters. Similarly, the nearest proposed Flat Canyon Tract underground workings are located more than 1.5 miles northwest of locations near the dam where Star Point Sandstone bedrock is mapped beneath the reservoir. As described above, the deep, inactive-zone groundwater systems typically intercepted in the Skyline Mine underground workings are not believed to be in good hydraulic communication with overlying shallow groundwater systems. For these reasons, it is anticipated that mining in the Flat Canyon Tract will not appreciably impact shallow groundwater systems that may be present that are associated with the presence of the Electric Lake surface water body (i.e. it is considered unlikely that shallow groundwater systems near Electric Lake will be in good hydraulic communication with the deep, inactive-zone groundwaters that are anticipated to be intercepted in the proposed underground Skyline Mine workings in the Flat Canyon Tract. Further, it is considered unlikely that the Electric Lake water surface would provide a constant head source for the deep inactive-zone groundwater systems in the Flat Canyon area) (Petersen Hydrologic, 2017)

As discussed in Section 2.3.4.5 Aquifer Characteristics of the Mine #4 Flat Canyon area, due to the complex geologic system in the area the potentiometric gradient is difficult to determine (Pate 2.3.4-2). It is noteworthy to mention that due to the age of the water encountered in the Star Point Sandstone, there is no significant modern use of the water. Otherwise the water that is thousands of years old would be getting replaced with modern water. However, since the Mine induces communication with the Star Point Sandstone its impacts to the surface and near-surface groundwater system has been considered. Plate 2.5.2-2 (Mine Pools Current (2016) and Estimated Final) illustrates the projected gradient of the Star Point aquifer both currently and at closure. Elevations of the mine-pools are based on a combination floor elevations and groundwater elevations of wells completed in the Star Point Sandstone. Pool volumes were calculated to hold approximately 9192.6 ac-ft in Mine #3, 4243.4 ac-ft in Old Mine #3, 6195.5 ac-ft in Mine #2 and 11,884.2 ac-ft in Mine #4, respectively (See Appendix S for calculations). Also included on the plate are the elevations of the mine openings to the surface. Current projections indicate Mines #2 and #4, when flooded at closure will fill to an approximate elevation of 8500 feet which is below both the Swens Canyon Vent Shaft (elev. 8710-ft) and the Mine portals (elev. 8573-ft). The Mine #3 workings (both 'Old Mine #3 and current) will fill to elevations of approximately 8,200 feet and 8,100 feet, respectively which is below both the Winter Quarters and Mine site portals. Based on these projections the flooding of the mine workings with Star Point Sandstone water will have minimal impact to the pre-mining flow path and surface hydrology. Moreover, with the inactive groundwater zone having no communication with the surface hydrology, no impacts to water quality are anticipated.

Also in conjunction with acquiring the Flat Canyon lease, the numeric groundwater modeling exercise that was initially conducted in 2002 through 2004 was reevaluated in 2016 (PHC Addendum Volume 2 – Appendix R). As a preface to the numeric groundwater model update, Appendix Q provides a general outline of the purpose, scope, and qualifiers of the more detailed numeric model that follows. The purpose of the initial modeling exercise was to determine whether all of the groundwater being encountered in the mine during that time could be sourced from the Star Point Sandstone. A primary caveat being that a typical numeric groundwater model initially creates a 'pre-inflow' steady-state conceptual model based on a well-defined aquifer, then models the transient model based on drawdown (or inflow data). Although drawdown/inflow was actively happening during the conceptual phase, the modeling exercise determined it was possible for all the inflow being encountered to be sourced from the underlying Star Point Sandstone; although the results were considered non-unique. From 2003 through 2015 significant portions of Mine #2 were allowed to flood to elevations of 160-300 feet above major mine inflow locations. During that time, in conjunction with the inundation of the mine workings, mine inflows decreased from approximately 4,000 gpm to less than 2,000 gpm, and the monitoring wells in the Star Point Sandstone showed some recovery. Using the original conceptual model with updated inflow and well data, the July 2016 update of the groundwater flow model (PHC Appendix R), was recalibrated. Although the model was updated with approximately another decade-worth of data, the ability to define a complex, hydrologic system with a limited number of monitoring locations is difficult. The 2016 model update suggests part of the observed recovery of the Star Point Sandstone is generated from a near-surface source. Two (2) scenarios for the recharge source are suggested: 1) water originating from the 'vertical recharge through the South Gooseberry fault from the shallow groundwater system', or; 2) water from 'Electric Lake, via a splay of the Diagonal Fault'. Ultimately, the source of the recharge and its mechanism is not clear. The modeling conclusions suggested the transient calibrations of both scenarios calibrated equally as well, and a combination of the two sources may be the most likely scenario.

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2.7.11 Electric Lake Discharge Site

In late 2020 Skyline constructed drill pad and buried pipeline to discharge mine water into Electric Lake. The approximate 100-foot by 125-foot pad and approximately 330-foot pipeline are located immediately west of State Road SR-264 in the NE1/4, NW1/4 of Section 34, T13S, R6E. The area is dominated by sagebrush and grasses as outlined in an Alpine Ecological Vegetative Analysis report (Appendix A-2, Volume 2). The pipeline and majority of the drill pad will be reclaimed immediately after construction. An approximately 20-foot by 20-foot area of the drill pad will be fenced where the underground and surface piping intersect, where minor valving will be present will not be reclaimed. Once the approximate original contours (AOC) are reestablished and topsoil repositioned the area will be extremely roughened and reseeded with the Interim Revegetation Seed Mixture for Sagebrush and Grass (Table 4.7-11A).

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No perennial streams are being undermined. Wife Canyon has various springs that day-light in or near the stream channel, that run on the surface a short distance prior to disappearing into the alluvium. Both the East and West Forks of Andrew Dairy Canyon shows the same characteristics in short reaches. Approximately 900-1300 feet of overburden exist in the area being undermined, further minimizing any impacts. Andrew Dairy Spring, which exists immediately outside the area to be mined is being monitored as Spring S25-32. Water Right 91-3917 is a Spring located above the area to be mined and will be monitored S26-1. No monitoring of aquatic resources is necessary in these drainages.
UP Canyon - Scofield Waste Rock site

The Scofield Waste Rock site is located in UP Canyon at the confluence of two ephemeral unnamed drainages. No aquatic wildlife habitat has been noted in either drainage.

Project Impacts on Fisheries Resources

The surface facility disturbances in the portal area encroached on sections of all three upper Eccles Creek forks. In order to reduce sedimentation of these stream segments and the main stream, the tributaries and a section of Eccles Creek proper immediately below the tributary confluences were diverted into closed culverts. This modified approximately 4,200 feet of total stream habitat but did not reduce available fish habitat since fish were not found above the U.S. Forest boundary, prior to the diversion. Downstream drift of macroinvertebrates from the upper reaches of these forks still occurs as before.

At the coal loadout facilities near the mouth of the canyon (Station ECO5), approximately 600 feet of stream was moved to the north into a new channel. The new channel is 100 feet shorter but has nearly the same gradient (3 feet additional vertical drop/1,000 feet horizontal channel).

Degradation of Eccles Creek between the National Forest boundary and the coal loadout facilities should continue to be minimal since road and conveyor plans were developed and are being implemented to minimize effects on the stream.

Water being discharged from the mine is augmenting the Eccles Creek stream flow. This increased stream flow is especially beneficial during summer months when normal stream flows are low. Water temperatures are also moderated by this increased flow.

There should be little impact on Huntington Creek above Electric Lake. Impacts to date have been associated only with the construction of a new UDOT highway. Sediment control measures minimized the impact during the construction activity.

Prior to construction of the Winter Quarters Ventilation Facility (WQVF) silt fencing or similar best management practice will be installed along the entire length of the construction zone to minimize sediment and debris from entering the creek. Once construction is complete and other sediment controls are installed, these situation structures will be removed. During the life of the WQVF pad, long term sediment control will be implemented thorough a sediment pond (UPDES discharge point 004).

At this point in time there are believed to be no other potential impacts on either Winter Quarters or Woods Canyon Creeks.

Prior to construction of the Swens Canyon Ventilation Facility (SCVF) silt fencing or similar best management practice will be installed along the section of road to be modified adjacent to minimized sediment and debris from entering Swens Canyon Creek. Once construction is complete, these sediment structures will be removed. The SCVF is a minimum of 350 feet north of the creek with a minimal potential of impacting the creek. An associated power line bringing power to the SCVF from the mine site runs overland. Avoiding the riparian areas of Huntington creek in the pole placement design was considered. A pole on the west side of the creek is less than 100-feet from the road, while the next pole is located more than 500-feet east the creek. No crossing of the creek with heavy equipment will occur with the installation of the power line.

In late 2020 Skyline's UPDES permit was modified to accommodate mine water discharge into Electric Lake. Due to antidegradation rules only the highest quality water can be discharged into the lake. The additional high-quality water will be beneficial to the fishery resources of the lake.

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The SCVF pad site encompasses approximately 9.7 acres with two (2) soil types present. The majority of the site is represented by the Hailman soil family, with a sandy loam on 5-15% slopes. The soil pit identified an estimated topsoil depth is approximately 16-inches (S1 from Figure 2 of soil survey). The remainder of the site consisting of the access road is represented by the Kamack soil family with a sandy loam on 10-35% slopes (S2), with an estimated topsoil depth of approximately 10-1nches. Prior to construction, soil samples were collected from the A and B horizon at sample locations 14SKY14 and 14SKY15 and analyzed for available nutrients nitrogen, phosphorus, and potassium per DOGM 2008 guidelines. Lab Soil Analysis of these samples are located in both Appendix D of "Order 2 Soil Survey of the Powerline Corridor Swens Pad Ventilation and Escape Shafts Coal Pile Expansion at the Skyline Mine" Appendix Volume A-2, Volume 2 of the M&RP and the 2016 Annual Report. Approximately 1-foot of topsoil was salvaged and stored. Plate 3.2.4-4F illustrates the removal areas, and estimated depths of combined topsoil and subsoil to be stockpiled totaling approximately 15,100 cu-yds. Topsoil (~8750 cu-yd) and subsoil (~6350 cu-yd) will be segregated on the pile using orange fencing/construction fabric. Once stored, the topsoil will be analyzed for available nitrogen, phosphorus, and potassium for future soil treatment. Efforts will be made to minimize the steepness of the slopes of the topsoil by configuring the pile with the steeper slopes being subsoil. A berm and silt trap will be used to retain the material until vegetation is established. The surface of the pile will also be deep-gouged, seeded, and top-dressed with mulch or straw.

Electric Lake Discharge Site (ELDS)

The ELDS consists of an approximately 100-foot by 125-foot drill pad and an approximately 330-foot buried pipeline with a 30-foot construction easement. An Alpine Ecological soils report for the site outlines the baseline condition (Appendix A-2, Volume 2). The soil pit indicates approximately 2.5-feet of A-horizon material exists at the site. Prior to construction topsoil will be salvaged and stored at both the drill pad and pipeline for replacement immediately following construction. Prior to construction soil samples will be collected from both the A and B horizons. The total area is approximately 0.5 acres in size, with the entire area being reclaimed immediately following construction other than an approximately 20-foot by 30-foot area.

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TABLE 2.12.2-1
GRAZING POTENTIAL FOR THE AREA TO BE AFFECTED BY MINING SURFACE OPERATIONS AND FACILITIES
(Does not include State Highway SR-264)

Surface Facilities Area	General Area Classification	Land Area (Acres)	Average Forage Production (lbs/ac)	Total Animal Unit Month (AUM)	Grazing Potential- Animal Unit Month (AUM) with 25% Harvest Efficiency for proper grazing utilization
1 Portal Yard Area	Spruce Fir	16.47	0	0.0	0.00
	Aspen	7.93	586	5.9	1.47
	Sagebrush	2.50	917	2.9	0.73
	Disturbed	8.50	0	0.0	0.00
	Riparian	1.00	182	0.2	0.06
Subtotal		36.40		9.0	2.25
2 Conveyor Corridor	Aspen	3.20	586	2.4	0.59
	Sagebrush	5.77	917	6.7	1.67
Subtotal		8.97		9.1	2.27
3 Railroad Loadout Area	Grass-Forb	10.32	746	9.7	2.44
	Spruce Fir	3.50	0	0.0	0.00
	Riparian	0.04	182	0.01	0.00
Subtotal		13.86		9.8	2.44
4 Waste Rock Disposal Area	Disturbed	12.81	0	0.0	0.00
Subtotal		12.81		0.0	0.00
5 Water Tank & Well Pads	Aspen	0.26	586	0.2	0.05
South Fork Breakout	Spruce-Fir	0.96	0	0.0	0.00
Subtotal		1.22		0.2	0.05
6 WQ Vent Pad	Sagebrush	2.36	1300	3.9	0.97
Subtotal		2.36		3.9	0.97
7 Swens Vent Pad	Sagebrush	6.33	917	7.3	1.84
Subtotal		6.33		7.3	1.84
8 Powerline	Aspen	14.5	586	10.8	2.69
	Sagebrush	1.62	917	1.9	0.47
	Spruce Fir	1.44	0	0.0	0.00
Subtotal		17.56		12.6	3.16
9 Electric Lake Discharge Line	Sagebrush	0.5	917	0.58	0.15
TOTAL		100.01		52.45	13.12

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extend approximately 2-feet above the pad elevation (Plate 2.3.4-4G). Plates 3.2.4-4A through -4G illustrate both the overall and detailed designs of the site. A detailed report outlining the designs of the pad, the hydrologic and geotechnical analysis, and other design specifics are provided in a separate report located in Appendix Volume 5, Section 24 (Skyline Mine Swens Canyon Ventilation Shaft Pad Design Report – Earthfax, December 2014). The construction specifications outlined in the Earthfax report were included in the construction bid package to be followed, which includes compaction tests. See page 3-21 for the Professional Engineer certification that the site was constructed as designed.

Sediment control structures used during construction such as silt fencing and straw bales will remain in place for one year after construction and will be removed anytime thereafter. Erosion control blankets, wattles, or straw bales will be used to control erosion during interim vegetation establishment. The interim seed mix (Table 4.7.11A) will be applied following construction and associated surface-preparation, and prior to the first snowfall. Additional details of the topsoil/subsoil handling plan are located in Section 4.6. The timing of final revegetation will follow a similar timing and sequence.

UPDES-005 Mine Discharge Line

The UPDES-005 Mine Discharge line was established in 2020 after adding the outfall to the Utah Pollution Discharge Elimination System (UPDES) permit from the Utah Division of Water Quality. The site is located immediately west of State Road SR-264 in the NE¼NW¼ Section 34, T13S, R6E, and discharges mine water into Electric Lake. Due to anti-degradation rules the water discharged into the Lake is required to be of the highest quality. The discharge line will pump water from approximately 700-ft below the surface from the mine. All equipment for pumping including pumps and power will be from within the mine. An 18-inch pipe and associated pumping design will have a maximum capacity to pump 10,000 gpm from the mine. After drilling and construction the site will consist of an approximately 20-foot by 30-foot fenced area containing a pipe protruding from the ground with associated plumbing. After a short distance the pipe will be buried beneath the ground surface and extend to lake. Prior to entering the lake, the discharge pipe will have a designed riprap structure to reduce the water velocity below erosive levels prior to entering Electric Lake. Construction disturbance includes an approximately 100-foot by 125-foot pad to drill the well and an approximately 30-foot by 330-foot easement to install the pipeline. The total disturbance is approximately 0.50 acres, with all disturbance being reclaimed after construction other than the 20-foot by 30-foot area. Plate 3.2.5-1 illustrates site construction, RB White Engineering report for outlet structure design is located in Appendix A-5.

Area 39. This 1.01 acre area addresses both the undisturbed area between the upper undisturbed ditch (UDW-4 from Earth Fax report) and the primary portion of the WQVF access road (DW-5 from Earth Fax report). Sediment from the area is controlled by a catch basin that incorporates a wattle to trap sediment prior entering a culvert taking water under the road (Plate 3.2.4-3A). The ditch has been widened in the vicinity of catch basin to accommodate the installation of the wattles. The outfall of the culvert, although not having a erosive velocity, is armored with riprap to further reduce any sediment loading.

Area 40: The Swens Canyon Ventilation Facility pad is an area that addresses both a small undisturbed area (UW3) and the pad (DW3) totaling 1.5 acres (Plate 3.2.4-4D). Storm water runoff and sediment from the area flows to the east-southeast area of the pad. Water and sediment reaching the east side of the pad will either be treated by a silt fence or directed to the south portion of the pad using a berm. Water and sediment reaching the south end of the pad is controlled by a swale and small catch basin located at the southern portion of the pad. At that location, the small amount of water will collect to a maximum depth of 1.28-inches and eventually evaporate. The maximum design velocity is 1.02 ft/sec which is not considered erosive. See Attachement A of Earthfax Swens Canyon Design Report in Appendix Volume 5, Engineering Calculations, Section 24 for details.

Area 41: The Swens Canyon Ventilation Facility Topsoil Pile is designed to safely retain runoff from a 100-year, 24-hour storm event (176 cu-yds.) and one year of predicted sediment yield (195 cu-yds.) Topsoil will be collected/contained in the sediment basin and will either be retained in-place or re-deposited on the pile. Once vegetation is established on the Topsoil Pile, the sediment yield will be significantly reduced. Plate 3.2.4-4D illustrates the area.

Area 42: Attachment 4.17-1 of Section 4.17 Subsidence Control Plan, Chapter 4 of this M&RP contains the Boulger Dam Subsidence Monitoring Plan. The plan includes six (6) Seismic sites (A-F) shown of Figure 1-1 of Attachment 4.17-1. The sites are approximately 0.01-acres in size. Sediment is controlled by existing vegetation as the sites were located on level ground with minimal disturbance during installation.

Area 43: The Swens power line corridor is appoximately 3.05 miles long by 50-feet wide extending from the Mine site to the Swens Canyon Vent Facility. Construction was conducted using primarily D6 CAT tracked dozer and rubber-tired vehicles. No blading of trails is anticipated but soil protection is outlined in Section 4.4.2. Based on USFS personnel request, trees removed during clearing of the power line corridor will be placed back on the corridor perpendicular to the slope for both sediment protection and to minimize ATV travel.

Area 44: The Electric Lake Discharge area is an approximately 30-foot by 20-foot area on a gravel pad containing a short section of pipe extending from underground, with associated valving and meter, then the pipe returns underground extending to Electric Lake. Sediment load is minimized and controlled by the gravel pad.

On all areas not reporting to a sediment pond, and classified as Alternate Sediment Control Areas, the alternate sediment control measure such as straw bales, silt fences, catch basins, excelsior mats, etc. will be maintained until there is adequate vegetative cover to properly filter any surface runoff (see Sec. 20, Vol. 5 for design). When this can be demonstrated, the alternate control measures will be removed and the area reclassified as an "Exempt area". (See Sec. 21, Vol. 5 for Demonstrations) On all areas classified as Exempt Areas, if they should become redisturbed they will be reclassified as ASCA areas and will have the runoff treated with a designed treatment.

Ch. 3, Sec. 3.

3.4 AREA AFFECTED BY EACH PHASE OF OPERATIONS

The area affected by the Skyline Mines project can be divided into two major categories:

(a) Surface acreage disturbed by construction/installation of coal handling and associated facilities or permitted areas, and

(b) Surface acreage overlying underground mine workings or adjacent areas.

Permitted Disturbed Surface Acreage

The offices, bathhouse, workshop, portal, fans, and other necessary facilities utilize a site of 42.55 acres. Approximately 0.26 acres is used for water tank and well pads. The coal loading and handling facility at the mouth of Eccles Canyon utilizes approximately 13.86 acres. The covered pipe belt conveyor, transporting material from the mine portals to loading points, disturbs approximately 14.18 acres. The waste rock disposal site is permitted to include utilizes approximately 32.48 acres. The South Fork breakout area has disturbed 0.60 acres. The James Canyon buried power line, buried pipeline, water wells pad and road include 4.85 acres. The Winter Quarters Ventilation Facility utilizes 7.93 acres with an additional 4.9 acres permitted to include the existing Winter Quarters Canyon road. The Swens Canyon Ventilation Facility utilizes 6.33 acres with an additional 18.46 acres permitted in the power line. The Electric Lake Discharge Line utilizes approximately 0.5 acres, much of which was contemporaneously reclaimed following construction. In total, the surface acres disturbed permitted area is ~~146.74~~147.24 acres. The disturbed and permitted area and bonded area for the Mine Portal area, Loadout area, Waste Rock Disposal area, Winter Quarters Ventilation Facility area, Swens Canyon Ventilation Facility and power line, and miscellaneous areas are shown on maps 3.2.1-1, 3.2.1-3, 3.2.8-1, 3.2.4-3a , 3.2.3-3 through 3.2.3-3f, ~~and~~ 3.2.4-4A through -4G,and 3.2.5-3, respectively.

The pre-mining phase of earth work and dirt removal commenced in the spring of 1980 and was completed in 1981. The actual construction and installation of facilities necessary for coal mining and handling began in early 1981.

Ch. 4, Sec. 4.3

Bonding Calculations

Direct Costs

Subtotal Demolition and Removal	$1,946,213	
Subtotal Backfilling and Grading	$1,504,237	
Subtotal Revegetation	$466,275	
Direct Costs Subtotal	$3,916,725	

Indirect Costs

Mob/Demob	$391,673	10.0%
Contingency	$195,836	5.0%
Engineering Redesign	$97,918	2.5%
Main Office Expense	$266,337	6.8%
Project Management Fee	$97,918	2.5%
Subtotal Indirect Costs	$1,049,682	26.8%
Total Cost 2019	**$4,966,407**	
Escalation factor		*5*
Number of years		*0.0232*
Escalation	*$576,103*	
Reclamation Cost Escalated	$5,542,511	
Reclamation Bond Amount (rounded to nearest $1,000) 2019 Dollars	**$5,543,000**	
Posted Bond March 18, 2015	$5,799,000	
Difference Between Cost Estimate and Bond	$256,000	
Percent Difference	4.41%	

Errors in permittee's total sheet: indirect should be updated, escalation should be held constant at $479,715, TOTAL rec bond amount in 2019 $5,455,000

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Shop Warehouse 01																			76154
	Administration Bld 02																			31834
	Mine No 1 Transfer Tower 03																			44692.5
	BC 2 Drive House 04																			10621
	BC 3 Drive House 05																			40854
	Crusher Raw Coal 06																			21819
	Truck Loadout 07																			2405
	Railcar Loadout 08																			24078
	Conveyors 8 total 09																			181777
	Water Tanks Two 10																			9550
	Pump House 11																			1825
	Well House Three 12																			4898
	Water Treatment Bld 13																			18365
	Misc Storage Bld 14																			7729
	Overland Conveyor 15																			97946
	Guard Rail 16																			25874
	Rock Dust Bld 17																			8712.5
	Overland Dust Collector 18																			1165
	Substation 19																			3067
	Power Line 20																			528
	Cap Magazine 21																			53
	Fuel Storage 22																			1546
	Propane Tanks 23																			2419
	Stacking Tube 24																			8427
	Reclaim Tunnel 25																			69705
	Slope Proctection Apron 26																			26782
	Concrete Lined Ditch 27																			2096
	Raw Coal Silo 28																			24183
	Parking Area Middle 29																			3743
	Truck Loadout Foundation 30																			356
	Road Pad Lower 31																			5799
	Silo Rail Loadout 32																			214374
	Loadout Foundation RR 33																			8813
	Pavement Rail Loadout 34																			49982
	Steel 35																			2690
	James Canyon 36																			139776
	Culvert Backfilling 37																			11777
	Channel Construction 38																			569631
	Equipment 39																			9637
	Portal Face Door 40																			9281
	Concrete Building 41																			2916
	Winter's Quarters Ventilation 42																			74882
	North of Graben Bleeder Shaft 43	REMOVED FROM BOND - NEVER CONSTRUCTED																		0
	Swens Canyon Ventilation Facility 44																			65229
	Well Abandonment 45																			28224
	Total																			1,946,213

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	(17) 2-inch Monitoring Wells Abandonment	Super Plug; 2-bags		11.16	50lb bag	400-ft					100-gallons							2		22.32
	W79-10-1B (Blocked @400')					400												2		22.32
	W79-26-1 (200')					200												1		11.16
	W2-1(98-2-1) (1519')					1549												8		89.28
	W99-4-1 (1470')					1470												7		78.12
	W20-28-1 (1690')					1690												8		89.28
	92-91-03 (132')					132												2		22.32
	08-1-5 (327')					327												2		22.32
	15-21-2 (2142')					2142												11		122.76
	16-24-1 (600')					600												3		33.48
	17-21-1 (1200')					1200												6		66.96
	17-34-1B (350')					350												2		22.32
	17-34-1S (910')					910												5		55.8
	18-28-1 (1160')					1160												6		66.96
	18-32-1B (1140')					1140												6		66.96
	Subtotal																			
	18-32-1S (1680')					1680												9		100.44
	18-5-1S (2525')					2525												13		145.08
	19-5-1B (1755')					1750												9		100.44
	Electric Lake Discharge Line (18-inch)	Concrete Ready Mix 8000 psi	03 31 13.35 0412	119	166	700	1.5				46					CY		46	CY	7636
	Vertical Plug																			
	Subtotal																			
	Drill Crew	2-man		125	hr									90						11250
	Water truck w/crew			100										72						7200
	Boulger Dam Piezometer abandonment	2-man		125	hr									8						1000
	Subtotal																			
	Subtotal																			
	Subtotal																			
	Total																			28224

Need to track this down

	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Portal 01															70928
Water Tank 02															12835
Lower Terrace 03															487.3
Middle Bench 04															258768
Upper Bench West Fork 05															137340
Southwest Fork 06															7750
Loadout Faclities 07															187522
South Fork Portal Area 08															71822
Waste Rock Disposal 09															399159
Pond Enlargement Interim 10															17
Pond Diversion DU2 Interim 11															449
Interim Sediment Control 12															5192
Overland Conveyor 13															1812
James Canyon 14															0
Winter Quarters 15															159928
North of Groben Bleeder Shaft 16	REMOVED FROM PERMIT														
Swens Canyon Ventilation Facility 17															178721
Electric Lake Discharge Line 18															11507
Total															1504237

Notes: Revised operator wages 6/21/16

Ref.	*Description*	*Materials*	*Means Reference Number*	*Unit Cost*	*O&P*	*Unit*	*Length*	*Widtl*	*Height*	*Diame*	*Area*	*Volum*	*Weight*	*Dens*	*Time*	*Numb*	*Unit*	*Quantity Factor*	*Unit*	*Cost*
1	**South Facing Slopes 1H:3H or Greater**																			
	Seeding	South Facing Slope Seed 1H . 3H or gentler	Table 4.7-1	300.15		/AC					39.81						AC	39.81	AC	11,949
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					39.81						AC	1734	MSF	71,966
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					39.81						AC	39.81	AC	11,505
	Subtotal																			95,420
2	**North Facing Slopes**																			
	Seeding	North Facing Slopes Seed	Table 4.7-2	267.02		/AC					20.33						AC	20.33	AC	5,429
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					20.33						AC	886	MSF	36,751
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					20.33						AC	20.33	AC	5,875
	Subtotal																			48,055
3	**Riparian Habitat**																			
	Seeding	Riparian Habitat Seed	Table 4.7-3	68.26		/AC					0.04						AC	0.04	AC	3
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					0.04						AC	2	MSF	72
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					0.04						AC	0.04	AC	12
	Subtotal																			87
4	**South to West Facing Slopes**																			
	Seeding	South to West Facing Riparian Habitat Seed	Table 4.7-4	450.73		/AC					39.81						AC	39.81	AC	17,943
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					39.81						AC	1734	MSF	71,966
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					39.81						AC	39.81	AC	11,505
	Subtotal																			101,415
5	**North to East Facing Slopes**																			
	Seeding	North to East Facing Riparian Habitat Seed	Table 4.7-5	343.31		/AC					20.33						AC	20.33	AC	6,980
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					20.33						AC	886	MSF	36,751
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					20.33						AC	20.33	AC	5,875
	Subtotal																			49,606
6	**Waste Rock**																			
	Seeding	Waste Rock Slopes Seed	Table 4.7-6A	136.52		/AC					12.81						AC	12.81	AC	1,749
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					12.81						AC	558	MSF	23,157
		Fertilizer Hydro Spread		289.00		/AC					12.81							12.81	AC	3,702
	Subtotal																			28,608
7	**James Canyon**																			
	Seeding	Waste Rock Slopes Seed	Table 4.7-6A	136.52		/AC					4.85						AC	4.85	AC	662
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					4.85						AC	211	MSF	8,768
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					4.85						AC	4.85	AC	1,402
	Subtotal																			10,831
8	**Riparian Stem Supplement**																			
	Stems	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		Ea										9800	Ea	18718	EA	35,751
	Subtotal																			35,751
9	**Silt Fence Interim Vegetation**																			
	Stems	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		Ea	20000										ea	20000	EA	38,200
	Subtotal																			38,200
10	**Reveg Loadout Sediment Pond**																			
	Seeding	Riparian Habitat Seed	Table 4.7-3	68.26		/AC					0.3						AC	0.3	/AC	20
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					0.3						AC	13	MSF	542
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					0.3						AC	0.3	/AC	87
	Subtotal																			650
11	**Winter Quarters Ventilation Facility Bond**																			
	South facing slopes																			
	Seeding	Final Reveg Seed Mix Rip Commun Win Qu Ven Fac	Table 4.7-9B	1007.86		/AC					2.36						AC	2.36	/AC	2,379
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					2.36						AC	103	/MSF	4,266
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					2.36						AC	2.36	/AC	682
	Quaking Aspen	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					2.36			400			ea	400	ea	764
	Blue Elderberry	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					2.36			400			ea	400	ea	764
	Subtotal																			8,855
12	**North of Graben Bleeder Shaft** THIS SITE WAS NEVER BUILT																			
	REVEGETATION																			
	NOG																			
	South facing slopes																			
	Seeding	South facing slope seed mix	Table 4.7-10B	209.80		/AC					1.7						AC	1.7	/AC	
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					1.7						AC	74	/MSF	
	Tubings	Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					1.7						AC	1.7	/AC	
	Quaking Aspen	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					1.7			200			ea	200	ea	
	red Elderberry	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					1.7			20			ea	20	ea	
	Mountain Snowberry	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		EA					1.7			100			ea	100	ea	
	Subtotal																			
13	**Swens Canyon Ventilation Facility**																			
	South facing slopes																			
	Seeding	Final Reveg Sage/Grass Swens Can Ven Fac south facing slope seed mix	Table 4.7-11B	287.10		/AC					6.33						AC	6.33	/AC	1,817
	Seeding	Power line contemporaneous reseeding following construction	Table 4.7-1	300.15		/AC											AC	1	AC	300
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					6.33						AC	276	/MSF	11,443
	Tubings	Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					6.33						AC	6.33	/AC	1,829
	Sagebrush	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					6.33			400			ea	400	ea	764
	rabbitbrush	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					6.33			400			ea	400	ea	764
	Subtotal																			16,918
14	**Electric Lake Discharge Line**																			
	East facing slopes																			
	seeding	Final Reveg Sage/Grass Community seed mix	Table 4.7-11B	287.10		/AC					0.5						AC	0.5	AC	144
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					0.5						AC	21.78	MSF	904
	Subtotal																			1,047
	Revegetation																			
	25% of Initial Seeding																			30,831
	Subtotal																			30,831
	Total										147									466,275

* Hay material only: assume 2 tons/ac (1 to 2 tons recommended in The Practical Guide to Reclamation in Utah pp 112-113)
*2014 R S Means and 2014 Nevada SRCE use $0.15/lb ($300/ton)

Note: MRP Hav costs varv from line item. Varies other errors in cell calcs

Tree Plar 10 4

	Reference		*Equipment Cost*	*Hourly Operating Costs*	*Equipment Overhead*	*Operator's Hourly Wage Rate*	*Hourly Cost*	*Number of Men or Eq.*	*Total Eq. & Lab. Costs*	*Units*	*Quantity*	*Units*	*Production Rate*	*Units*	*Equip. + Labor Time/Dis.*	*Units*	*Cost*
	Page	*Year*															
Skyline Mine **Electric Lake Discharge Line**																	
Majority of work done during construction.																	
Only a 20-ft by 30-ft pad will need to be																	
reclaimed at final reclamation.																	
Backfilling and grading																	
CAT 345BL II	(10-23)	(1st14)	17095	113.1	0.1	55.4	292.97	1	292.97	HR					10	HR	2930
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	642.97	1	642.97	HR					10	HR	6430
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	83.28	1	83.28	HR					10	HR	833
CLAB							62.1	1.5	54.98	HR					10	HR	550
Foreman Average, Outside							84.25	1	76.35	HR					10	HR	764
Subtotal																	11507

Ch. 4, Sec. 4.4

The Electric Lake Discharge line was installed to transfer clean water from the mine into Electric Lake. For installation of the line an approximate 100-ft by 125-ft pad was constructed to drill the hole, then an approximately 30-ft wide by 330-ft. long corridor was needed to bury the line from the hole to the lake. Following construction, the pad and pipeline were reclaimed with the exception of a 20-ft by 30-ft pad where piping transitioned from vertically underground to horizontally below the surface to the lake. Prior to construction topsoil was salvaged and store for replacement. Once the topsoil is returned to its original location, the surface will be extremely roughened in preparation for reseeding. At final reclamation, the vertical pipe will be cut off below surface and backfilled. Similarly, the pipe leading to the lake will be cut off below grade and buried. The pad will be returned to approximate original contours (AOC).

4.4.3 Soil Stabilization

In addition to the vegetative stabilization discussed in Section 4.7 - REVEGETATION PLAN, physical stabilization of the soil is also planned. The specific methods to be implemented will be defined on the basis of additional soil analyses at the time of reclamation. An example of the soil stabilization methodology that might be used includes the placement of crushed and heavier material at the toe of road fill slopes and along stream banks.

4.4.4 Stabilization of Rills and Gullies

All rills and gullies which erode to a depth of nine inches or more will be filled, regraded and reseeded unless there is less than two feet of cover; then when the rills reach six inches in depth, the areas will be regraded and reseeded. The areas may be regraded and reseeded for other situations if deemed necessary by the Permittee and the regulatory agencies.

Ch. 4 Sec. 4.6

The topsoil and subsoil from the Swens Canyon Ventilation Facility (SCVF) area will be collected from the disturbed area as construction advances. Prior to construction, soil samples will be collected from the A and B horizon at sample locations 14SKY14 and 14SKY15 and analyzed for available nutrients nitrogen, phosphorus, and potassium per DOGM 2008 guidelines. The associated soil survey (see Appendix A-2, Volume 2) the depth of topsoil ranges from approximately 0.83 to 1.3 feet. It is estimated approximately 8,750 cu-yds of topsoil and 6,350 cu-yds of subsoil will be collected and stored. The total topsoil, subsoil removal will store approximately 15,100 cu-yd of material. Efforts will be made to segregate the topsoil and topsoil.

The soil units are mapped as the Hailman family and Kamack family which are both considered a sandy loam found on slopes of 5-15% and 10-35%, respectively. The Available Water Capacity (AWC) suitability for the topsoil component of these units is considered Good to Fair while the AWC suitability for the subsoil in these units is considered Fair to Poor.
Of the two (2) soil samples collected in the area of the pad, the EC, Sodium Absorption Rate (SAR), and TOC were all in acceptable ranges to use the available material (see Appendix D of Long Resources Order 2 Soil Survey, Appendix A-2 Volume 2 for details). The Topsoil storage area is designed with a capacity of 16,400 cu-yds, located immediately south of the SCVF pad (see Plate 3.2.4-4F).

Topsoil and subsoil from the Electric Lake Discharge Line area will be salvaged and stored prior to construction starting. The site will be treated as a typical exploration site as the material will be replaced shortly after construction. The construction site consists of an approximately 100-ft by 125-ft pad used for the construction of a vertical hole into the mine, and an approximately 30-ft by 330-ft corridor to bury the horizontal portion of the line from the vertical section to the lake. Only an approximate 20-ft by 30-ft pad will remain during the life of the site. Total disturbance during construction is approximately 0.5 acres. Topsoil and subsoil will be bermed / windrowed for replacement following construction. An Alpine Ecological soil report from the site indicates approximately 2.5-ft of A horizon material exists from the soil pit dug (Appendix A-2, Volume 2). Prior to construction, a soil sample will be collected from the A horizon and analyzed for available nutrients nitrogen, phosphorus, and potassium per DOGM 2008 guidelines.

Ch. 4. Sec. 4.7

4.7.9 Winter Quarters Ventilation Facility (WQVF)

Refer to both Section 2.7 and the Mt. Nebo Vegetation report located in Appendix A-2, Volume 2 for a discussion of the vegetation for the WQVF. The interim and final revegetation seed mixes for the WQVF area are listed in Tables 4.7-8A through 4.7-8C. Reclamation success standards are based on the reference area(s) identified in the Mt. Nebo report. Noxious plants invading the WQVF permit area will be controlled by hand-grubbing, and/or approved herbicides. Surveillance will be monitored annually during the liability period.

4.7.11 Swens Canyon Ventilation Facility (SCVF)

Refer to both Section 2.7 and the Mt. Nebo Vegetation report located in Appendix A-2, Volume 2 for a discussion of the vegetation for the SCVF. The interim and final revegetation seed mixes for the SCVF area are listed in Tables 4.7-11A, and 4.7-11B, respectively. Following topsoil and subsoil handling outlined in Section 4.6, seed distribution, and any remedial soil treatments, seed will be retained using a hydro-mulch, certified weed-free straw, erosion control blankets, a combination or other best technology currently available at the time. Reclamation standards are based on a combination of the reference area identified in the Mt. Nebo report, and the recommendations within the report. Any reseeding necessary along the power line corridor will be done contemporaneously during construction and use seed mixes outlined in Tables 4.7-1, -4, or -5 depending on the directional aspect of the slope. The area has been mapped as crucial summer range for deer and elk by the Utah Division of Wildlife Resources (DWR). Consequently, a pre-set woody species value of 2,500 plants per acre is currently proposed for a revegetation success standard at the proposed disturbed Sagebrush/Grass area. However, that may be re-evaluated at bond release if an increased percentage of forbs and grasses is determined more desirable for the post-mining land uses. A modification in the woody-species will be based on consultation with USFS, DWR, DOGM, and mine personnel. Noxious plants invading the SCVF permit area will be controlled by hand-grubbing, and/or approved herbicides. Surveillance will be monitored annually during the liability period.

4.7.12 Electric Lake Discharge Line

Refer to both Section 2.7 and the Alpine Ecological report located in Appendix A-2, Volume 2 for additional information on the vegetation. A majority of the site will be reclaimed following construction/installation of the discharge line. Only an approximately 20-ft by 30-ft pad will remain of het 0.5 acre disturbance. Immediately following construction, the site will be seeded using the mix outlined in Table 4.7.11-B.

Ch. 4, Sec. 4.12

TABLE 4.12-1

PROPOSED POSTMINING LANDUSE

Area	Present Ownership	Premining Landuse	Proposed Postmining Use	Alternative Use	Capacity To Support Proposed Use	Relationship To Existing Landuse Policies
Mine Site and Exploratory Excavations	USFS	Wildlife/ Grazing Habitat	Wildlife/ Grazing Habitat	Picnic Area	Adequate	Compatible
Conveyor and Pipeline	Private	Grazing/ Wildlife Habitat	Grazing/ Wildlife Habitat	Wildlife Habitat	Adequate	Compatible
Main Access Road	State	Forest Access and Service Road	State Road	None	Adequate	Compatible
Loadout	Private	Grazing, Picnic and Stock Pens*	Grazing/ Wildlife	Wildlife Habitat	Adequate	Compatible
Waste Rock Disposal	Private	Grazing/ Wildlife Habitat	Grazing/ Wildlife Habitat	Wildlife Habitat	Adequate	Compatible
South Fork Breakout	USFS	Wildlife/ Grazing Habitat	Wildlife/ Grazing Habitat Forestry	Wildlife Habitat	Adequate	Compatible
James Canyon	USFS/Private	Wildlife/ Grazing Habitat	Wildlife/ Grazing Habitat	Wildlife Habitat	Adequate	Compatible
Winter Quarters Ventilation Facility	Private	Grazing Mining Wildlife	Grazing Wildlife	Adequate	Adequate	Compatible
Swens Canyon Ventilation Facility	USFS	Wildlife/ Grazing	Wildlife/ Grazing	Adequate	Adequate	Compatible
Electric Lake Discharge Line	USFS	Wildlife Grazing	Wildlife Grazing	Adequate	Adequate	Compatible

The owner's representative requests that the pit fill be leveled off so that it can be used for corrals. The leveled-off fill will be reclaimed to native rangeland per the Reclamation Plan.

4.12.7Winter Quarters Ventilation Facility (WQVF)

The pre-mining land use was native rangeland providing habitat for grazing and wildlife, with associated impacts from mining and timber harvesting. The WQVF pad site and access are all on private land. The pre-existing road will not be reclaimed and any associated road improvements will remain. At reclamation, the mine openings will be sealed and/or backfilled, the pad, pad-access road, and associated facilities will be removed and the Approximate Original Contour (AOC) be returned. Once the reclamation commitments have been achieved, the pre-mining land uses will be adequately re-established.

4.12.8 This section was removed from the permit as the site was never constructed.

4.12.9 South Fork Breakout
The pre-mining land use provided habitat for wildlife, wildlife grazing,and forestry. A portion of the 0.96 acre disturbed and permit area boundary was approved for full bond release in 2017, and released from the disturbed and permit area boundary. 0.36 acres, including the road and topsoil area, were approved for full bond release while 0.60 acres remains within the disturbed and permit area boundary and will be reclaimed by Skyline Mine. See plate 3.2.11-1 for details.

4.12.10 Electric Lake Discharge Line
The pre-mining land use provided habitat for wildlife and grazing. At reclamation the small 20-ft by 30-ft pad will be reclaimed and the pipe buried in place. The vast majority of the disturbance was reclaimed immediately following installation.

Skyline Mine
Vegetative Analysis of Proposed Water Well Drill Site and Water Well Reference Site

Report Prepared By

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For
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July 2020

Table of Contents

Introduction

The purpose of the proposed water well drill site is to drill a well for water. Heavy equipment to be utilized will access the well area via existing roads.

Total estimated disturbance area for the water well drill site in 2020 is 0.275 acres. Reclamation of the disturb area will occur in the fall of 2020 after completion of the drilling of the well.

Skyline Mine is a coal mine with its surface facilities located about 4 miles southwest of the town of Scofield in Carbon County, Utah. The proposed water well drill site is located approximately 3.2 miles southwest of the surface facilities of the mine. The proposed drill site is located in the bottom of a valley in Emery County. The vegetation on the drill site is a dry meadow shrub and grassland. The elevations of the drill sites is 8,609 feet above sea level.

Methods

Sampling Standards

Methodologies used for this analysis were performed in accordance with vegetation guidelines supplied by the State of Utah, Division of Oil, Gas and Mining (DOGM). In July of 2020, quantitative and qualitative data were collected in the plant communities proposed for drilling activities as well as reference areas that were chosen for future revegetation success standards.

Sampling Methodology for Cover, Frequency and Composition

The areas that is proposed to be disturbed is centered on the proposed drill site. Therefore, the vegetation around the drill site needed to be analyzed. It was determined that the best method to determine vegetative cover frequency and composition on this area would be nested frequency belt lines as described in the U.S. Forest Service Rangeland Ecosystem Analysis and Monitoring Handbook (FSH 2209.21). Five 100 ft. beltlines were established in five different compass directions radiating from the proposed drill site and reference site point. With this methodology the vegetation composition around the proposed drill site and reference site would be determined. The five compass directions used were the following from magnetic North: Belt 1 at 23 degrees, Belt 2 at 121 degrees, Belt 3 at 173 degrees, Belt 4 at 269 degrees and Belt 5 at 296 degrees. Every 5 ft. along each transect line a ½ m^2 nested frequency frame was placed on alternating sides of the transect line. Species composition and frequency were recorded using the frame. Ground cover was also determined using the frame. The percent cover of each species was then estimated within each frame. A total of 100 nested frequency data points were therefore taken at each proposed drill site and each reference site. Plant nomenclature follows the USDA-ARS Plant Database (plants.usda.gov).

Placement of Reference Sites

The reference site was chosen to represent future revegetation success standards. The reference site was chosen by walking far enough away from the proposed drill site so it would not be disturbed during the drilling activity. Locations for the reference site was chosen by visually looking at the site and trying to choose a site that looked similar in vegetative composition to the proposed drill site.

Sampling Methodology for Density

Density estimates for the woody plant species on the proposed drill site and reference areas were made using a distance method called the point-quarter technique. In this method, random points were placed on the sample sites and measured into four quarters. The distance to the nearest woody plant species were then recorded in each quarter. The average point to individual distance was equal to the square root of the mean area per individual.

Photographs and Map

A map was created with the proposed drill site and reference site (Appendix 5). In addition, photographs were taken of each belt line from the center point (Appendix 3-4).

Threatened, Endangered, Candidate and Sensitive Species

The inventory of federally listed threatened, endangered and candidate plant species for Emery and Sanpete Counties was consulted prior to field work. Both Emery and Sanpete County lists were consulted because the proposed drill site is close to the Sanpete/Emery County line. In addition, the State of Utah, Department of Natural Resource's biodiversity database and the USDA Forest Service Intermountain Region's list of proposed, endangered, threatened and sensitive species for the Manti portion of the Manti-La Sal National Forest was consulted for possible impacts by the proposed project.

If applicable, this information would be used to drive species of concern field surveys if any of the species or habitats were found on or near the proposed project.

Results

Water Well Drill Site

The proposed water well drill site is located in the bottom of a valley in Emery County. The vegetation on the drill site is a dry meadow shrub and grassland.

There were no overstory species. The most common understory species were *Achnatherum nelsonii* (Columbia Needlegrass), *Artemisia cana* (Silver Sagebrush) and *Carex* (Carex spp.). A list of all species encountered in the sample quadrats is listed in Appendix 1.

Total living cover for this area was estimated at 66.5%, of which 66.5% was from understory cover and 0% was from overstory cover (Appendix 1). The composition of the understory cover was 40% grasses, 2% forbs and 24% shrubs.

Water Well Reference Site

The proposed water well reference site is located in the bottom of a valley in Emery County. The vegetation on the drill site is a dry meadow shrub and grassland.

There were no overstory species. The most common understory species were *Achnatherum nelsonii* (Columbia Needlegrass), *Artemisia cana* (Silver Sagebrush) and *Carex* (Carex spp.). A list of all species encountered in the sample quadrats is listed in Appendix 2.

Total living cover for this area was estimated at 63%, of which 63% was from understory cover and 0% was from overstory cover (Appendix 2). The composition of the understory cover was 31% grasses, 14.5% forbs and 17.5% shrubs.

Analysis of Similarities Between Drill Site and Reference Site

Specific parameters for those plant communities that would be disturbed by the proposed drilling activities were compared statistically using an unpaired t test with the correlating reference area that could be used for revegetation success standard following final reclamation of the site. When total living cover values of the proposed drill site were compared to the corresponding reference site there were significant differences found between the sites. The total cover on the reference site was not significantly different from the total cover on the proposed drill site. The reference site had significantly more forbs than the proposed drill site. It appears that sheep had been bedded down in the proposed drill site earlier in the year which could account for the difference in the presence of forbs in the proposed drill site.

When total woody species density values of the drill site were compared to the reference site there was no significant difference.

Threatened, Endangered, Candidate and Sensitive Species

The following is a table of potential endangered, threatened, candidate and sensitive plant species know to occur in Sanpete and Emery Counties. Next to each species name information is provided about the likelihood of occurrence for each species in the proposed drill site areas.

Federally listed endangered, threatened, candidate and sensitive species for Emery and Sanpete County.	
Endangered	
Pediocactus despainii (San Rafael cactus)	This species is found in open pinyon-juniper communities at 6,000-6,200 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.

Schoenocrambe barnebyi (Barnaby reed-mustard)	This species is found in mixed shadscale, eriogonum and ephedra communities at 5,600-5,700 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species
Sclerocatus wrightiae (Wright fishhook cactus)	This plat is found on the Mancos Shale Formation in salt desert shrub to juniper communities at 4,790-6,120 ft. elevation. The study area is above the elevation range for this species. The vegetative types are very different and there is no Mancos Shale in the study area. The proposed project will not impact this plant species.
Threatened	
Astragalus montii (Heliotrope milk-vetch)	This species is found in alpine on windblown ridges and snowdrift sites at 10,500-11,000 ft. elevation. The study areas are below the elevation range for this species. The habitat is different. The know locations of this species are well South of the study area. The proposed project will not impact this plant species
Cycladenia humilis var jonesii (Jones Cyladenia)	This species is found in cool desert shrub and juniper communities at 4,400-6,000 ft. elevation.

	The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Pediocactus despainii (Despain Footcactus)	This species is found in open piyon-juniper communities at 6,000-6,200 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Townsendia aprica (Last Chance townsendia)	This species is found in salt desert shrub and pinyon-juniper communities in the Arapien and Mancos Shale formations at 6,100-8,000 ft. elevation. The study areas are not found in the Arapien or Mancos Shale formation. The vegetative types are very different. The proposed project will not impact this plant species.
Candidate/Sensitive	
Aster kingie var barnebyana (Barneby woody aster)	This species is found in mountain mahogany-oak communities in rock outcrops composed of Precambrian quartzite at 7,345-7,610 ft. elevation. There are not outcrops of Precambrian quartzite in the study areas. The vegetative types are very different.

	The proposed project will not impact this plant species.
Astragalus consobrinus (Bicknell milkvetch)	This species is found in sagebrush-grassland and pinyon-juniper communities on the Mancos Shale formation at 5,200-9,000 ft. elevation. The study areas are not found in the Mancos Shale formation. The vegetative types are very different. The proposed project will not impact this plant species.
Astragalus subcinereus var. basalticus (Basalt milkvetch or Silver milkvetch)	This species is found in pinyon-juniper and ponderosa communities at 4,520-7,970 ft. elevtation. The vegetative types of the study areas are very different and the know population of this plant are found in southern Emery County. The proposed project will not impact this plant species.
Cryptantha compacta (Mound cryptanth)	This species is found in salt desert shrub and mixed desert shrub communities at 4,950-9,250 ft. elevation. The vegetative types of the study areas are very different. The proposed project will not impact this plant species.
Cryptantha creutzfeldtii (Creutzfeldt-flower)	This species is found in mat atriplex communities on the Mancos Shale formation at 5,250-6,495 ft. elevation.

	The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Cymopterus coulteri (Coulter biscuitroot)	This species is found in black sagebrush, shadscale, desert shrub and juniper communites at 4,955-6,000 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Erigeron carringtonae (Carrington daisy)	This species is found in medows and escarpment margins at 10,000-11,000 ft. elevation. The study areas are below the elevation range. The proposed project will not impact this plant species.
Erigonoum corymbosum var. smithii (Big Flattop buckwheat or Smith wild buckwheat)	This species is found in purple-sage matchweed, ephedra-Indian ricegrass and rabbitbrush communities at 5,200-5,610 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Festuca dasyclada (Sedge fescue)	This species is found on open slopes and ridges in sagebrush, mountain brush, and

	juniper communities on the Green River Shale Formation and limestone gravels at 6,990-10,000 ft. elevation. The study areas are in a different formation. The proposed project will not impact this plant species.
Gilia tenuis (Mussentuchit Gilia)	This species is found in pinyon-juniper woodlands. The study sites have a very different vegetative type. The proposed project will not impact this plant species.
Hedysarum occidentale var. canone (Canyon sweetvetch or Coal sweetvetch)	This species is found in pinyon-juniper, sagebrush and wash communities at 5,000-8,000 ft. elevation. The study sited have a very different vegetative type. The proposed project will not impact this plant species.
Hymenoxys depressa (Low hymenoxys or Depressed bitterweed)	This species is found in ephedra, sagebrush, shadscale and pinyon-juniper communities at 4,400-7,100 ft. elevation. The study sites have a very different vegetative type. The proposed project will not impact this plant species.
Hymenoxys helenioides (Helenium hymenoxys or Intermountain bitterweed)	This species is found in mountain brush, sagebrush, aspen and meadow communities at 8,800-10,700 ft. elevation.

	Know populations of this species are found at quite a distance south and north of the study site. The proposed project will not impact this plant species.
Lygodesmia entrada (Entrada rushpink)	This species is found in mixed desert shrub and juniper communities at 4,400-4,800 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Mentzelia argillosa (Arapien stickleaf)	This species is found in salt desert shrub and pinyon-juniper communities on the Arapien Shale formation at 5,000-6,200 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The Arapien Shale formation is not found in the study areas. The proposed project will not impact this plant species.
Mentzelia multicaulis var. librina (Book Cliffs blazing star)	This species is found in sagebrush, rabbitbrush, and pinyon-juniper communities at 6,200 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different.

	The proposed project will not impact this plant species.
Penstemon tidestromii (Tidestrom beardtongue)	This species is found in desert shrub, sagebrush, and pinyon-juniper communities at 5,300-8,200 ft elevation. The study sites have a very different vegetative type. The proposed project will not impact this plant species.
Penstemon wardii (Ward beardtongue)	This species is found in desert shub, pinyon-juniper, sagebrush, shadescale and greasewood communities on the Arapien Shale formation at 5,495-6,810 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Phacelia utahensis (Utah phacelia)	This species is found in salt desert shrub communites on the Arapien Shale Formation at 5,500-5,700 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Psorothamnus polydenius var. jonesii (Jones indigo-bush or glandular indigo-bush)	This species is found in salt desert shrub communities on Mancos Shale formations at 4,820 ft. elevation.

	The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Silene petersonii (Maguire campion, Wasatch limestone catchfly or Peterson catchfly)	This species is found in ponderosa pine, rocky mountain juniper, bristlecone pine, spruce-fier, and aspen-sagebrush communities on open calcareous and igneous gravels at 6,955-11,200 ft. elevation. The study sites have no open calcareous and igneous gravels. The proposed project will not impact this plant species.
Sphaeralcea psoraloides (Psoralea globemallow)	This species is found in zuckia ephedra communities at 4,000-6,000 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Talinum thompsonii (Thompson talinum)	This species is found on silicious conglomeratic gravels in pinyon-juniper and ponderosa pine communities at 7,500 ft. elevation. The study sites do not contain any silicious conglomeratic gravels. The proposed project will not impact this plant species.

Summary

Total estimated disturbance area for proposed water well drill site in 2020 is 0.275 acres. Reclamation of the disturb area will occur in the fall of 2020 after completion of the drilling of the water well.

Drilling activities will necessitate disturbance to the vegetation in this area. The plant community at the proposed water well drill site is in a native condition, while the reference site is in a native condition. The plant community where drilling is proposed was quantitatively sampled, along with a reference area chosen to be used for final revegetation success standards. Additionally, endangered, threatened, candidate and sensitive plant species know to occur in Sanpete and Emery counties will not be impacted by the proposed drilling action.

Appendix 1- Data Summary Tables for Water Well Drill Site

Water Well Drill Site	**2020**	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegrass)	21	31.5
Bromus inermis (Smooth Brome)	0.4	0.6
Carex (Carex spp.)	16.5	25
Juncus arcticus (Hulten Mountain Rush)	2	3
FORBS		
Antennaria (Pussytoes spp.)	0.3	0.5
Cirsium scariosum (Meadow Thistle)	0.07	0.1
Hymenoxys hoopesii (Orange Sneezeweed)	1	2
Penstemon rydbergii (Rydberg's Penstemon)	0.7	1
TREES/SHRUBS		
Artemisia cana (Silver Sagebrush)	20	30
Artemisia tridentate vaseyana (Mountain Big Sagebrush)	4	5.5
Chrysothamnus viscidiflorus (Yellow Rabbitbrush)	0.4	0.6

Water Well Drill Site 2020	
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	0
Understory Cover	66.5
Litter	6
Bare Ground	27.5
Total Living Cover	66.5
% Composition	
Grasses	40
Forbs	2
Shrubs	24
Trees	0

Water Well Drill Site 2020	
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Artemisia cana (Silver Sagebrush)	2,741
Artemisia tridentate vaseyana (Mountain Big Sagebrush)	420
Chrysothamnus viscidiflorus (Yellow Rabbitbrush)	98
TOTAL	3,259

Appendix 2- Data Summary Tables for Water Well Drill Site Reference Site

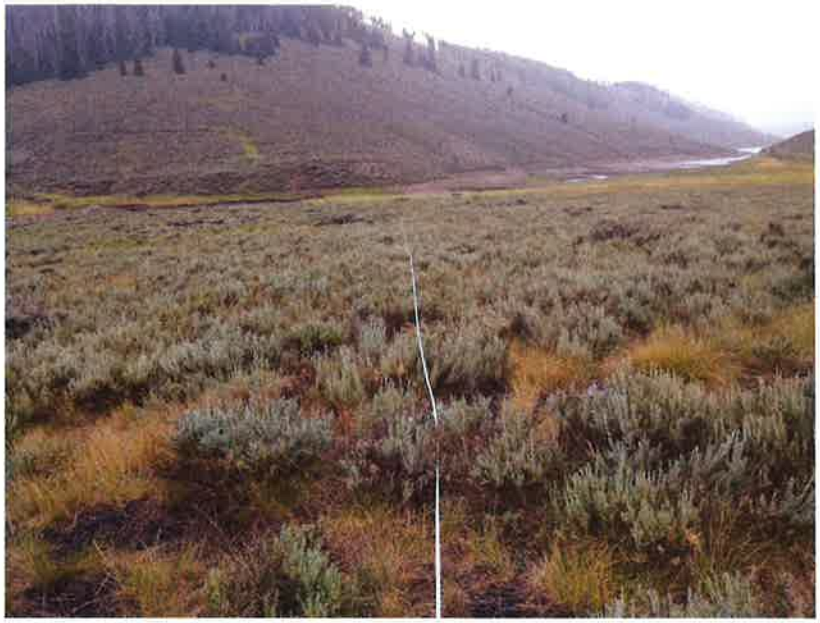
Water Well Drill Site Reference Site	2020	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegrass)	16	25
Bromus inermis (Smooth Brome)	3	5
Carex (Carex spp.)	12	18.5
Juncus arcticus (Hulten Mountain Rush)	0.2	0.3
FORBS		
Antennaria (Pussytoes spp.)	0.6	1
Hymenoxys hoopesii (Orange Sneezeweed)	7	11
Phlox austromontana (Mountain Phlox)	6	10
Potentilla gracilis (Slender Cinquefoil)	0.4	0.6
TREES/SHRUBS		
Artemisia cana (Silver Sagebrush)	16	25
Artemisia tridentate vaseyana (Mountain Big Sagebrush)	2	3
Chrysothamnus viscidiflorus (Yellow Rabbitbrush)	0.3	0.4

Water Well Drill Site Reference Site	2020
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	0
Understory Cover	63
Litter	3
Bare Ground	34
Total Living Cover	63
% Composition	
Grasses	31
Forbs	14.5
Shrubs	17.5
Trees	0

Water Well Drill Site Reference Site	2020
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Artemisia cana (Silver Sagebrush)	2,161
Artemisia tridentate vaseyana (Mountain Big Sagebrush)	527
Chrysothamnus viscidiflorus (Yellow Rabbitbrush)	63
TOTAL	2,751

Appendix 3- Photos Water Well Drill Site

Water Well Drill Site Belt 1

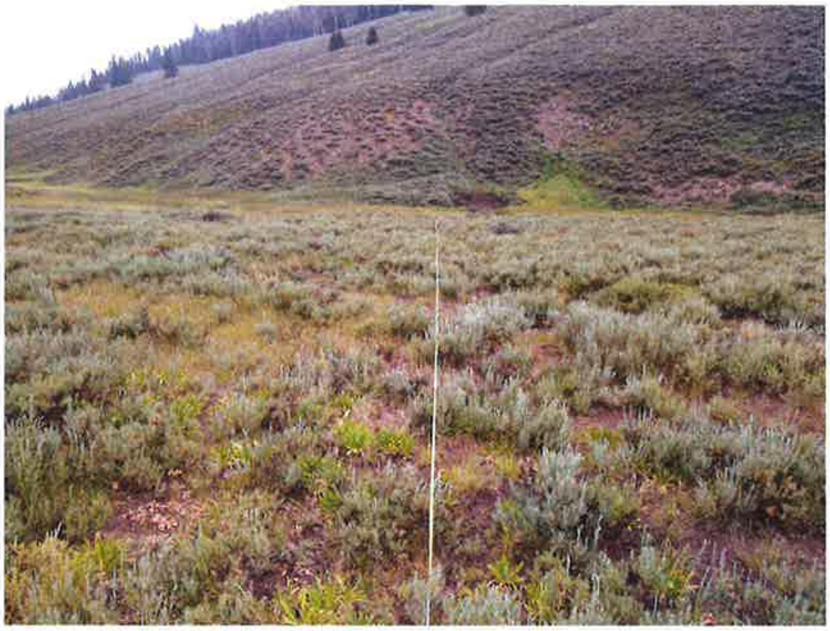

Water Well Drill Site Belt 2


Water Well Drill Site Belt 3

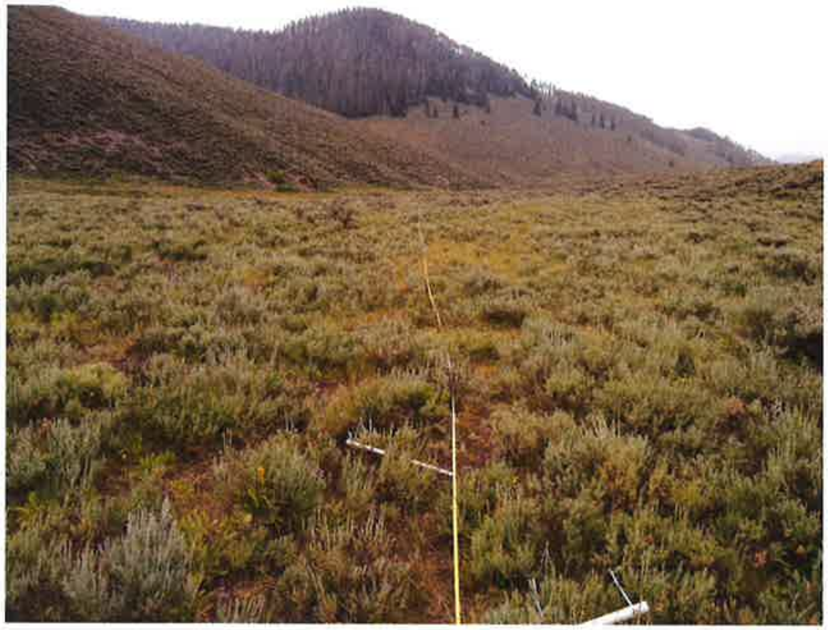

Water Well Drill Site Belt 4


Water Well Drill Site Belt 5

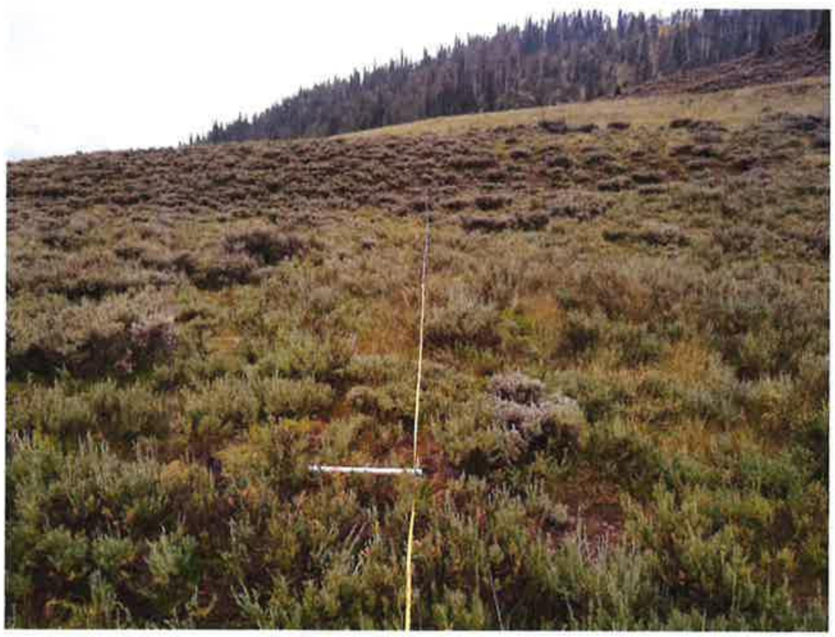
Appendix 4- Photos of Water Well Drill Site Reference



Water Well Drill Site Reference Belt 1



Water Well Drill Site Reference Belt 2



Water Well Drill Site Reference Belt 3

Water Well Drill Site Reference Belt 4

Water Well Drill Site Reference Belt 5

Appendix 5- Study Area Map

Water Well Drill Site and Reference Site

Appendix 6 - UTM Coordinates of Water Well Drill Site and Reference Site

Water Well Drill Site	12 S	0 479478 E	4388836 N
Water Well Reference	12 S	0 479409 E	4389066 N

July 24, 2020

Gregg Galecki
Skyline Mine
HC 35 Box 380
Helper, Utah 84526

Dear Gregg

Alpine Ecological has conducted a soil survey on the proposed water well on behalf of Skyline Mine. The survey was conducted in order to comply with requirements of Utah Division of Oil, Gas and Mining (DOGM).

NRCS Soil Data

There has been no soil survey conducted in the area of the proposed water well. The United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) have conducted soil surveys approximately 9 miles Northeast of the proposed drill site. The USDA-NRCS Web Soil Survey (WSS) utility and associated soil reports were used in determining the soil types in the proposed disturbance area (Appendices A & B).

According to the information provided by the NRCS, soils in the vicinity of the proposed drill site is comprised of the Silas-Brycan Loams Complex as well as 7 others. The Silas-Brycan Loams Complex soils were identified on the valley bottoms of the soil survey areas.

The proposed water well is located on a east facing, toe slope, base slope, mountain base. This soil most closely resembles the Silas-Brycan Loams Complex.

Site Reconnaissance

Site reconnaissance was conducted by Dr. Stevens. The proposed water well site location was identified the soil survey was conducted at the proposed site. This was done to ensure that the same soils were being surveyed that would be disturbed with the proposed drill project. (Appendix C).

Since there were no soil surveys previously conducted in the proposed drill site area by the NRCS Dr. Stevens investigated road cuts and other exposed soils within the NRCS soil survey area east of the affected areas to familiarize himself with the previously classified soils.

Soil Profiles

Soil investigations were conducted at the proposed water well drill location on July 22, 2020. A soil profile (Sp water well) was excavated near the proposed drill location to gather representative soils data for the proposed drill site. The soil pit was excavated by hand to a depth of approximately 1 meter. The pit was logged and photographed (Appendices D and E). The soils in the pits correlated with Silas-Brycan Loams Complex soils identified by the NRCS in nearby areas. The site was excavated on a east facing, toe slope, base slope, mountain base.

Please feel free to contact me if you have any questions.

Sincerely,
Alpine Ecological

Allan Stevens PhD

Appendix A

Map and Legends of NRCS Soil Survey
(obtained from WSS)

Map Scale: 1:126,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0, 1500, 3000, 6000, 9000

Feet: 0, 5000, 10000, 20000, 30000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Carbon Area, Utah, Parts of Carbon and Emery Counties
Survey Area Data: Version 10, Sep 11, 2018

Soil Survey Area: Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties
Survey Area Data: Version 1, Dec 27, 2013

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 10, 2009—Nov 8, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
22	Croydon loam, 30 to 50 percent slopes	136.7	0.3%
23	Curecanti family-Pathead complex	4,376.0	8.5%
29	Dumps, mine	20.1	0.0%
30	Falcon-Rock outcrop complex	5.4	0.0%
105	Senchert family-Senchert complex	188.4	0.4%
109	Silas-Brycan loams	144.1	0.3%
115	Trag stony loam, 30 to 60 percent slopes	1,094.0	2.1%
117	Trag-Beje-Senchert complex	2.6	0.0%
118	Trag-Croydon complex	1,272.7	2.5%
125	Uinta-Toze families complex	607.1	1.2%
Subtotals for Soil Survey Area		**7,847.0**	**15.3%**
Totals for Area of Interest		**51,197.1**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
NOTCOM	No Digital Data Available	43,350.1	84.7%
Subtotals for Soil Survey Area		**43,350.1**	**84.7%**
Totals for Area of Interest		**51,197.1**	**100.0%**

Appendix B

Soil Series Descriptions for Silas-Brycan Loams Complex as Developed by the NRCS
(obtained from WWS)

109-Silas-Brycan Loams

Map Unit Setting

- Elevation 7,680-8,580
- Mean annual precipitation: 16 to 20 inches
- Mean annual air temperature: 38 to 45 degrees F
- Frost free period: 60 to 80 days

Map Unit Composition

- Silas and similar soils: 65%
- Brycan and similar soils: 20%
- Minor components: 15%

Description of Silas

Setting

- Landform: Valleys
- Down-slope shape: Linear
- Across-Slope shape: Concave
- Parent Material: Alluvium derived from sandstone and shale

Properties and qualities

- Slope: 0-3%
- Depth to restrictive feature: More than 80 inches
- Drainage class: Somewhat poorly drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
- Depth to water table: About 18-42 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Calcium carbonate, maximum content: 5%
- Available water capacity: High (about 9.6 in)

Interpretive groups

- Land capability (nonirrigated): 6w
- Ecological site: Wet Fresh Meadow

Typical profile

- A – 0-28 inches, loam
- C – 28-60 inches, loam, sandy loam

Description of Brycan

Setting

- Landform: Alluvial fans
- Down-slope shape: Concave
- Across-Slope shape: Convex
- Parent Material: Alluvium derived from sandstone and shale

Properties and qualities

- Slope: 3-8%
- Depth to restrictive feature: More than 80 inches
- Drainage class: Well drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Calcium carbonate, maximum content: 5%
- Available water capacity: High (about 9.9 inches)

Interpretive groups

- Land capability (nonirrigated): 6C
- Ecological site: Mountain loam

Typical profile

- A – 0-12 inches, loam
- B – 12-32 inches, loam
- C – 32-60 inches, silt loam

Appendix C

Google Earth Image of the Proposed Drill Site and Soil Pit Location


Water Well Soil

Appendix D
Soil Profile Log

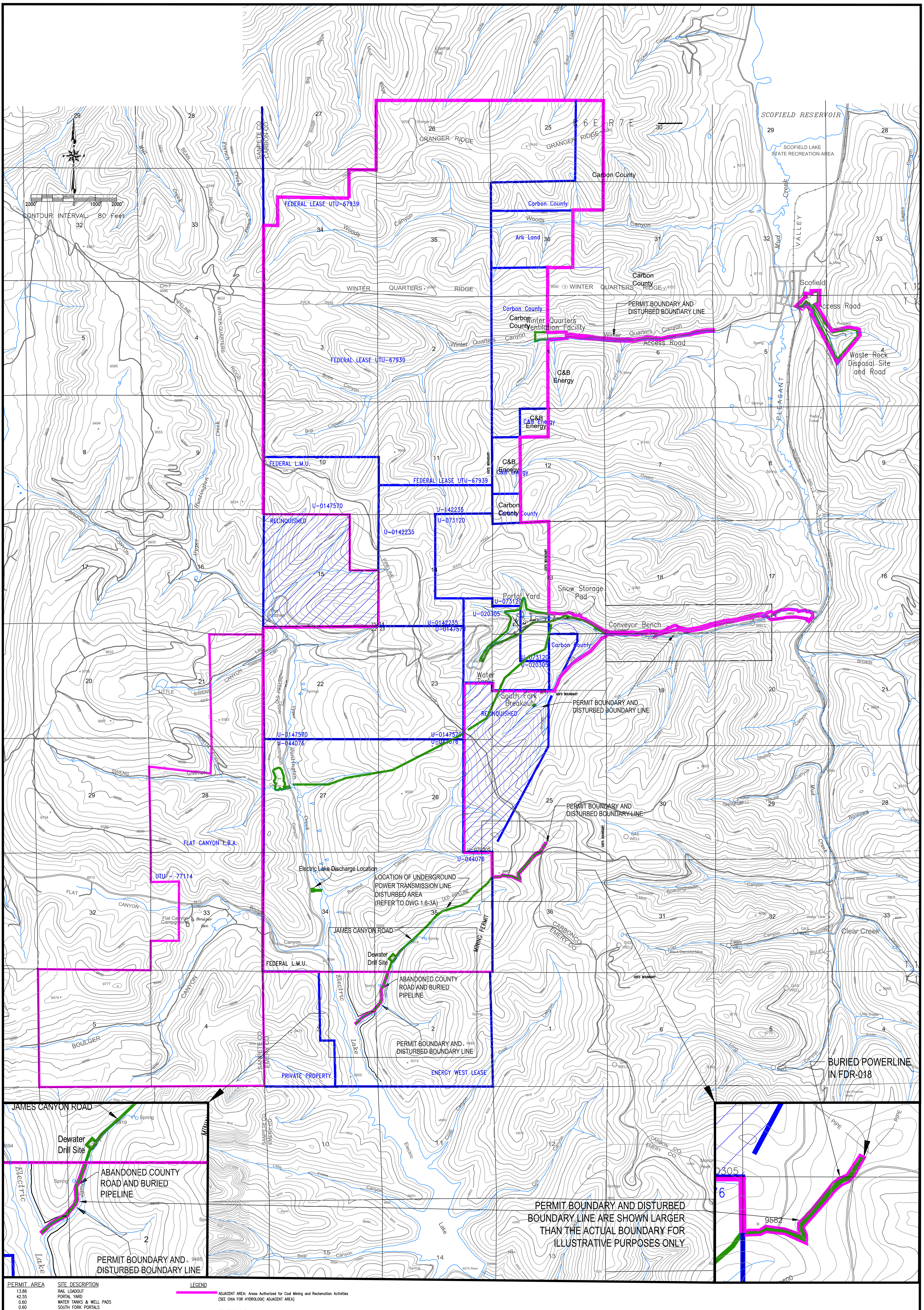
Soil Profile Log
Sp Water Well

Name	Allan Stevens	**Drainage Pattern**	Pinnate
Date	July 22, 2020	**Drainage**	WD Well Drained
Weather	Rainy (48° F)	**Flooding**	NO None
Location	39°38'56.72"N 111°14'21.53"W	**Ponding**	None
Slope Aspect	East	**Depth to Water**	Unknown
Slope Gradient	0-3%	**Plant Cover**	STLE, CAREX, ARCA
Slope Complexity	Complex	**Parent Material**	COL Coluvium
Slope Shape	CV Concave Convex	**Erosion**	W1 0-25% erosion from water
Hillslope Profile	TS Toe Slope	**Surface Fragment**	Stony or Bouldery
Geomorphic	BS Base Slope MB Mountain Base		

Diagnostic Horizons	**Observation Method**	**Depth (cm)**	**Boundary**		**Color**		**Texture**	**Structure**	**Reaction (HCl)**	**% Rock Fragment and Size**	**% Roots Size and Location**
			Distinctness	Topography							
A	SP	0-31	Abrupt	Smooth	Very Dark Grey	10YR 3/1	SL	VF, gr	ST	CG 20%	VF 30%
B	SP	31-66	Abrupt	Smooth	Dark Brown	10YR 3/3	SL	F, sb	ST	CG 45%	F 5%
C	SP	66-			Dark Grayish Brown	10YR 4/2	SCL	F, sb	ST	C 60%	None

Depth	**Description**
0-31	Sandy Loam with very fine root material, very fine granular, coarse gravel, moist
31-66	Sandy Loam with fine root material, fine subangular blocky, coarse gravel, moist
66-	Sandy Clay Loam with no root material, fine subangular blocky, cobly, moist

Appendix E
Soil Profile Photo



PERMIT AREA	SITE DESCRIPTION
13.86	RAIL LOADOUT
42.55	PORTAL YARD
0.60	WATER TANKS & WELL PADS
0.60	SOUTH FORK PORTALS
14.18	CONVEYOR BENCH
32.48	WASTE ROCK DISPOSAL SITE
7.93	WINTER QUARTERS VENTILATION FACILITY
4.90	WINTER QUARTERS ROAD (not reclaimed)
1.60	JAMES CANYON BURIED PIPELINE
0.30	JAMES CANYON BURIED POWER LINE
2.95	JAMES CANYON WATER WELLS AND ROAD
14.50	Swens Shaft and Power line (powe line not reclaimed)
0.50	Electric Lake Discharge Location
136.95	

LEGEND

- ADJACENT AREA: Areas Authorized for Coal Mining and Reclamation Activities (SEE CHIA FOR HYDROLOGIC ADJACENT AREA)
- PERMIT BOUNDARY
- LEASE BOUNDARY

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

LEASE ACREAGE WITHIN ADJACENT AREA

FEDERAL COAL	ACREAGE
U-0147570	1532.70
U-0142235	520.0
U-073120	557.22
U-044076	2489.32
U-020305	279.40
UTU-67939	4061.52
UTU-771114	2692.16
TOTAL	12,132.32

NON-FEDERAL COAL	ACREAGE
C&B COAL	120.00
CARBON COUNTY	811.25
ARK LAND COMPANY	240.00
Cunningham / Tracy	346.68
TOTAL	1,517.93

NOT ALL ACREAGE FOR EACH LEASE IS WITHIN THE PERMIT BOUNDARY, REFER TO PART 1, TABLE 1.114.

ADJACENT AREA SITE DESCRIPTION:
Active Lease Areas, Permit Boundary, and 1/2 Mile beyond Waste Rock Disposal Site

13,525 ACRES SITE PERMIT BOUNDARY

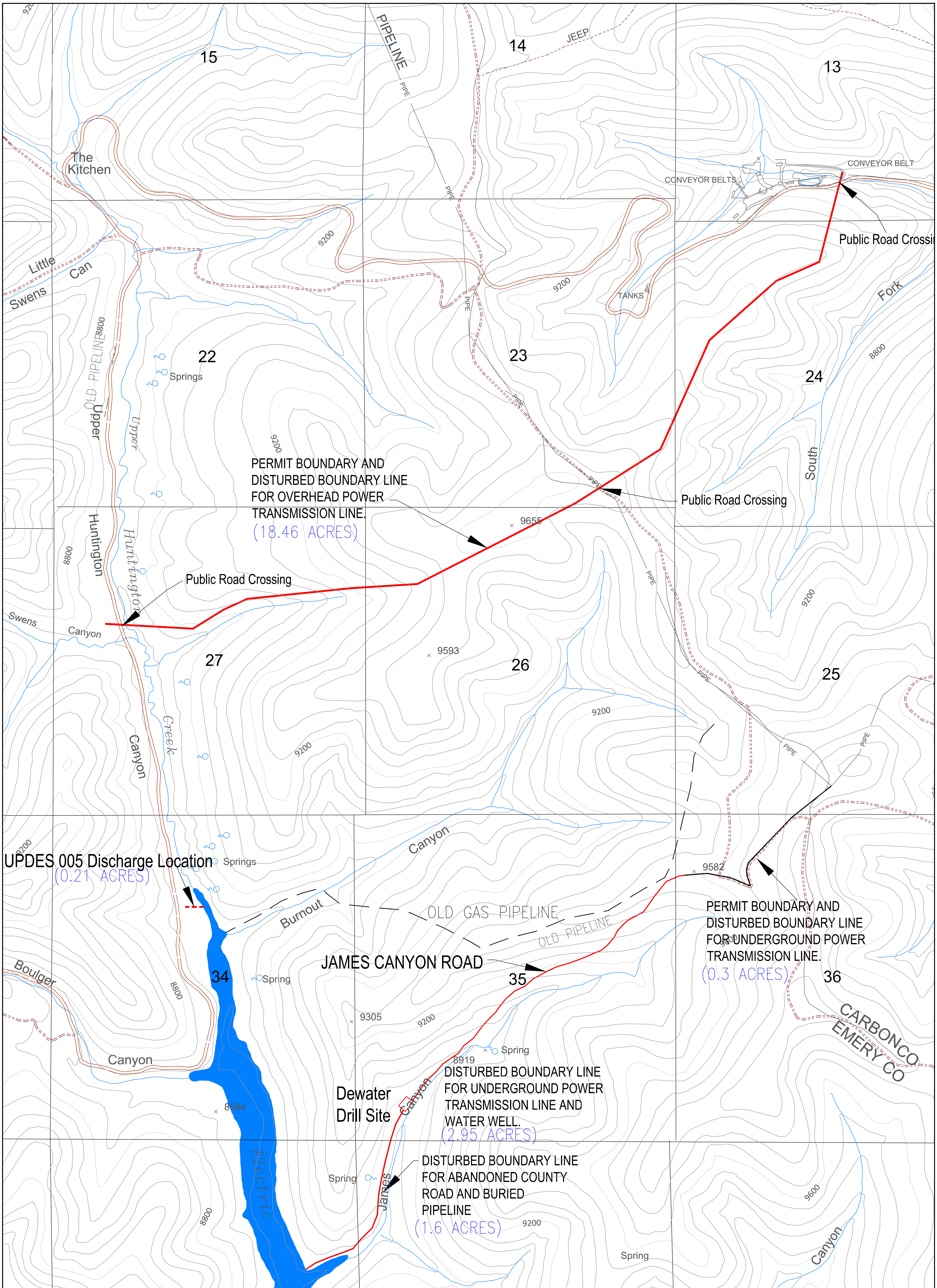
BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

DATE	No.	REVISIONS	DR./CHKD.
AUG 02	1		/VSM
NOV 02	2		/VSM
JUNE 07	3	MODIFIED PERMIT BOUNDARY (IBC & WASTE ROCK) SKYLINE MINES PERMIT AREA, LEASE AREAS.	BR/GG
MAR 2010	4	ADDED ADJACENT AREA, MODIFIED PERMIT AND LEASE BOUNDARIES	AB/GG
JUL 2010	5	ADDED WINTER QUARTERS ACCESS ROAD	AB/GG
AUG 2010	6	MODIFIED ADJACENT AREA	AB/GG
OCT 2012	7	Modified Adjacent Area with Lease Mod. and Relinquishments	GG/GG
July 2014	8	Corrected permit boundary to include water line from Tanks	GG/GG
April 2015	9	Added the NOG shaft pad	TE/GG
May 2016	10	Added Swens shaft pad and power line	JA/GG
Dec. 2016	11	Added Flat Canyon Lease – UTU-77114	JA/GG
Oct 17	12	Removed South Fork Road	TE/GG
1/2/20	13	Removed NOG shaft from drawing and legend	TE/GG
7/2/20	10	Removed Road Crossings from Swens Powerline	TE/GG
9/3/20	11	Added Electric Lake Discharge Location	TE/GG

SKYLINE MINE PERMIT AREA

Canyon Fuel Company, LLC
Skyline Mines
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463

SCALE: 1" = 2000'	DATE: 9/24/01	CK.BY: G. Galecki	REVISION: 15 9-3-20
DWG. NO.: 1.6-3		DR.BY: JCA	
CAD FILE: 1.6-3REV12			



LEGEND

DISTURBED AREA BOUNDARY LINE

I CERTIFY THAT THE INFORMATION CONTAINED HEREON IS CORRECT TO THE BEST OF MY KNOWLEDGE.

2000' 0' 1000' 2000'

CONTOUR INTERVAL: 80 Feet

DATE	#	REVISIONS	DR. / CHKD.
12/30/2015	1	ADD POWER LINE CORRIDOR FOR SWEN CYN PAD	TE / GG
6/8/2020	2	Updated disturbed area acres	TE / GG
7/14/2020	3	Removed road crossings from Swens Powerline	TE / GG
7/15/2020	4	Added road crossings from Swens Powerline	TE / GG
9/4/2020	5	Added UPDES 005 Discharge Location	TE / GG

SKYLINE BURIED PIPE AND POWER LINES

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632

DATE: 10/17/2001 | CK.BY: G. Galecki | REVISION: 5 (9/4/20)

CAD FILE: 1.6-3(A) | SCALE: FULL | DR.BY: J. Armstrong

DWG. NO.: 1.6-3(A)

Richard B. White, PE, PLLC
13441 South Lone Peak Lane • Draper, Utah 84020 • 801-673-6647

September 10, 2020

Gregg Galecki
Canyon Fuel Company, LLC
Skyline Mine
HCR 35 Box 380
Helper, UT 84526

Subject: Evaluation of Potential Geomorphic Impacts of Mine-Water Discharge into the Upper Portion of Electric Lake

Dear Gregg:

Pursuant to your request, I have evaluated the potential geomorphic impacts of discharging water from the Skyline Mine into the upper reaches of Electric Lake in Emery County, Utah. It is my understanding that a new borehole will be drilled into the mine and water will be pumped through this borehole to the lake at a rate of up to 10,000 gallons per minute ("gpm"). Although the discharge from the mine will likely vary with time, I assumed a flow at this rate to estimate worst-case conditions.

I evaluated conditions at the two alternative discharge locations shown on Figure 1. It is my understanding that the North site is the preferred location for the discharge. Both alternative discharge locations may be upstream from or below the lake surface depending on normal, operational lake level fluctuations. Since the discharge location may be upstream from the lake during periods of low lake level, I have prepared recommendations for energy dissipation to minimize impacts to the exposed stream channel and adjacent overbank areas during periods of lower lake level. The results of my evaluation and design recommendations are provided below.

Field Data Collection Methods

Photographs taken during the site survey on August 25, 2020 are provided in Attachment A. The cross section at each alternative discharge location was surveyed using a Topcon RL-H5A horizontal self-leveling rotary laser with LS-80L receiver. The surveys were shot using relative elevations, independent of each location. Horizontal distances were measured using a Keson 100-foot heavy-duty fiberglass tape which was stretched to minimize sag. Elevations and location data were collected at each important feature or change in grade (e.g., channel banks, historic lake levels, slope breaks, etc.).

The longitudinal profile of the creek water surface was also surveyed at points 100 feet up- and downstream from the cross sections to establish hydraulic grade lines. Based on observations made during the field survey, the stream channel lies beneath the elevation of the lake high-water line at least to the elevation of the top of the west terrace bank at the North location and to an elevation at least 2 feet above the west terrace bank at the South location.

Data Evaluation

PacifiCorp has collected nearly continuous streamflow data since 2006 from the location shown on Figure 1 as UPL-10, upstream from the alternative discharge locations. Although periods of no data have occurred sporadically during the period of record (most commonly during winter months), average daily flow records are available for the majority of the period.

Average daily flow data are available for the period of record, but peak daily flow data are currently available only for the period of November 7, 2018 through the present. Since flood frequency evaluation methods rely on peak daily flow data rather than average daily flow data, estimates of annual peak flows were derived for the years when peak flow data were unavailable by multiplying the annual maximum average daily flows by a correction factor. The correction factor was determined by calculating the ratio of peak to average daily flow for the 20 days of highest peak flow in 2019 and 2020 (i.e., the period when both average daily and peak daily flow data were available for the months when peak flows typically occur in the area). The average of those ratios was 1.789. The largest average daily flow for each year was then multiplied by this factor to obtain the estimated annual peak flow for that year. The actual peak measured flows for 2019 and 2020 were used in the analysis.

The annual peak flow estimates and data were entered into a spreadsheet developed by Yochum (2014)[1]. This spreadsheet utilizes the Log-Pearson Type III Distribution to calculate peak flow rates at various return periods, as recommended by the Interagency Advisory Committee on Water Data (1982)[2]. Estimates that utilized the generalized skew were selected as being most representative of the site. The resulting data and calculations are provided in Attachment B and summarized in Table 1.

TABLE 1

Discharge-Frequency Estimates for Upper Huntington Creek

Return Period (yr)	Peak Discharge (cfs)
10	207
25	269
50	317
100	366

[1] Yochum, S. 2014. Log-Pearson Frequency Analysis Spreadsheet, Version 2.5, 6/2014. Excel spreadsheet available as a direct download via Google search.
[2] Interagency Advisory Committee on Water Data. 1982. Guidelines for Determining Flood Flow Frequency. Bulletin #17B of the Hydrology Subcommittee. U.S. Geological Survey. Reston, VA.

The depth and average velocity of flow at each location were determined using the surveyed cross sections and Manning's equation for open-channel flow. Roughness coefficients were estimated based on professional judgment. The surveyed cross section data were entered into a spreadsheet prepared by the Pima County Flood Control District[3]. Flow depths and velocities were determined for each of the peak flows, both alone and with the addition of mine discharge at a rate of 10,000 gpm (22.28 cubic feet per second ["cfs]).

The results of the open-channel flow calculations are provided in Attachment C, with flow depth calculations summarized in Figure 2 for the natural (no mine discharge) condition. The effect of the mine-water discharge on the velocity and depth of flow in Upper Huntington Creek are shown in Figures 3 and 4, respectively. As indicated therein, discharging 10,000 gpm of mine water into the creek has the potential to increase the velocity of flow by 0.1 to 0.2 ft/s and increasing the flow depth by similar magnitudes (0.1 to 0.2 foot, depending on the flood frequency).

Field observations indicate that the natural stone in the bottom of the channel ranges in size from about 0.5 to 18 inches at the North location and 0.5 to 24 inches at the South location. In both cases, the median diameter of the stone is estimated to be 4 to 6 inches.

The erosional stability of the channel bed at each cross section was determined based on the maximum permissible velocity methods of the U.S. Natural Resources Conservation Service (2007)[4]. For the channel bed, the maximum permissible velocity was set equal to the basic velocity of Figure 5. Based on a stone diameter of 4 inches, the allowable velocity would be approximately 10.8 ft/s for sediment-laden flow (i.e., the condition during a peak flow event). Since the D_{75} is larger than the D_{50} of 4 to 6 inches estimated in the field, the actual allowable velocity would be greater than 10.8 ft/s. Figure 3 indicates that the estimated velocities of flow, even with a mine-water discharge of 10,000 gpm, would be less than 6 ft/s. Thus, I consider the channel bed in both locations to be erosionally stable.

The stability of the banks was assessed based on field observations, professional judgment, and guidelines provided by Rosgen (2001)[5]. Neither the North nor the South alternative location exhibited active erosion at the time of the field visit. The east and west banks of the North location are well vegetated and stable. The west bank immediately downstream from the potential discharge location was not vegetated but was well armored at its base. Some erosion of that bank was evident, probably due to sloughing as a result of saturation of the bank during period of high lake level. The erosion hazard in this reach is categorized as low.

---

[3] Pima County Regional Flood Control District. Normal Flow Discharge Using Manning's Equation. Excel spreadsheet available as a direct download via Google search.

[4] U.S. Natural Resources Conservation Service. 2007. Threshold Channel Design. Chapter 8 of Part 654: Stream Restoration Design, National Engineering Handbook. Washington, D.C.

[5] Rosgen, D.L. 2001. A Practical Method of Computing Streambank Erosion Rate. Proceedings of the Seventh Federal Interagency Sedimentation Conference. Volume I, Section II: Stream Restoration. pp. II-9 through II-17.

The west bank of the creek at the South location was moderately-well armored with stone or vegetation. However, the east bank (on an outside bend of the creek) exhibited active sloughing, again probably due to saturation of the bank during periods of high lake level. The erosion hazard of this reach is categorized as moderate.

Design Recommendations

It is my understanding that the U.S. Forest Service (the land management agency in the Upper Huntington Creek area) has requested that the discharge location be below the high-water line of Electric Lake. Field observations indicate that both of the potential discharge locations are below the high-water level. This is verified by Figure 6, which is a Google Earth Image of the upper reach of Electric Lake taken in September 2011.

The current design anticipates that the discharge line from the new boreholel will consist of 18-inch diameter HDPE. The velocity of the discharge from this line was calculated based on straight-line distances from the probable borehole site to the alternative discharge locations, as well as elevations obtained from Google Earth. The results of these calculations are presented in Attachment D. As indicated therein, it is estimated that the velocity of flow at a discharge rate of 10,000 gpm will be 18.2 ft/s at the North site and 17.9 ft/s at the South site.

I recommend that the energy associated with those discharge velocities be dissipated using a riprap apron. The design presented in Figure 7 is based on the recommendations of Thompson and Kilgore (2006)[6] and the calculations presented in Attachment E. The purpose of the apron will be to spread the flow and create roughness, thereby decreasing the velocity.

The design calculations presented in Attachment E indicate that the riprap used to construct the apron should have a median diameter of 9 inches. Based on the size distribution suggested by Haan et al. (1994)[7], I recommend the riprap gradation contained in Table 2.

TABLE 2

Recommended Gradation for Riprap Apron

Percent Finer	Nominal Diameter (in)
0	1.5
20	4.5
50	9
100	18

[6] Thompson, P.L. and R.T. Kilgore. 2006. Hydraulic Design of Energy Dissipators for Culverts and Channels. Hydraulic Engineering Circular No. 14, Third Edition. U.S. Federal Highway Administration. Arlington, VA.
[7] Haan, C.T., B.J. Barfield, and J.C. Hayes. 1994. Design Hydrology and Sedimentology for Small Catchments. Academic Press. San Diego, CA.

The apron should be installed at zero grade on relatively level ground immediately west of the active stream channel, on the local overbank area below the top of the adjacent, higher terrace (see Figure 2). I recommend that silt fencing be installed immediately downstream from the area where the apron is being installed to protect the stream channel during construction. This silt fencing can be removed following installation of the apron.

If the South discharge location is selected, additional riprap of the same dimension as the apron should be installed at the downstream edge of the apron to join and blend with the natural stone in the channel bottom. This additional riprap will not be necessary at the North discharge location as long as the vegetation between the east edge of the apron and the west edge of the active stream channel remains undisturbed.

I have appreciated the opportunity to assist with this project. Please contact me if you have any questions.

Sincerely,

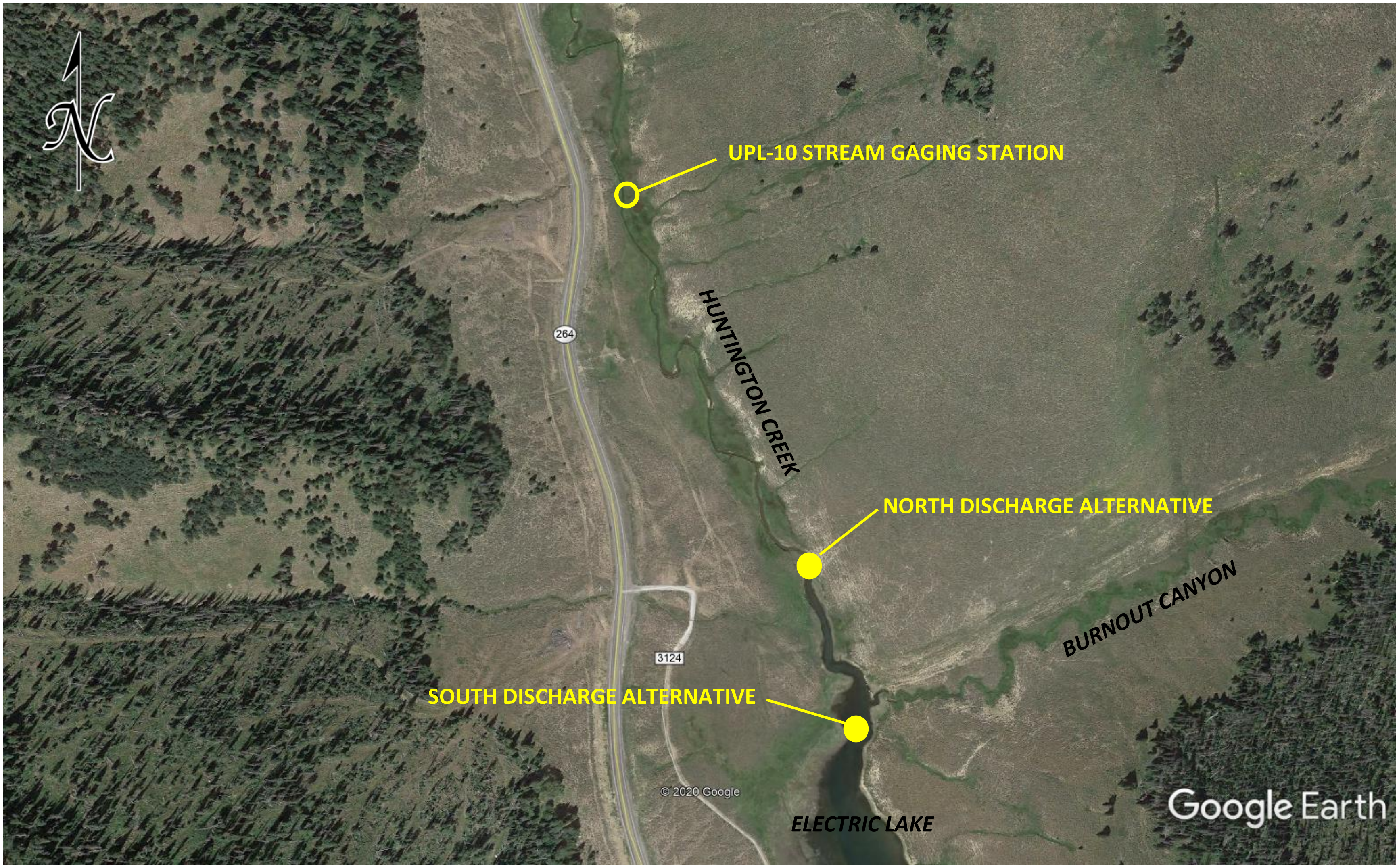
Rick

Richard B. White, P.E.
Consulting Civil and Environmental Engineer

REGISTERED PROFESSIONAL ENGINEER
No. 168246
RICHARD B. WHITE
NOT VALID WITHOUT A SIGNATURE
10 Sep 2020
STATE OF UTAH

Attachments:
Figure 1 – Site Features
Figure 2 – Flow Elevations for Peak Flows with 10- and 100-Year Return Periods
Figure 3 – Effect of Mine Discharge on Flow Velocity
Figure 4 – Effect of Mine Discharge on Flow Depth
Figure 5 – Allowable Velocity in Channel Bed
Figure 6 – 2011 Aerial Image of the Upper Reach of Electric Lake
Figure 7 – Riprap Apron Design Details

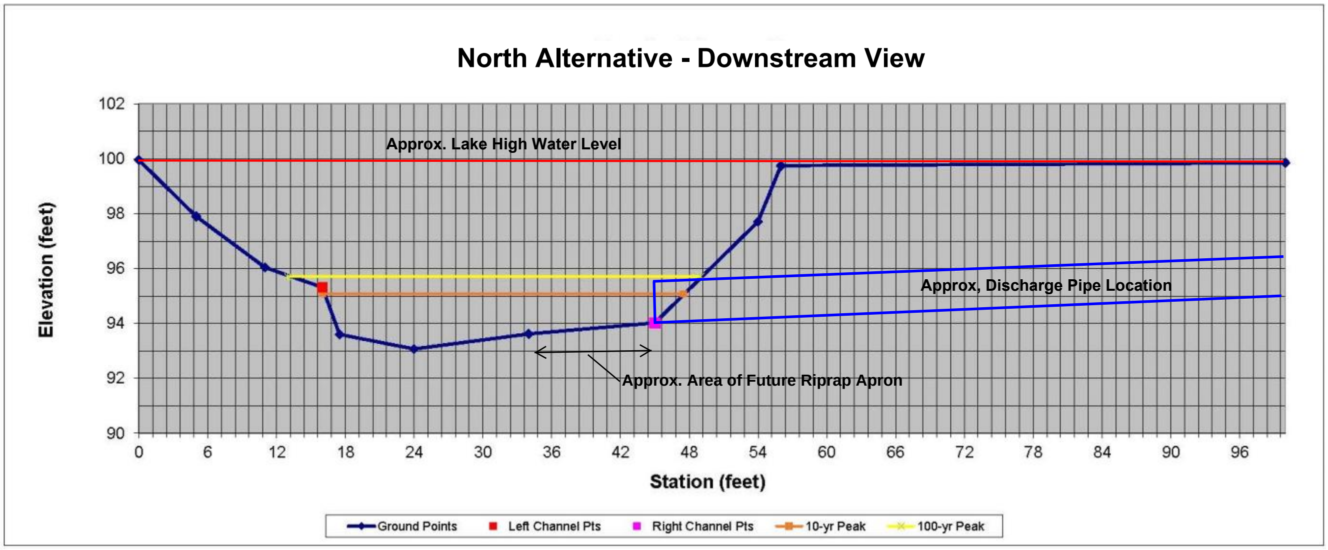
Attachment A – Site Photographs Taken 25 Aug 2020
Attachment B – Results of Discharge Frequency Analyses
Attachment C – Results of Flow Depth and Velocity Analyses
Attachment D – Results of Pipe Discharge Analyses
Attachment E – Riprap Apron Design Calculations



SOURCE: GOOGLE EARTH IMAGE DATED 26 AUG 2019

FIGURE 1. SITE FEATURES.

R • B • WHITE
P.E.



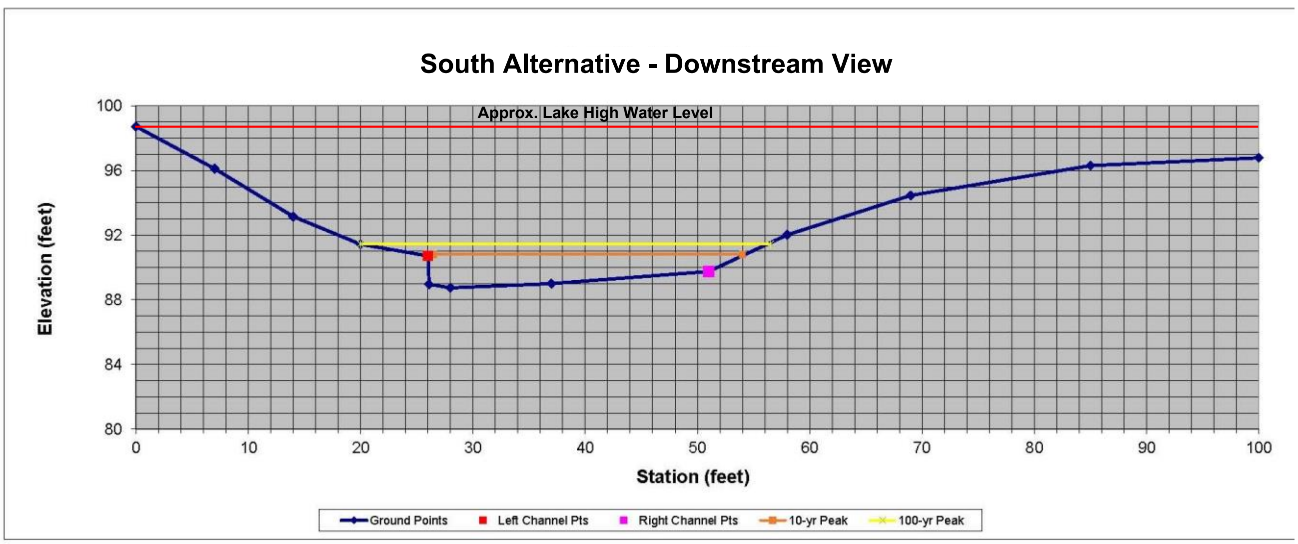
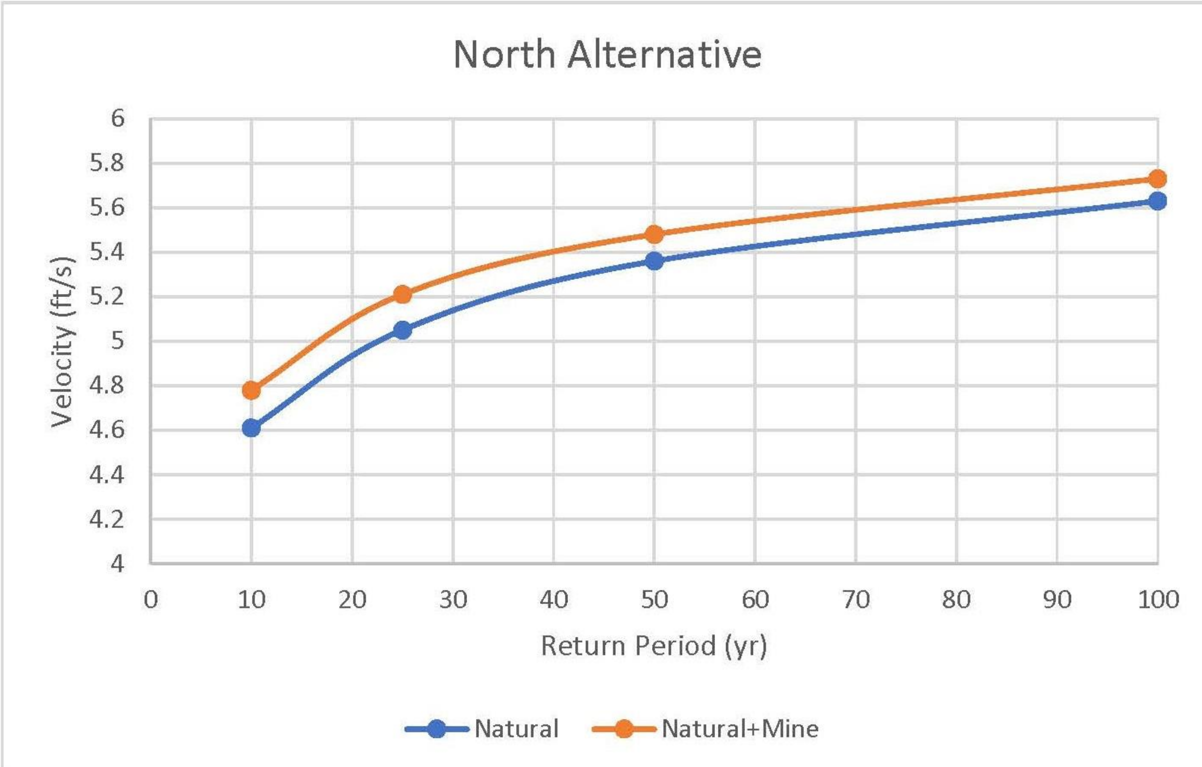


FIGURE 2. FLOW ELEVATIONS FOR PEAK FLOWS WITH 10- AND 100-YEAR RETURN PERIODS.

R * B * WHITE
P.E.



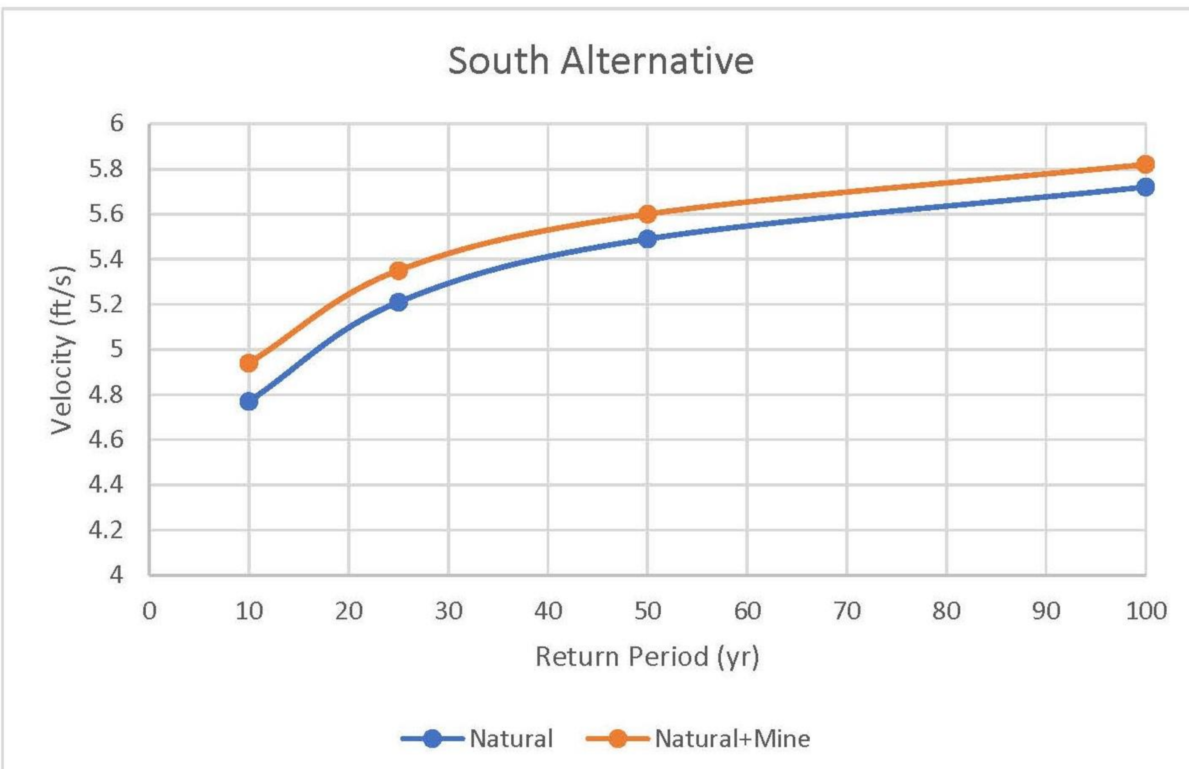


FIGURE 3. EFFECT OF MINE DISCHARGE ON FLOW VELOCITY.

R B WHITE P.E.

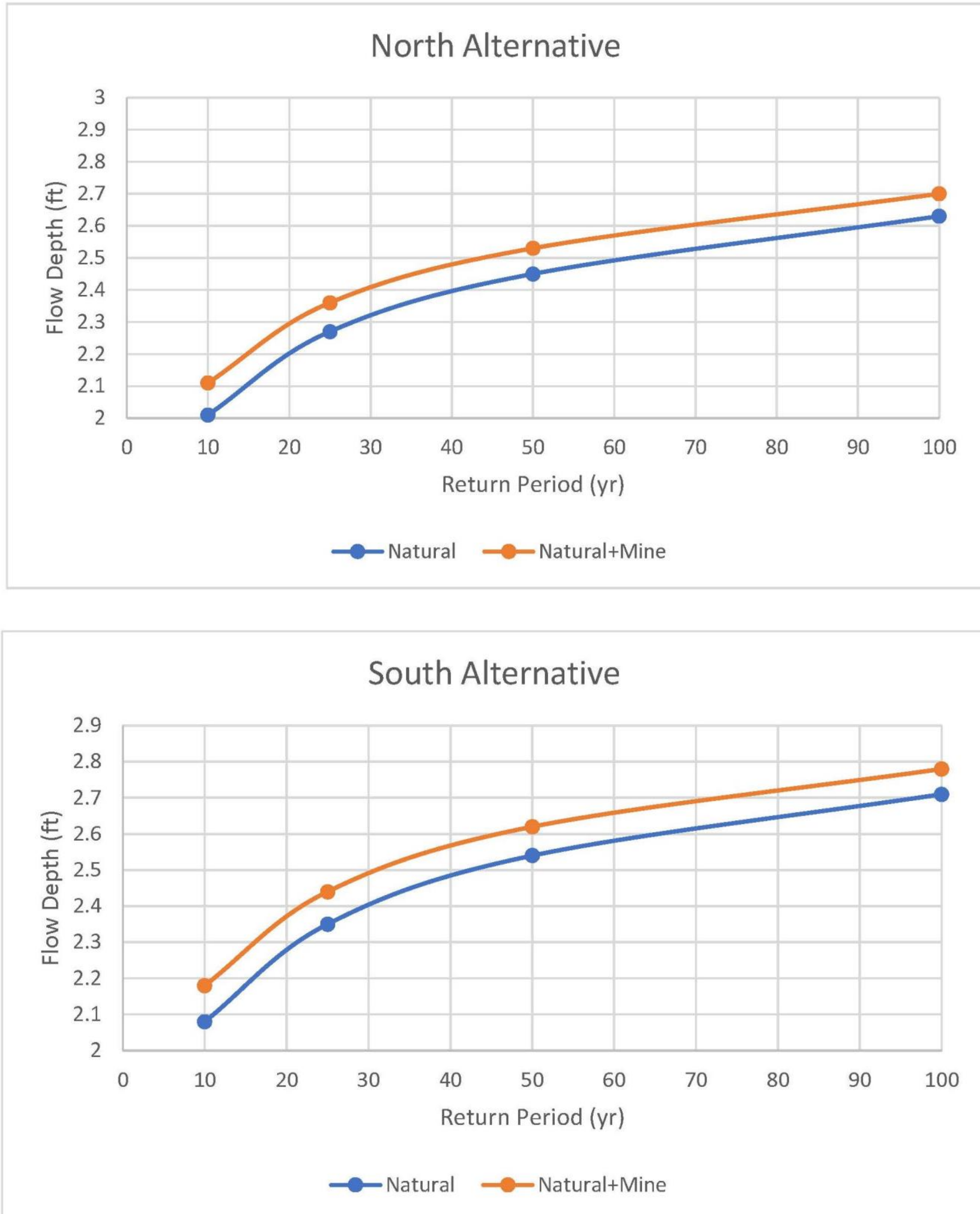
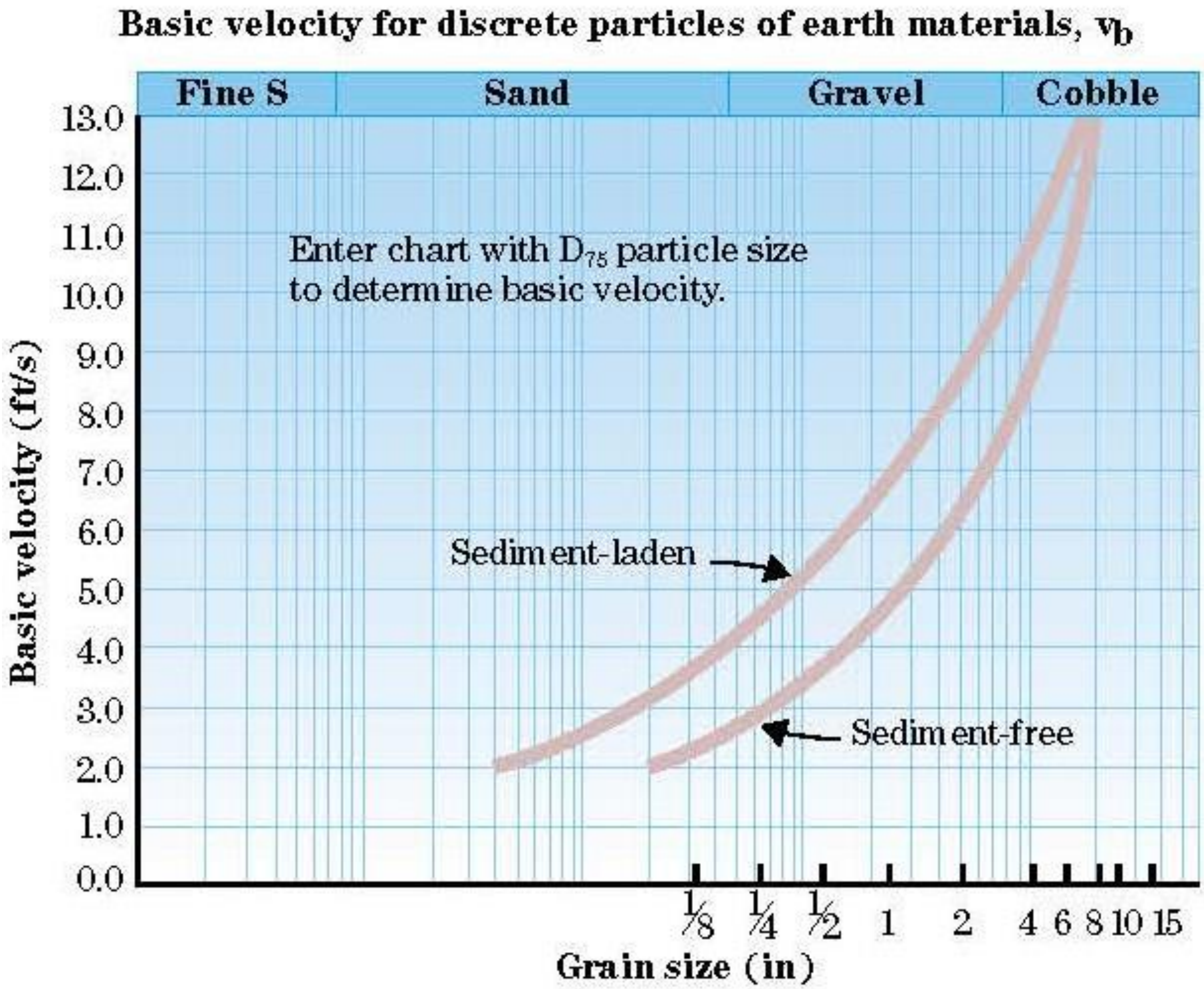


FIGURE 4. EFFECT OF MINE DISCHARGE ON FLOW DEPTH.



SOURCE: U.S. NATURAL RESOURCES CONSERVATION SERVICE (2007)

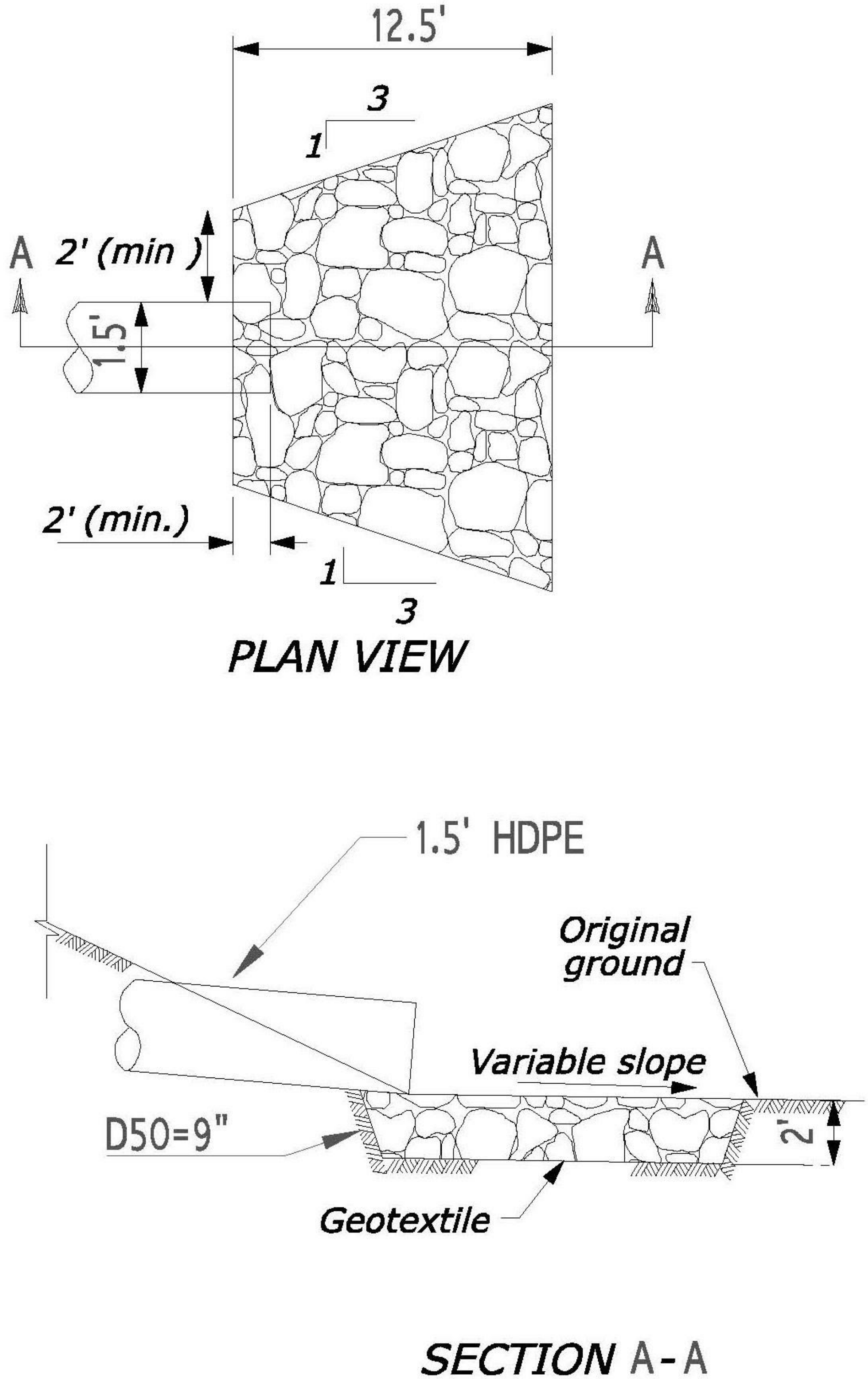
FIGURE 5. ALLOWABLE VELOCITY IN CHANNEL BED.

R • B • WHITE
P.E.

SOURCE: GOOGLE EARTH IMAGE DATED 14 SEP 2011.

FIGURE 6. 2011 AERIAL IMAGE OF THE UPPER REACH OF ELECTRIC LAKE.

R • B • WHITE
P.E.



NOTE: DRAWING PREPARED BY TAYLON EARL, CANYON FUEL COMPANY.

FIGURE 7. RIPRAP APRON DESIGN DETAILS.

R★B★WHITE
P.E.

ATTACHMENT A

Site Photographs Taken 25 Aug 2020

Photo 1 – Upstream view of North site. Riprap apron would be installed in the grassy area on the left.

Photo 2 – Downstream view of North site.

Photo 3 – View east from terrace at North site. High lake level is approximately at the terrace level.

Photo 4 - Upstream view of North site. Riprap apron would be installed on the left overbank area.

Photo 5 – Downstream view of the South site.

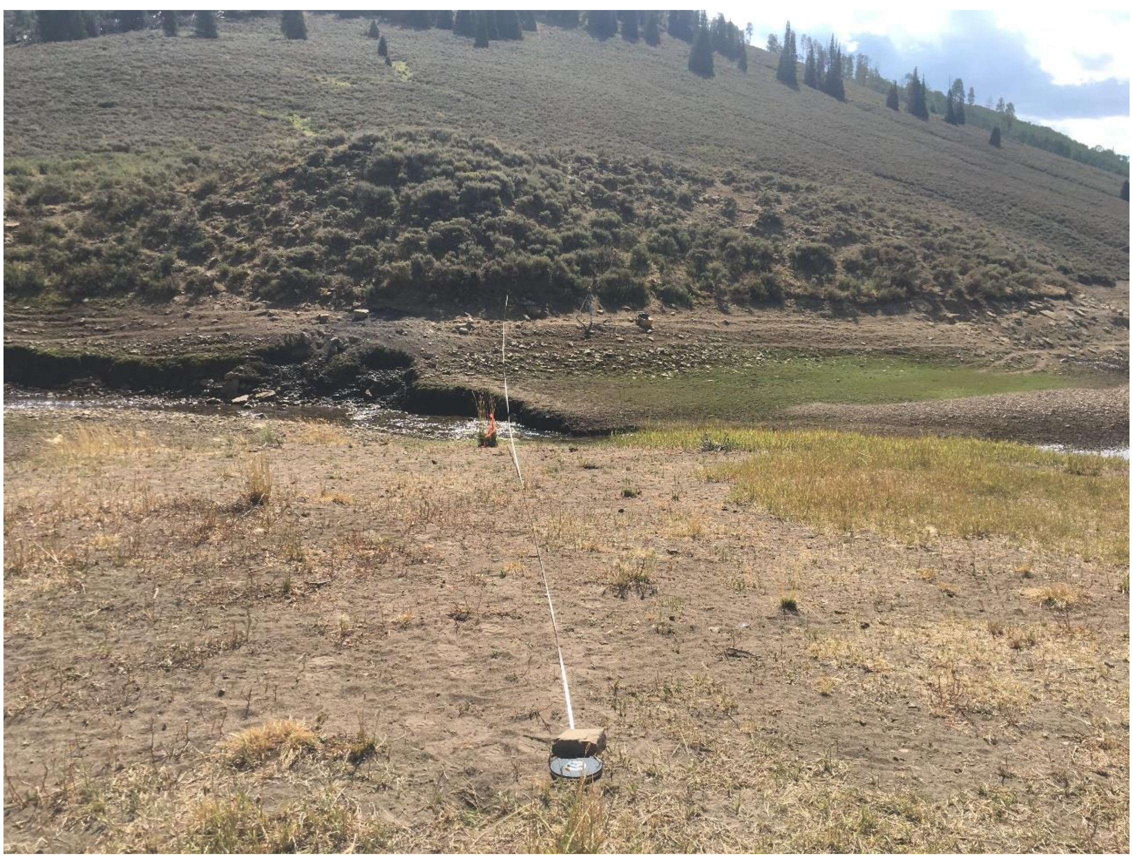


Photo 6 - View east from terrace at South site. High lake level is visible on east bank.

ATTACHMENT B

Results of Discharge Frequency Analyses

NRCS Log-Pearson Frequency Analysis Spreadsheet, Version 2.0, 3/2003

Page 1 of 3

Project: *Skyline Mine - Electric Lake Discharge*
Streamgage: *Upper Huntington Creek*
Date: *9/4/2020* **Performed By:** *RB White*

Without Generalized Skew

Average:	4.5417
Standard Deviation:	0.63105551
Skew Coefficient[1]:	-0.0182119
Length of systematic record:	15
Number of historic peaks:	0
Length of Data Record:	15
Length of Historic Record:[5]	----

Recurrence Interval[2] (years)	Percent Chance	K-Value	Ln(Q)	Peak[4] Discharge (cfs)	90% Confidence Interval Upper (cfs)	Lower (cfs)
200	0.5	2.559	6.1565	472	1,050	301
100	1	2.313	6.0010	404	840	265
50	2	2.044	5.8317	341	662	231
25	4	1.745	5.6427	282	509	198
10	10	1.280	5.3493	210	341	154
5	20	0.843	5.0735	160	237	121
2	50	0.003	4.5437	94	125	71
1.25	80	-0.841	4.0110	55	73	37

With Generalized Skew

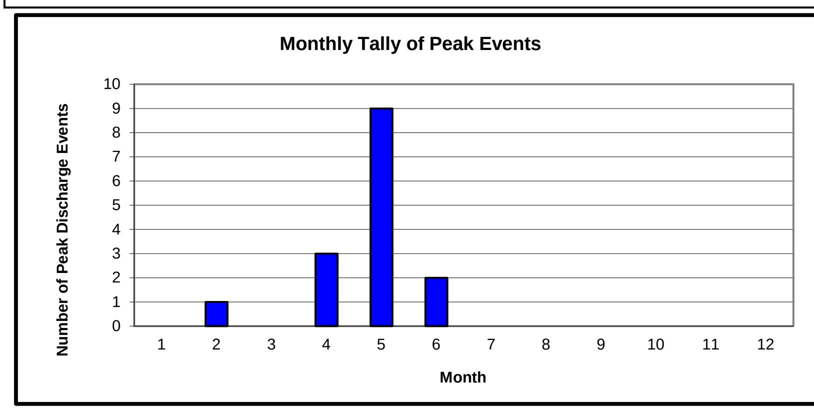
Generalized Skew Coefficient[3]:	-0.2500
MSE Generalized Skew[3]:	0.0320
A:	-0.328543
B:	0.935265
station skew:	-0.018212
MSE Station Skew:	0.32119219
Weighted skew coefficient[1]:	-0.2289995

Recurrence Interval[2] (years)	Percent Chance	K-Value	Ln(Q)	Peak[4] Discharge (cfs)	90% Confidence Interval Upper (cfs)	Lower (cfs)
200	0.5	2.361	6.0315	416	876	272
100	1	2.157	5.9026	366	731	245
50	2	1.929	5.7590	317	598	218
25	4	1.669	5.5951	269	477	190
10	10	1.254	5.3332	207	334	152
5	20	0.851	5.0787	161	238	121
2	50	0.038	4.5656	96	128	73
1.25	80	-0.828	4.0190	56	74	38

(1) Station and generalized skews must be between -2.00 and +3.00 in this spreadsheet.
(2) Considering the relatively short length of most gage records, less frequent peak estimates need to be used with considerable care.
(3) Computed one of four ways (see "generalized skew coefficient" worksheet): Mean and variance (standard deviation^2) of station skews coefficients in region; skew isolines drawn on a map or regions; skew prediction equations; read from Plate 1 of Bulletin 17B (reproduced in this spreadsheet), with MSE Generalized Skew = 0.302.
(4) Results are automatically rounded to three significant figures, the dominant number of significant figures in the K-Value table.
(5) Historic frequency analysis assumes that intervening years reflect systematic record.

Comments:

Peak Timing:



Month	Count
1	0
2	1
3	0
4	3
5	9
6	2
7	0
8	0
9	0
10	0
11	0
12	0

NRCS Log-Pearson Frequency Analysis Spreadsheet, Version 2.0, 3/2003

Project: *Skyline Mine - Electric Lake Discharge*
Streamgage: *Upper Huntington Creek*
Date: *9/4/2020* **Performed By:** *RB White*

Input Data

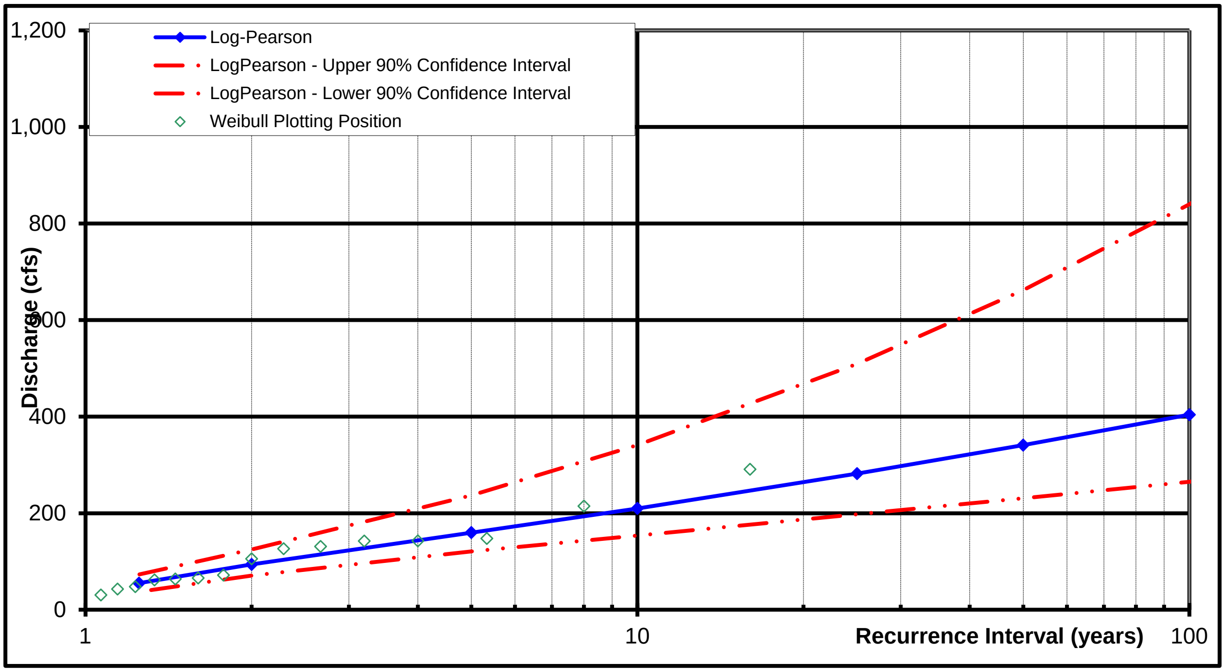
Station ID: *UPL-10* **Latitude, Longitude:** -- --
Drainage Area (mi^2): *0* **County:** *Emery*
Number of low outliers eliminated: *0* **State:** *Utah*

	Date	Discharge (cfs)	Historic?	Outlier?		Date	Discharge (cfs)	Historic?	Outlier?		Date	Discharge (cfs)	Historic?	Outlier?
1	05/20/2006	126	n	n	51	----	----	n	n	101	----	----	n	n
2	05/13/2007	66	n	n	52	----	----	n	n	102	----	----	n	n
3	05/20/2008	143	n	n	53	----	----	n	n	103	----	----	n	n
4	04/24/2009	291	n	n	54	----	----	n	n	104	----	----	n	n
5	06/04/2010	64	n	n	55	----	----	n	n	105	----	----	n	n
6	06/07/2011	148	n	n	56	----	----	n	n	106	----	----	n	n
7	05/03/2012	48	n	n	57	----	----	n	n	107	----	----	n	n
8	05/15/2013	62	n	n	58	----	----	n	n	108	----	----	n	n
9	05/19/2014	72	n	n	59	----	----	n	n	109	----	----	n	n
10	05/07/2015	43	n	n	60	----	----	n	n	110	----	----	n	n
11	05/17/2016	143	n	n	61	----	----	n	n	111	----	----	n	n
12	04/27/2017	131	n	n	62	----	----	n	n	112	----	----	n	n
13	05/10/2018	31	n	n	63	----	----	n	n	113	----	----	n	n
14	04/29/2019	215	n	n	64	----	----	n	n	114	----	----	n	n
15	02/10/2020	106	n	n	65	----	----	n	n	115	----	----	n	n
16	----	----	n	n	66	----	----	n	n	116	----	----	n	n
17	----	----	n	n	67	----	----	n	n	117	----	----	n	n
18	----	----	n	n	68	----	----	n	n	118	----	----	n	n
19	----	----	n	n	69	----	----	n	n	119	----	----	n	n
20	----	----	n	n	70	----	----	n	n	120	----	----	n	n
21	----	----	n	n	71	----	----	n	n	121	----	----	n	n
22	----	----	n	n	72	----	----	n	n	122	----	----	n	n
23	----	----	n	n	73	----	----	n	n	123	----	----	n	n
24	----	----	n	n	74	----	----	n	n	124	----	----	n	n
25	----	----	n	n	75	----	----	n	n	125	----	----	n	n
26	----	----	n	n	76	----	----	n	n	126	----	----	n	n
27	----	----	n	n	77	----	----	n	n	127	----	----	n	n
28	----	----	n	n	78	----	----	n	n	128	----	----	n	n
29	----	----	n	n	79	----	----	n	n	129	----	----	n	n
30	----	----	n	n	80	----	----	n	n	130	----	----	n	n
31	----	----	n	n	81	----	----	n	n	131	----	----	n	n
32	----	----	n	n	82	----	----	n	n	132	----	----	n	n
33	----	----	n	n	83	----	----	n	n	133	----	----	n	n
34	----	----	n	n	84	----	----	n	n	134	----	----	n	n
35	----	----	n	n	85	----	----	n	n	135	----	----	n	n
36	----	----	n	n	86	----	----	n	n	136	----	----	n	n
37	----	----	n	n	87	----	----	n	n	137	----	----	n	n
38	----	----	n	n	88	----	----	n	n	138	----	----	n	n
39	----	----	n	n	89	----	----	n	n	139	----	----	n	n
40	----	----	n	n	90	----	----	n	n	140	----	----	n	n
41	----	----	n	n	91	----	----	n	n	141	----	----	n	n
42	----	----	n	n	92	----	----	n	n	142	----	----	n	n
43	----	----	n	n	93	----	----	n	n	143	----	----	n	n
44	----	----	n	n	94	----	----	n	n	144	----	----	n	n
45	----	----	n	n	95	----	----	n	n	145	----	----	n	n
46	----	----	n	n	96	----	----	n	n	146	----	----	n	n
47	----	----	n	n	97	----	----	n	n	147	----	----	n	n
48	----	----	n	n	98	----	----	n	n	148	----	----	n	n
49	----	----	n	n	99	----	----	n	n	149	----	----	n	n
50	----	----	n	n	100	----	----	n	n	150	----	----	n	n

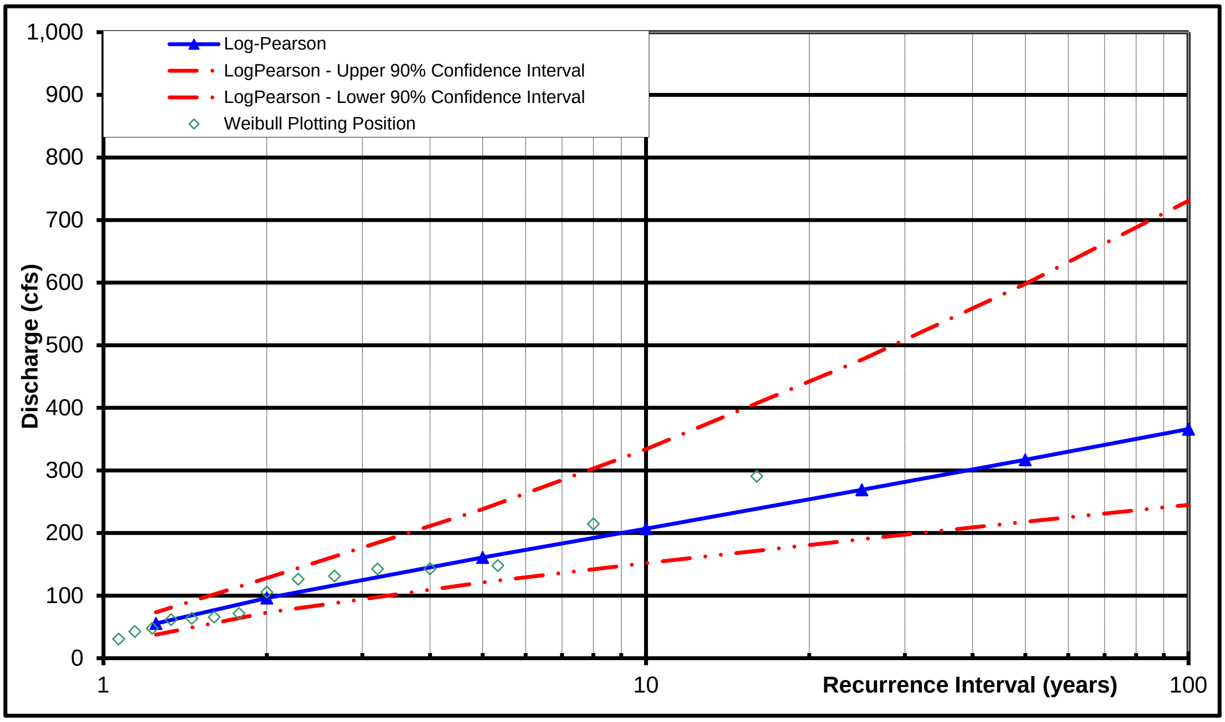
NRCS Log-Pearson Frequency Analysis Spreadsheet, Version 2.0, 3/2003 *Page 3 of 3*

Project: *Skyline Mine - Electric Lake Discharge*
Streamgage: *Upper Huntington Creek*
Date: *9/4/2020* **Performed By:** *RB White*

Discharge-Frequency, with Gage Skew
Upper Huntington Creek



Discharge-Frequency, with Generalized Skew
Upper Huntington Creek



ATTACHMENT C

Results of Flow Depth and Velocity Analyses

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

10-year Peak, Natural Event	**Flood Event**
Skyline Mine Discharge to Huntington Creek - North Option	**Site**
RB White	**Preparer**

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select appropróate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	11	(min of 7, max of 100)
ASSUMED WSEL =	95.08	ft
CHNL SLOPE =	0.0096	ft/ft
COMPOSITE CHNL n =	0.040	dim
OVERBANK n =	0.075	dim

	CHNL 1	CHNL 2	
BANK STA LEFT =	16.0		ft
BANK STA RIGHT =	45.0		ft
DISCHARGE =	207		cfs

GOVERNING EQUATIONS:

$Q = V A$

$R = A / P$

$V = (1.49 R^{0.66} S^{0.5}) / n$

$F = V / (g A / T)^{0.5}$

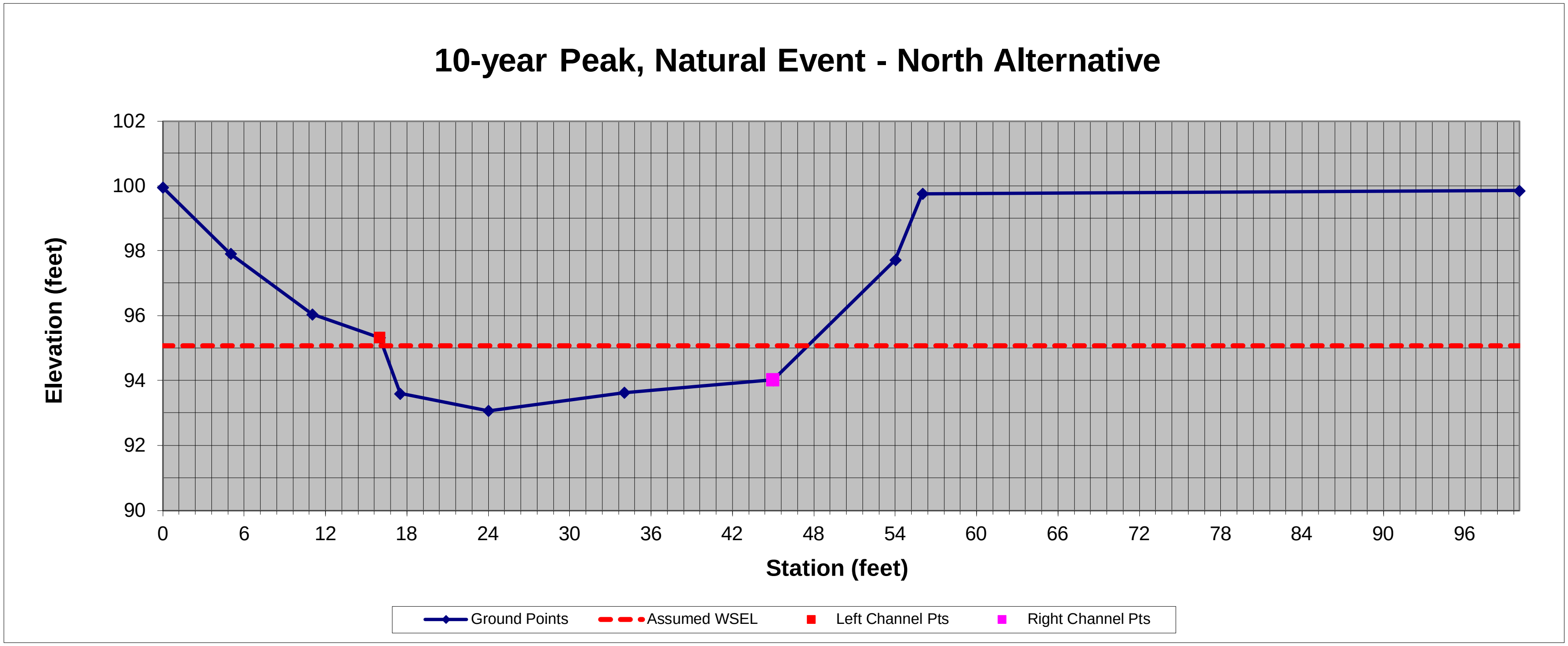
n =	Manning's roughness coefficient	D =	flow depth
A =	flow area	T =	topwidth
P =	wetted perimeter	Q =	discharge
R =	hydraulic radius	g =	gravitational acceleration
V =	flow velocity	Δ =	denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft^2)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV^2
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	100.0																	
0	5.0	97.9	0.075	0.0	0.0	0.0													
0	11.0	96.0	0.075	0.0	0.0	0.0													
0	16.0	95.3	0.075	0.0	0.0	0.0													
0	17.5	93.6	0.040	0.0	1.0	0.0		2.0					1.48			1.3			
0	24.0	93.1	0.040	0.0	11.3	0.0		6.5					2.01			6.5			
0	34.0	93.6	0.040	0.0	17.4	0.0		10.0					2.01			10.0			
0	45.0	94.0	0.040	0.0	13.9	0.0		11.0					1.46			11.0			
0	54.0	97.7	0.075	1.4	0.0	0.0	2.8			0.49	1.21	1.06			2.6			1.7	2
0	56.0	99.8	0.075	0.0	0.0	0.0													
0	100.0	99.9	0.075	0.0	0.0	0.0													

Elmin =	93.1
Elmax =	100.0

	FROUDE NUMBER	A (ft^2)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV^2
		OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	1.4			2.8			0.49	0.00	1.06			2.6			2	0.0
CHNL 1 VALUES =	0.68		43.5			29.5		1.47	4.72		2.01			28.8		205	44.7
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.68			44.9			32.3		4.61			2.01			31.4	207	42.7
CRITICAL FLOW VALUES =															274.8	665	



10-year Peak, Natural Event - North Alternative
Elevation (feet)
102
100
98
96
94
92
90
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
96
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

10-year Peak with 10,000 gpm Mine Water Discharge	Flood Event
Skyline Mine Discharge to Huntington Creek - North Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	11		(min of 7, max of 100)
ASSUMED WSEL =	95.18		ft
CHNL SLOPE =	0.0096		ft/ft
COMPOSITE CHNL n =	0.040		dim
OVERBANK n =	0.075		dim
	CHNL 1	CHNL 2	
BANK STA LEFT =	16.0		ft
BANK STA RIGHT =	45.0		ft
DISCHARGE =	230		cfs

GOVERNING EQUATIONS:

$Q = V A$	n = Manning's roughness coefficient		D = flow depth
$R = A / P$	A = flow area		T = topwidth
$V = (1.49 R^{0.66} S^{0.5}) / n$	P = wetted perimeter		Q = discharge
$F = V / (g A / T)^{0.5}$	R = hydraulic radius		g = gravitational acceleration
	V = flow velocity		Δ = denotes incremental value

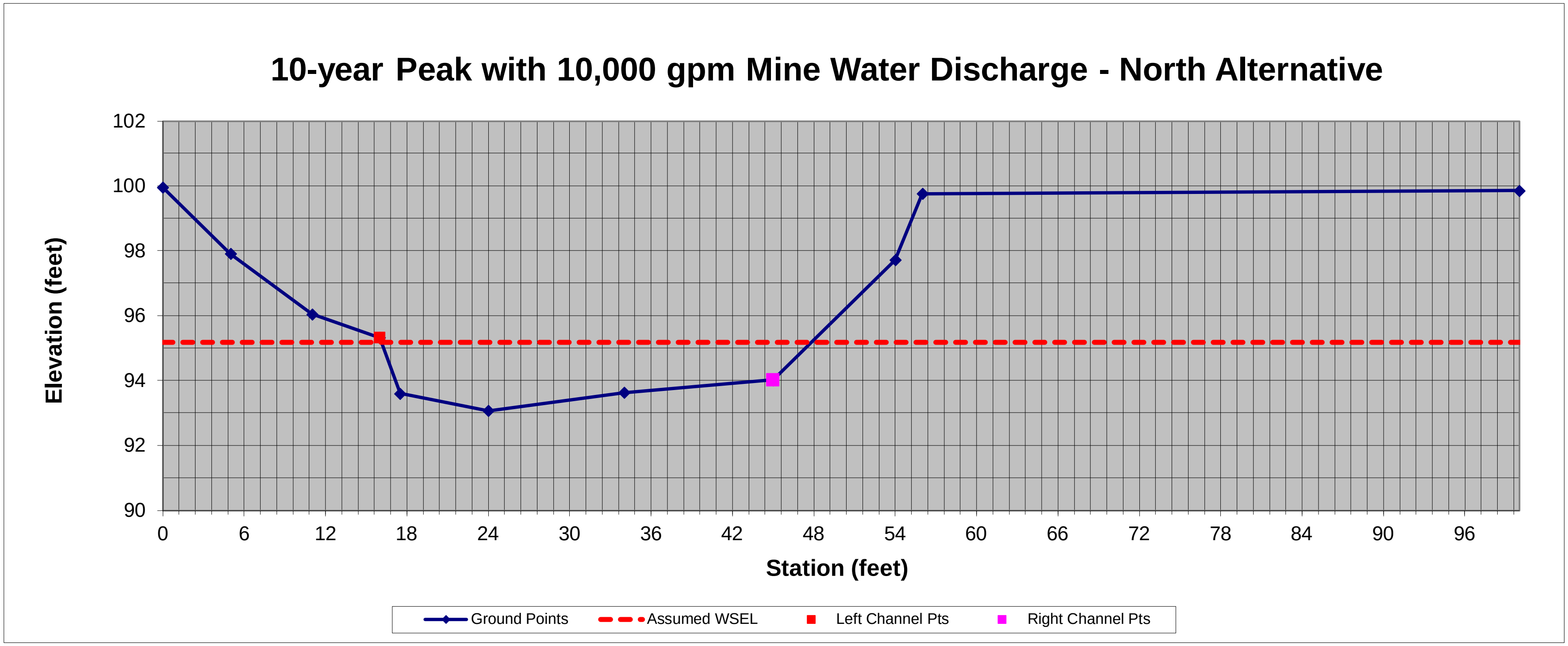
Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft²)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV²
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	100.0																	
0	5.0	97.9	0.075	0.0	0.0	0.0													
0	11.0	96.0	0.075	0.0	0.0	0.0													
0	16.0	95.3	0.075	0.0	0.0	0.0													
0	17.5	93.6	0.040	0.0	1.1	0.0		2.1					1.58			1.4			
0	24.0	93.1	0.040	0.0	12.0	0.0		6.5					2.11			6.5			
0	34.0	93.6	0.040	0.0	18.4	0.0		10.0					2.11			10.0			
0	45.0	94.0	0.040	0.0	15.0	0.0		11.0					1.56			11.0			
0	54.0	97.7	0.075	1.6	0.0	0.0	3.1			0.54	1.28	1.16			2.8			2.1	2
0	56.0	99.8	0.075	0.0	0.0	0.0													
0	100.0	99.9	0.075	0.0	0.0	0.0													

Elmin = 93.1

Elmax = 100.0

	FROUDE NUMBER	A (ft²) OB	A CH 1	A CH 2	P (ft) OB	P CH 1	P CH 2	R (ft)	V (ft/s)	MAXIMUM D (ft) OB	MAX D CH 1	MAX D CH 2	T (ft) OB	T CH 1	T CH 2	Q (cfs)	DV²
OVERBANK VALUES =	0.00	1.6			3.1			0.54	0.00	1.16			2.8			2	0.0
CHNL 1 VALUES =	0.68		46.4			29.6		1.57	4.91		2.11			28.9		228	50.8
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.68			48.0			32.7		4.78			2.11			31.7	230	48.3
CRITICAL FLOW VALUES =															274.8	665	


10-year Peak with 10,000 gpm Mine Water Discharge - North Alternative
Elevation (feet)
102
100
98
96
94
92
90
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
96
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

25-year Peak, Natural Event	Flood Event
Skyline Mine Discharge to Huntington Creek - North Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	11		(min of 7, max of 100)
ASSUMED WSEL =	95.34		ft
CHNL SLOPE =	0.0096		ft/ft
COMPOSITE CHNL n =	0.040		dim
OVERBANK n =	0.075		dim
	CHNL 1	CHNL 2	
BANK STA LEFT =	16.0		ft
BANK STA RIGHT =	45.0		ft
DISCHARGE =	269		cfs

GOVERNING EQUATIONS:

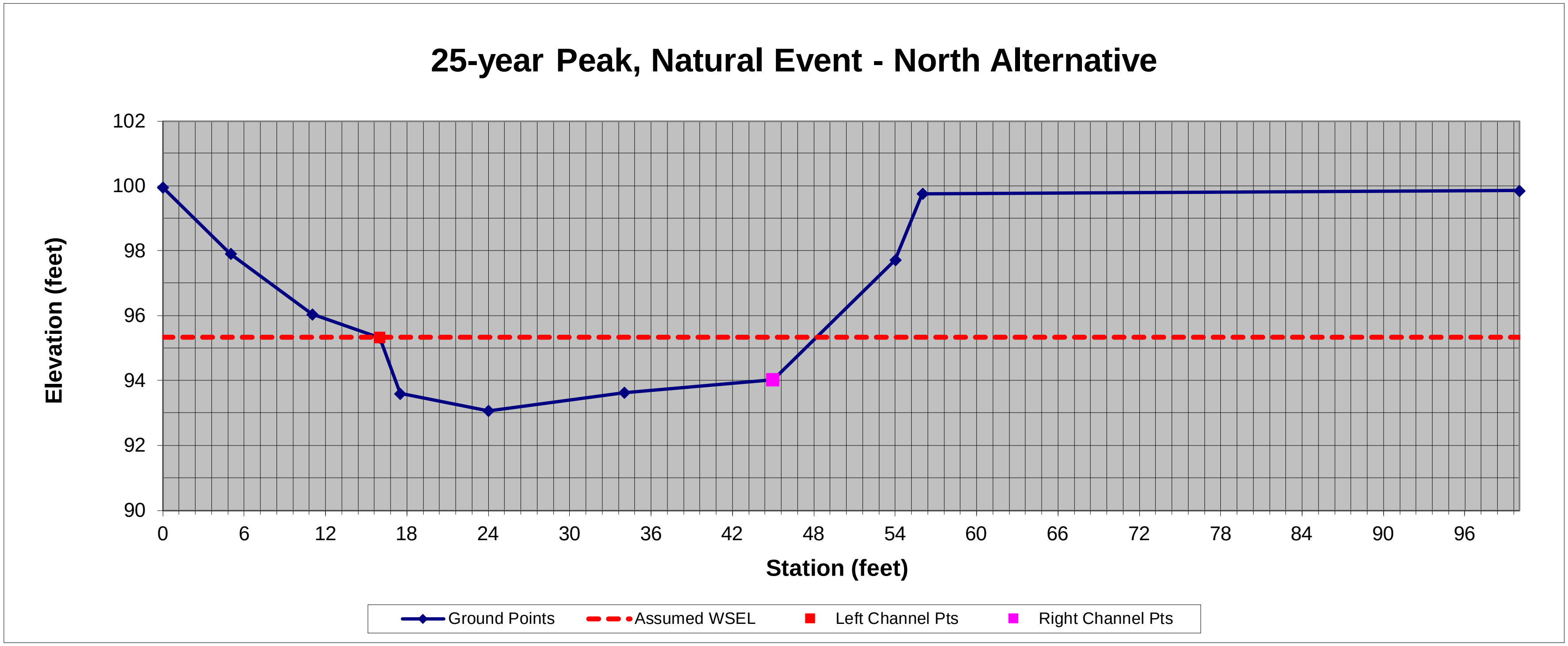
- $Q = V A$
- $R = A / P$
- $V = (1.49 R^{0.66} S^{0.5}) / n$
- $F = V / (g A / T)^{0.5}$

n =	Manning's roughness coefficient	D =	flow depth
A =	flow area	T =	topwidth
P =	wetted perimeter	Q =	discharge
R =	hydraulic radius	g =	gravitational acceleration
V =	flow velocity	Δ =	denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft^2)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV^2
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	100.0																	
0	5.0	97.9	0.075	0.0	0.0	0.0													
0	11.0	96.0	0.075	0.0	0.0	0.0													
0	16.0	95.3	0.075	0.0	0.0	0.0	0.1			0.01	0.09	0.02			0.1			0.0	0
0	17.5	93.6	0.040	0.0	1.3	0.0		2.3					1.74			1.5			
0	24.0	93.1	0.040	0.0	13.0	0.0		6.5					2.27			6.5			
0	34.0	93.6	0.040	0.0	20.0	0.0		10.0					2.27			10.0			
0	45.0	94.0	0.040	0.0	16.7	0.0		11.0					1.72			11.0			
0	54.0	97.7	0.075	2.1	0.0	0.0	3.5			0.61	1.40	1.32			3.2			3.0	3
0	56.0	99.8	0.075	0.0	0.0	0.0													
0	100.0	99.9	0.075	0.0	0.0	0.0													

	FROUDE	A (ft^2)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV^2
Elmin = 93.1 Elmax = 100.0	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	2.1			3.6			0.59	0.00	1.32			3.4			3	0.0
CHNL 1 VALUES =	0.69		51.0			29.8		1.71	5.21		2.27			29.0		266	61.5
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.69			53.1			33.4		5.05			2.27			32.4	269	58.0
CRITICAL FLOW VALUES =															274.8	665	



25-year Peak, Natural Event - North Alternative
Elevation (feet)
102
100
98
96
94
92
90
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
96
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

25-year Peak with 10,000 gpm Mine Water Discharge	Flood Event
Skyline Mine Discharge to Huntington Creek - North Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	11	(min of 7, max of 100)	
ASSUMED WSEL =	95.43	ft	
CHNL SLOPE =	0.0096	ft/ft	
COMPOSITE CHNL n =	0.040	dim	
OVERBANK n =	0.075	dim	
	CHNL 1	CHNL 2	
BANK STA LEFT =	16.0		ft
BANK STA RIGHT =	45.0		ft
DISCHARGE =	292	cfs	

GOVERNING EQUATIONS:

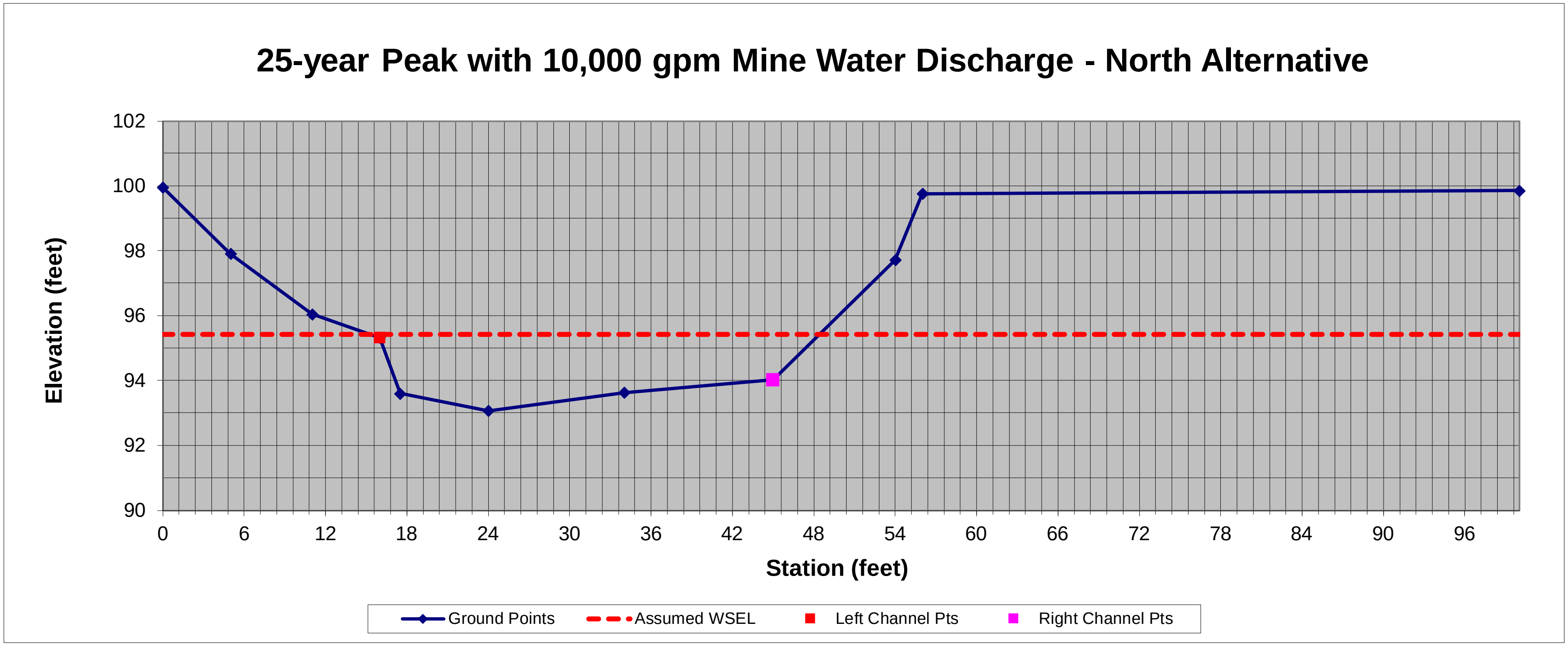
- $Q = V A$
- $R = A / P$
- $V = (1.49 R^{0.66} S^{0.5}) / n$
- $F = V / (g A / T)^{0.5}$

n =	Manning's roughness coefficient	D =	flow depth
A =	flow area	T =	topwidth
P =	wetted perimeter	Q =	discharge
R =	hydraulic radius	g =	gravitational acceleration
V =	flow velocity	Δ =	denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft^2)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV^2
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	100.0																	
0	5.0	97.9	0.075	0.0	0.0	0.0													
0	11.0	96.0	0.075	0.0	0.0	0.0													
0	16.0	95.3	0.075	0.0	0.0	0.0	0.8			0.05	0.28	0.11			0.8			0.0	0
0	17.5	93.6	0.040	0.0	1.5	0.0		2.3					1.83			1.5			
0	24.0	93.1	0.040	0.0	13.6	0.0		6.5					2.36			6.5			
0	34.0	93.6	0.040	0.0	20.9	0.0		10.0					2.36			10.0			
0	45.0	94.0	0.040	0.0	17.7	0.0		11.0					1.81			11.0			
0	54.0	97.7	0.075	2.4	0.0	0.0	3.7			0.65	1.46	1.41			3.4			3.5	3
0	56.0	99.8	0.075	0.0	0.0	0.0													
0	100.0	99.9	0.075	0.0	0.0	0.0													

	FROUDE	A (ft^2)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV^2
Elmin = 93.1 Elmax = 100.0	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	2.5			4.5			0.55	0.00	1.41			4.2			4	0.0
CHNL 1 VALUES =	0.70		53.6			29.8		1.80	5.38		2.36			29.0		289	68.4
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.71			56.1			34.3		5.21			2.36			33.2	292	64.0
CRITICAL FLOW VALUES =															274.8	665	



25-year Peak with 10,000 gpm Mine Water Discharge - North Alternative
Elevation (feet)
102
100
98
96
94
92
90
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
96
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

50-year Peak, Natural Event	Flood Event
Skyline Mine Discharge to Huntington Creek - North Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	11	(min of 7, max of 100)
ASSUMED WSEL =	95.52	ft
CHNL SLOPE =	0.0096	ft/ft
COMPOSITE CHNL n =	0.040	dim
OVERBANK n =	0.075	dim

	CHNL 1	CHNL 2	
BANK STA LEFT =	16.0		ft
BANK STA RIGHT =	45.0		ft
DISCHARGE =	317		cfs

GOVERNING EQUATIONS:

$Q = V A$

$R = A / P$

$V = (1.49 R^{0.66} S^{0.5}) / n$

$F = V / (g A / T)^{0.5}$

n =	Manning's roughness coefficient	D =	flow depth
A =	flow area	T =	topwidth
P =	wetted perimeter	Q =	discharge
R =	hydraulic radius	g =	gravitational acceleration
V =	flow velocity	Δ =	denotes incremental value

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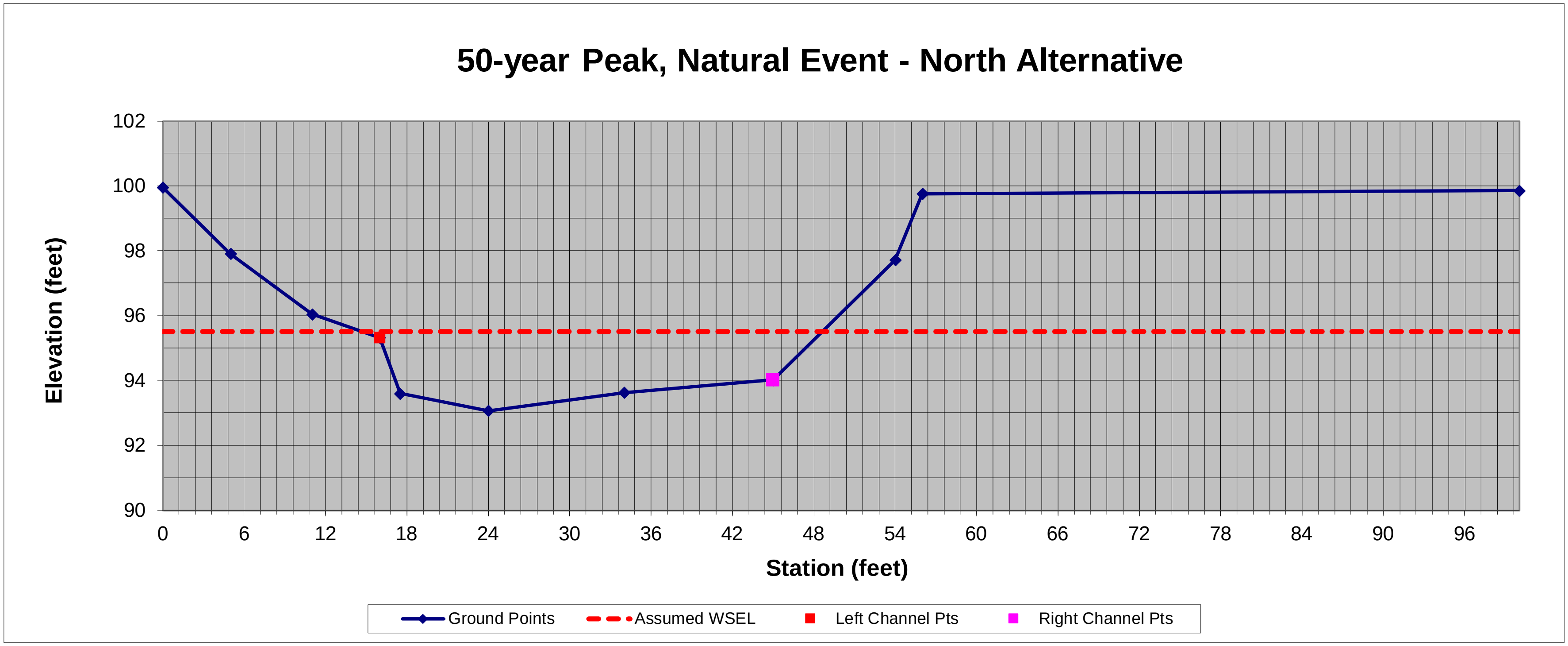
PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft^2)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV^2
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	100.0																	
0	5.0	97.9	0.075	0.0	0.0	0.0													
0	11.0	96.0	0.075	0.0	0.0	0.0													
0	16.0	95.3	0.075	0.1	0.0	0.0	1.4			0.10	0.42	0.20			1.4			0.1	0
0	17.5	93.6	0.040	0.0	1.6	0.0		2.3					1.92			1.5			
0	24.0	93.1	0.040	0.0	14.2	0.0		6.5					2.45			6.5			
0	34.0	93.6	0.040	0.0	21.8	0.0		10.0					2.45			10.0			
0	45.0	94.0	0.040	0.0	18.7	0.0		11.0					1.90			11.0			
0	54.0	97.7	0.075	2.7	0.0	0.0	4.0			0.69	1.52	1.50			3.7			4.2	3
0	56.0	99.8	0.075	0.0	0.0	0.0													
0	100.0	99.9	0.075	0.0	0.0	0.0													

		FROUDE	A (ft^2)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV^2
Elmin =	93.1	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
Elmax =	100.0																	
OVERBANK VALUES =		0.00	2.9			5.4			0.54	0.00	1.50			5.0			4	0.0
CHNL 1 VALUES =		0.70		56.2			29.8		1.89	5.56		2.45			29.0		312	75.6
CHNL 2 VALUES =					0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =		0.72			59.1			35.2		5.36			2.45			34.0	317	70.3
CRITICAL FLOW VALUES =																274.8	665	


50-year Peak, Natural Event - North Alternative
Elevation (feet)
102
100
98
96
94
92
90
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
96
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

50-year Peak with 10,000 gpm Mine Water Discharge	Flood Event
Skyline Mine Discharge to Huntington Creek - North Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	11	(min of 7, max of 100)	
ASSUMED WSEL =	95.60	ft	
CHNL SLOPE =	0.0096	ft/ft	
COMPOSITE CHNL n =	0.040	dim	
OVERBANK n =	0.075	dim	
	CHNL 1	CHNL 2	
BANK STA LEFT =	16.0		ft
BANK STA RIGHT =	45.0		ft
DISCHARGE =	339	cfs	

GOVERNING EQUATIONS:

- $Q = V A$
- $R = A / P$
- $V = (1.49 R^{0.66} S^{0.5}) / n$
- $F = V / (g A / T)^{0.5}$

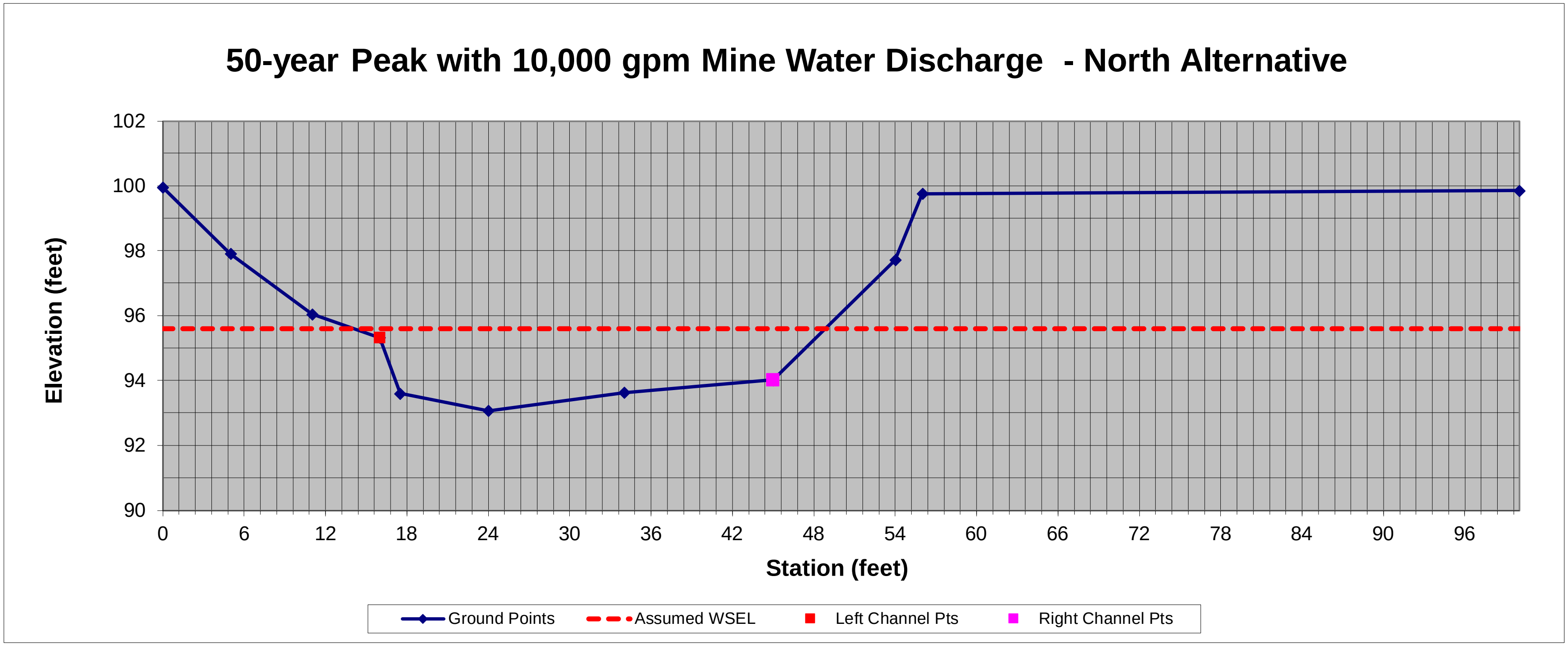
n = Manning's roughness coefficient; A = flow area; P = wetted perimeter; R = hydraulic radius; V = flow velocity; D = flow depth; T = topwidth; Q = discharge; g = gravitational acceleration; Δ = denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft^2)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV^2
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	100.0																	
0	5.0	97.9	0.075	0.0	0.0	0.0													
0	11.0	96.0	0.075	0.0	0.0	0.0													
0	16.0	95.3	0.075	0.3	0.0	0.0	2.0			0.14	0.52	0.28			1.9			0.1	0
0	17.5	93.6	0.040	0.0	1.7	0.0		2.3					2.00			1.5			
0	24.0	93.1	0.040	0.0	14.7	0.0		6.5					2.53			6.5			
0	34.0	93.6	0.040	0.0	22.6	0.0		10.0					2.53			10.0			
0	45.0	94.0	0.040	0.0	19.6	0.0		11.0					1.98			11.0			
0	54.0	97.7	0.075	3.0	0.0	0.0	4.2			0.73	1.58	1.58			3.9			4.8	4
0	56.0	99.8	0.075	0.0	0.0	0.0													
0	100.0	99.9	0.075	0.0	0.0	0.0													

Elmin =	93.1	
Elmax =	100.0	

	FROUDE NUMBER	A (ft^2)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV^2
		OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	3.3			6.1			0.54	0.00	1.58			5.8			5	0.0
CHNL 1 VALUES =	0.71		58.6			29.8		1.96	5.71		2.53			29.0		334	82.4
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.72			61.9			36.0		5.48			2.53			34.8	339	76.0
CRITICAL FLOW VALUES =															274.8	665	


50-year Peak with 10,000 gpm Mine Water Discharge - North Alternative
Elevation (feet)
102
100
98
96
94
92
90
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
96
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

100-year Peak, Natural Event	Flood Event
Skyline Mine Discharge to Huntington Creek - North Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

	CHNL 1	CHNL 2	
NBR GROUND PNTS =	11		(min of 7, max of 100)
ASSUMED WSEL =	95.70		ft
CHNL SLOPE =	0.0096		ft/ft
COMPOSITE CHNL n =	0.040		dim
OVERBANK n =	0.075		dim
BANK STA LEFT =	16.0		ft
BANK STA RIGHT =	45.0		ft
DISCHARGE =	368		cfs

GOVERNING EQUATIONS:

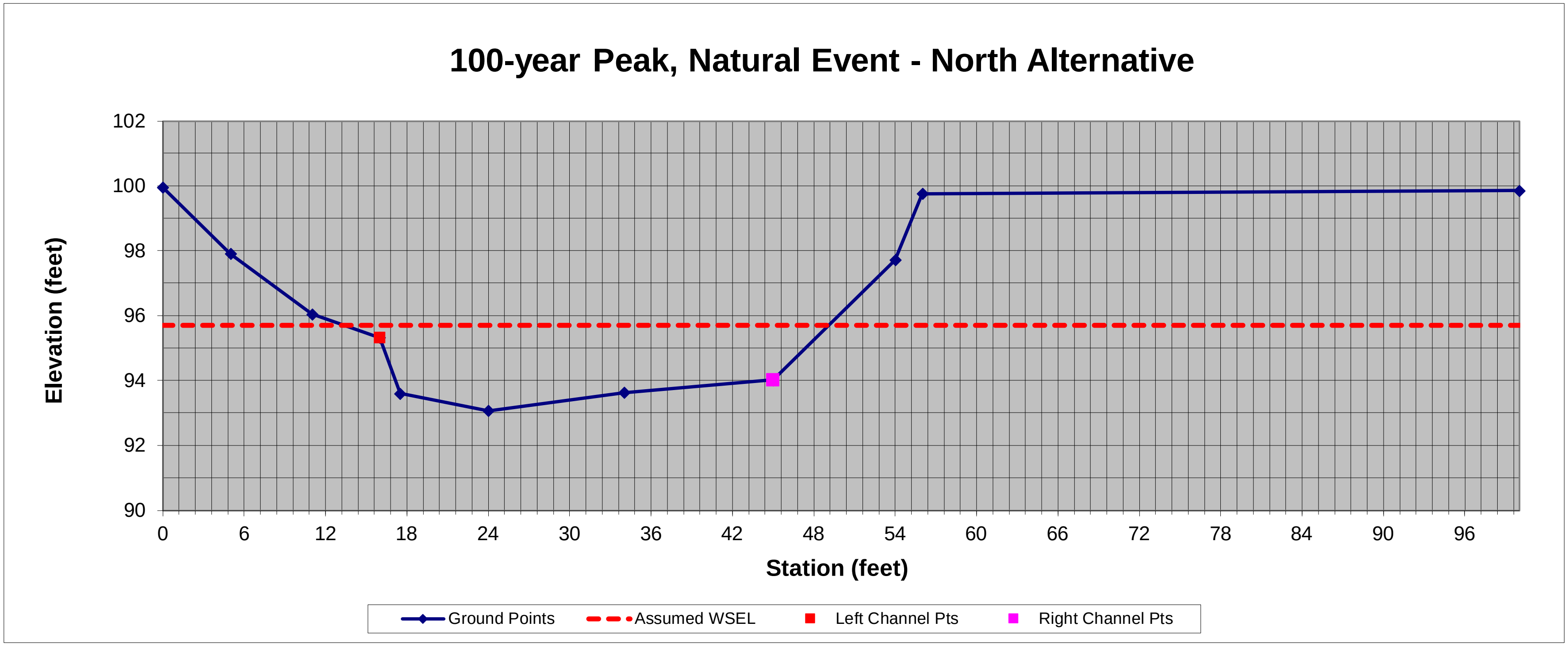
- $Q = V A$
- $R = A / P$
- $V = (1.49 R^{0.66} S^{0.5}) / n$
- $F = V / (g A / T)^{0.5}$

n =	Manning's roughness coefficient	D =	flow depth
A =	flow area	T =	topwidth
P =	wetted perimeter	Q =	discharge
R =	hydraulic radius	g =	gravitational acceleration
V =	flow velocity	Δ =	denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft^2)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV^2
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	100.0																	
0	5.0	97.9	0.075	0.0	0.0	0.0													
0	11.0	96.0	0.075	0.0	0.0	0.0													
0	16.0	95.3	0.075	0.5	0.0	0.0	2.7			0.19	0.64	0.38			2.6			0.3	0
0	17.5	93.6	0.040	0.0	1.9	0.0		2.3					2.10			1.5			
0	24.0	93.1	0.040	0.0	15.4	0.0		6.5					2.63			6.5			
0	34.0	93.6	0.040	0.0	23.6	0.0		10.0					2.63			10.0			
0	45.0	94.0	0.040	0.0	20.7	0.0		11.0					2.08			11.0			
0	54.0	97.7	0.075	3.4	0.0	0.0	4.4			0.78	1.64	1.68			4.1			5.6	5
0	56.0	99.8	0.075	0.0	0.0	0.0													
0	100.0	99.9	0.075	0.0	0.0	0.0													

Elmin = 93.1	FROUDE	A (ft^2)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV^2
Elmax = 100.0	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	3.9			7.1			0.56	0.00	1.68			6.7			6	0.0
CHNL 1 VALUES =	0.71		61.5			29.8		2.06	5.89		2.63			29.0		362	91.4
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.73			65.4			36.9		5.63			2.63			35.7	368	83.4
CRITICAL FLOW VALUES =															274.8	665	



100-year Peak, Natural Event - North Alternative
Elevation (feet)
102
100
98
96
94
92
90
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
96
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

100-year Peak with 10,000 gpm Mine Water Discharge	**Flood Event**
Skyline Mine Discharge to Huntington Creek - North Option	**Site**
RB White	**Preparer**

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	11	(min of 7, max of 100)	
ASSUMED WSEL =	95.77	ft	
CHNL SLOPE =	0.0096	ft/ft	
COMPOSITE CHNL n =	0.040	dim	
OVERBANK n =	0.075	dim	
	CHNL 1	**CHNL 2**	
BANK STA LEFT =	16.0		ft
BANK STA RIGHT =	45.0		ft
DISCHARGE =	389	cfs	

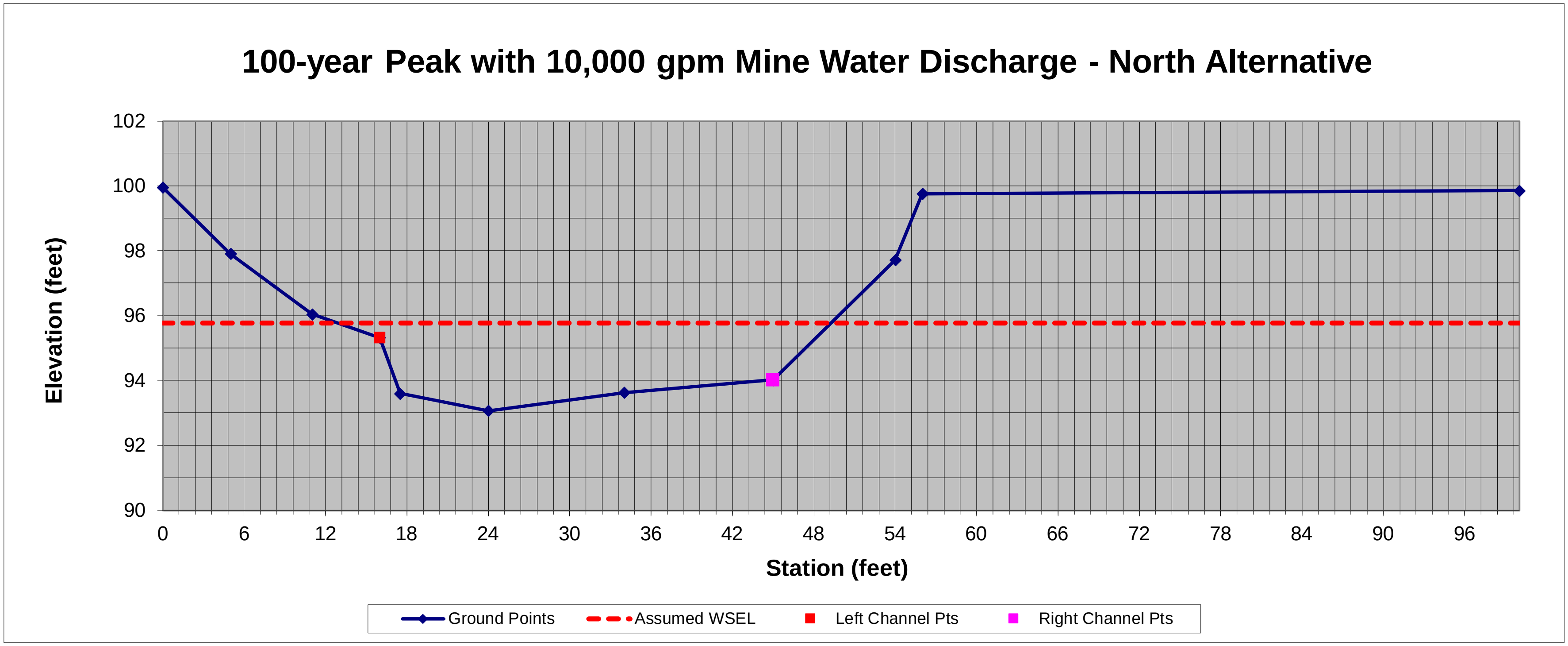
GOVERNING EQUATIONS:

$Q = VA$	n = Manning's roughness coefficient	D = flow depth	
$R = A/P$	A = flow area	T = topwidth	
$V = (1.49 R^{0.66} S^{0.5}) / n$	P = wetted perimeter	Q = discharge	
$F = V / (g A / T)^{0.5}$	R = hydraulic radius	g = gravitational acceleration	
	V = flow velocity	Δ = denotes incremental value	

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft^2)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV^2
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	100.0																	
0	5.0	97.9	0.075	0.0	0.0	0.0													
0	11.0	96.0	0.075	0.0	0.0	0.0													
0	16.0	95.3	0.075	0.7	0.0	0.0	3.2			0.22	0.71	0.45			3.1			0.5	0
0	17.5	93.6	0.040	0.0	2.0	0.0		2.3					2.17			1.5			
0	24.0	93.1	0.040	0.0	15.8	0.0		6.5					2.70			6.5			
0	34.0	93.6	0.040	0.0	24.3	0.0		10.0					2.70			10.0			
0	45.0	94.0	0.040	0.0	21.5	0.0		11.0					2.15			11.0			
0	54.0	97.7	0.075	3.7	0.0	0.0	4.6			0.81	1.69	1.75			4.3			6.3	5
0	56.0	99.8	0.075	0.0	0.0	0.0													
0	100.0	99.9	0.075	0.0	0.0	0.0													

	FROUDE	A (ft^2)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV^2
Elmin = 93.1 / **Elmax =** 100.0	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	4.4			7.8			0.57	0.00	1.75			7.4			7	0.0
CHNL 1 VALUES =	0.72		63.5			29.8		2.13	6.02		2.70			29.0		382	98.0
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.74			67.9			37.6		5.73			2.70			36.4	389	88.6
CRITICAL FLOW VALUES =															274.8	665	


100-year Peak with 10,000 gpm Mine Water Discharge - North Alternative
Elevation (feet)
102
100
98
96
94
92
90
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
96
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

10-year Peak, Natural Event	Flood Event
Skyline Mine Discharge to Huntington Creek - South Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	13	(min of 7, max of 100)	
ASSUMED WSEL =	90.82	ft	
CHNL SLOPE =	0.0095	ft/ft	
COMPOSITE CHNL n =	0.040	dim	
OVERBANK n =	0.035	dim	
	CHNL 1	CHNL 2	
BANK STA LEFT =	26.0		ft
BANK STA RIGHT =	51.0		ft
DISCHARGE =	207	cfs	

GOVERNING EQUATIONS:

$Q = V A$

$R = A / P$

$V = (1.49 R^{0.66} S^{0.5}) / n$

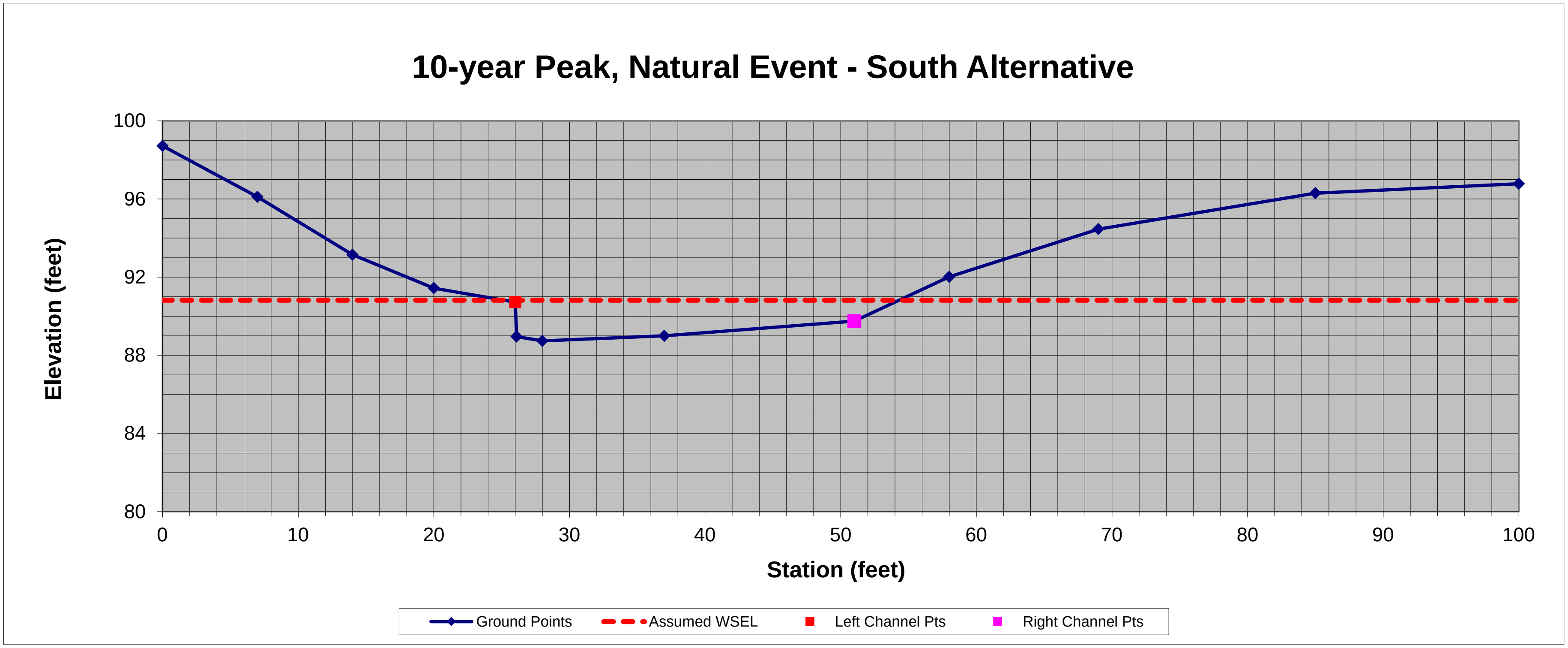
$F = V / (g A / T)^{0.5}$

n =	Manning's roughness coefficient	D =	flow depth
A =	flow area	T =	topwidth
P =	wetted perimeter	Q =	discharge
R =	hydraulic radius	g =	gravitational acceleration
V =	flow velocity	Δ =	denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft²)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV²
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	98.7																	
0	7.0	96.1	0.035	0.0	0.0	0.0													
0	14.0	93.2	0.035	0.0	0.0	0.0													
0	20.0	91.4	0.035	0.0	0.0	0.0													
0	26.0	90.7	0.035	0.0	0.0	0.0	0.8			0.05	0.56	0.10			0.8			0.0	0
0	26.1	89.0	0.040	0.0	0.1	0.0		1.8					1.86			0.1			
0	28.0	88.7	0.040	0.0	3.7	0.0		1.9					2.08			1.9			
0	37.0	89.0	0.040	0.0	17.6	0.0		9.0					2.08			9.0			
0	51.0	89.8	0.040	0.0	20.2	0.0		14.0					1.82			14.0			
0	58.0	92.0	0.035	1.8	0.0	0.0	3.5			0.51	2.64	1.07			3.3			4.7	7
0	69.0	94.5	0.035	0.0	0.0	0.0													
0	85.0	96.3	0.035	0.0	0.0	0.0													
0	100.0	96.8	0.035	0.0	0.0	0.0													

	FROUDE NUMBER	A (ft²)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV²
Elmin = 88.7 / Elmax = 98.7		OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	1.8			4.3			0.42	0.00	1.07			4.1			5	0.0
CHNL 1 VALUES =	0.66		41.6			26.7		1.56	4.87		2.08			25.0		203	49.3
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.69			43.4			31.0		4.77			2.08			29.1	207	47.4
CRITICAL FLOW VALUES =															274.8	665	



10-year Peak, Natural Event - South Alternative
Elevation (feet)
100
96
92
88
84
80
0
10
20
30
40
50
60
70
80
90
100
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

10-year Peak with 10,000 gpm Mine Water Discharge	Flood Event
Skyline Mine Discharge to Huntington Creek - South Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	13		(min of 7, max of 100)
ASSUMED WSEL =	90.92		ft
CHNL SLOPE =	0.0095		ft/ft
COMPOSITE CHNL n =	0.040		dim
OVERBANK n =	0.035		dim
	CHNL 1	CHNL 2	
BANK STA LEFT =	26.0		ft
BANK STA RIGHT =	51.0		ft
DISCHARGE =	229		cfs

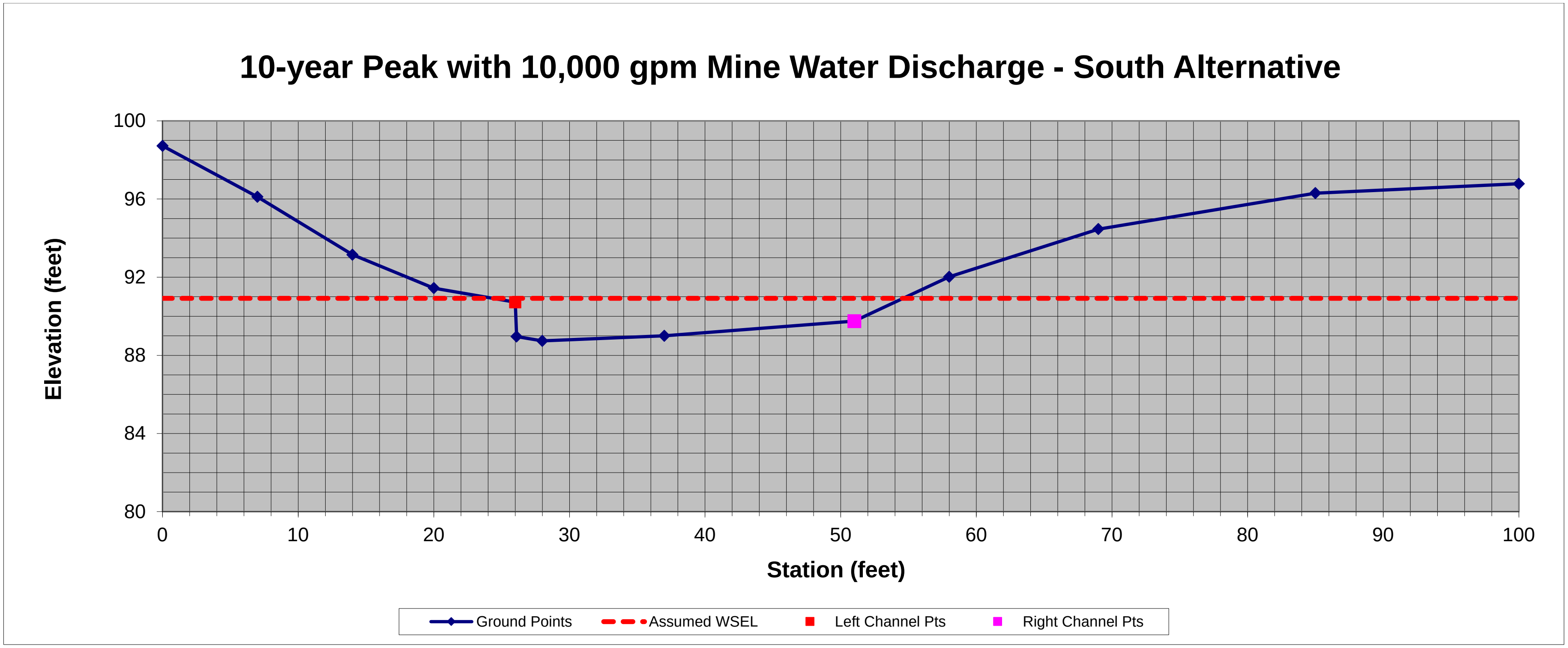
GOVERNING EQUATIONS:

Q =	V A	n =	Manning's roughness coefficient	D =	flow depth
R =	A / P	A =	flow area	T =	topwidth
V =	$(1.49 R^{0.66} S^{0.5}) / n$	P =	wetted perimeter	Q =	discharge
F =	$V / (g A / T)^{0.5}$	R =	hydraulic radius	g =	gravitational acceleration
		V =	flow velocity	Δ =	denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft²)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV²
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	98.7																	
0	7.0	96.1	0.035	0.0	0.0	0.0													
0	14.0	93.2	0.035	0.0	0.0	0.0													
0	20.0	91.4	0.035	0.0	0.0	0.0													
0	26.0	90.7	0.035	0.2	0.0	0.0	1.7			0.10	0.89	0.20			1.7			0.1	0
0	26.1	89.0	0.040	0.0	0.1	0.0		1.8					1.96			0.1			
0	28.0	88.7	0.040	0.0	3.9	0.0		1.9					2.18			1.9			
0	37.0	89.0	0.040	0.0	18.5	0.0		9.0					2.18			9.0			
0	51.0	89.8	0.040	0.0	21.6	0.0		14.0					1.92			14.0			
0	58.0	92.0	0.035	2.1	0.0	0.0	3.8			0.56	2.80	1.17			3.6			5.9	9
0	69.0	94.5	0.035	0.0	0.0	0.0													
0	85.0	96.3	0.035	0.0	0.0	0.0													
0	100.0	96.8	0.035	0.0	0.0	0.0													

Elmin = 88.7	FROUDE	A (ft²)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV²
Elmax = 98.7	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	2.3			5.5			0.42	0.00	1.17			5.3			6	0.0
CHNL 1 VALUES =	0.67		44.1			26.7		1.65	5.06		2.18			25.0		223	55.8
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.70			46.4			32.2		4.94			2.18			30.3	229	53.3
CRITICAL FLOW VALUES =															274.8	665	



10-year Peak with 10,000 gpm Mine Water Discharge - South Alternative
Elevation (feet)
100
96
92
88
84
80
0
10
20
30
40
50
60
70
80
90
100
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

25-year Peak, Natural Event	**Flood Event**
Skyline Mine Discharge to Huntington Creek - South Option	**Site**
RB White	**Preparer**

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

	CHNL 1	CHNL 2	
NBR GROUND PNTS =	13		(min of 7, max of 100)
ASSUMED WSEL =	91.09		ft
CHNL SLOPE =	0.0095		ft/ft
COMPOSITE CHNL n =	0.040		dim
OVERBANK n =	0.035		dim
BANK STA LEFT =	26.0		ft
BANK STA RIGHT =	51.0		ft
DISCHARGE =	270		cfs

GOVERNING EQUATIONS:

$Q = V A$

$R = A / P$

$V = (1.49\, R^{0.66}\, S^{0.5}) / n$

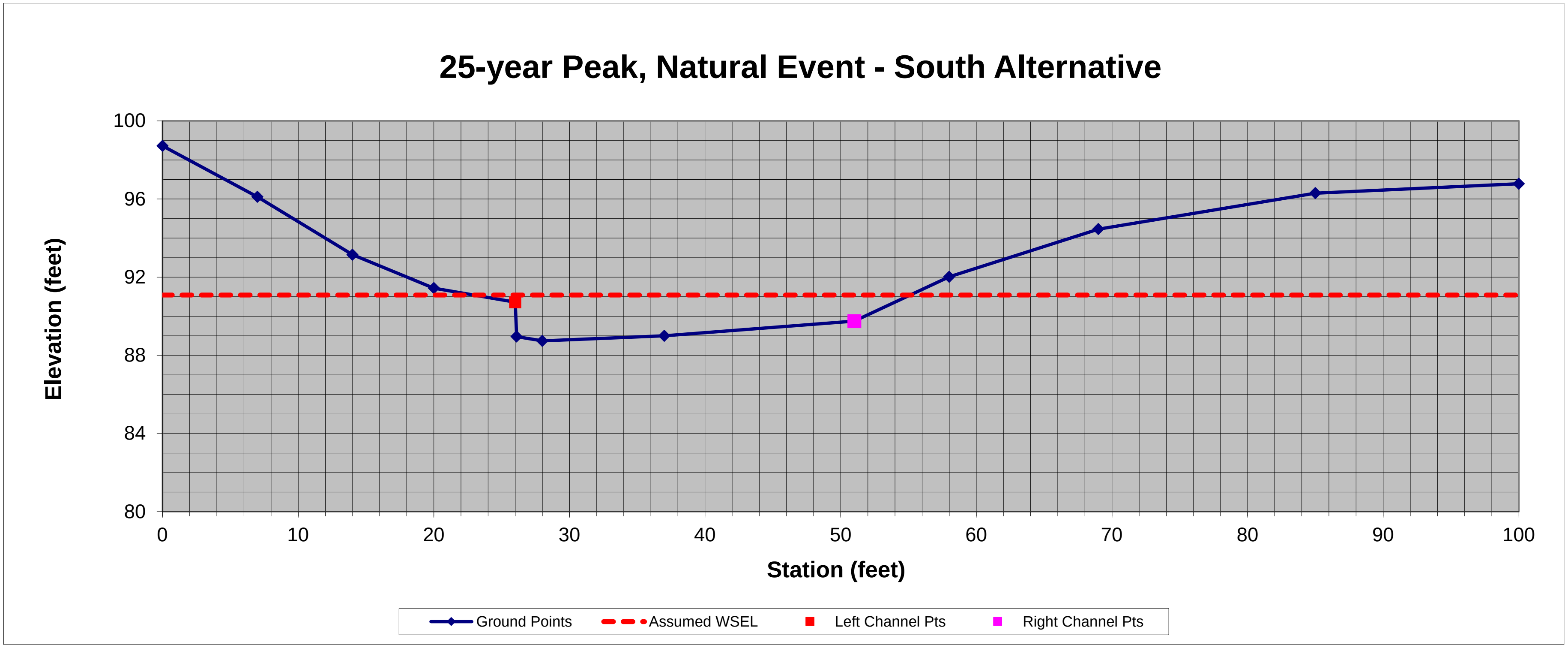
$F = V / (g\, A / T)^{0.5}$

- n = Manning's roughness coefficient
- A = flow area
- P = wetted perimeter
- R = hydraulic radius
- V = flow velocity
- D = flow depth
- T = topwidth
- Q = discharge
- g = gravitational acceleration
- Δ = denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft²)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV²
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	98.7																	
0	7.0	96.1	0.035	0.0	0.0	0.0													
0	14.0	93.2	0.035	0.0	0.0	0.0													
0	20.0	91.4	0.035	0.0	0.0	0.0													
0	26.0	90.7	0.035	0.6	0.0	0.0	3.1			0.18	1.34	0.37			3.1			0.8	1
0	26.1	89.0	0.040	0.0	0.1	0.0		1.8					2.13			0.1			
0	28.0	88.7	0.040	0.0	4.3	0.0		1.9					2.35			1.9			
0	37.0	89.0	0.040	0.0	20.0	0.0		9.0					2.35			9.0			
0	51.0	89.8	0.040	0.0	24.0	0.0		14.0					2.09			14.0			
0	58.0	92.0	0.035	2.8	0.0	0.0	4.3			0.64	3.06	1.34			4.1			8.5	13
0	69.0	94.5	0.035	0.0	0.0	0.0													
0	85.0	96.3	0.035	0.0	0.0	0.0													
0	100.0	96.8	0.035	0.0	0.0	0.0													

		FROUDE	A (ft²)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV²
Elmin =	88.7																	
Elmax =	98.7	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =		0.00	3.3			7.4			0.45	0.00	1.34			7.2			9	0.0
CHNL 1 VALUES =		0.68		48.4			26.7		1.81	5.38		2.35			25.0		260	68.0
CHNL 2 VALUES =					0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =		0.73			51.7			34.1		5.21			2.35			32.2	270	63.9
CRITICAL FLOW VALUES =																274.8	665	



25-year Peak, Natural Event - South Alternative
Elevation (feet)
100
96
92
88
84
80
0
10
20
30
40
50
60
70
80
90
100
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

25-year Peak with 10,000 gpm Mine Water Discharge	Flood Event
Skyline Mine Discharge to Huntington Creek - South Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select appropoate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	13		(min of 7, max of 100)
ASSUMED WSEL =	91.18		ft
CHNL SLOPE =	0.0095		ft/ft
COMPOSITE CHNL n =	0.040		dim
OVERBANK n =	0.035		dim
	CHNL 1	CHNL 2	
BANK STA LEFT =	26.0		ft
BANK STA RIGHT =	51.0		ft
DISCHARGE =	292		cfs

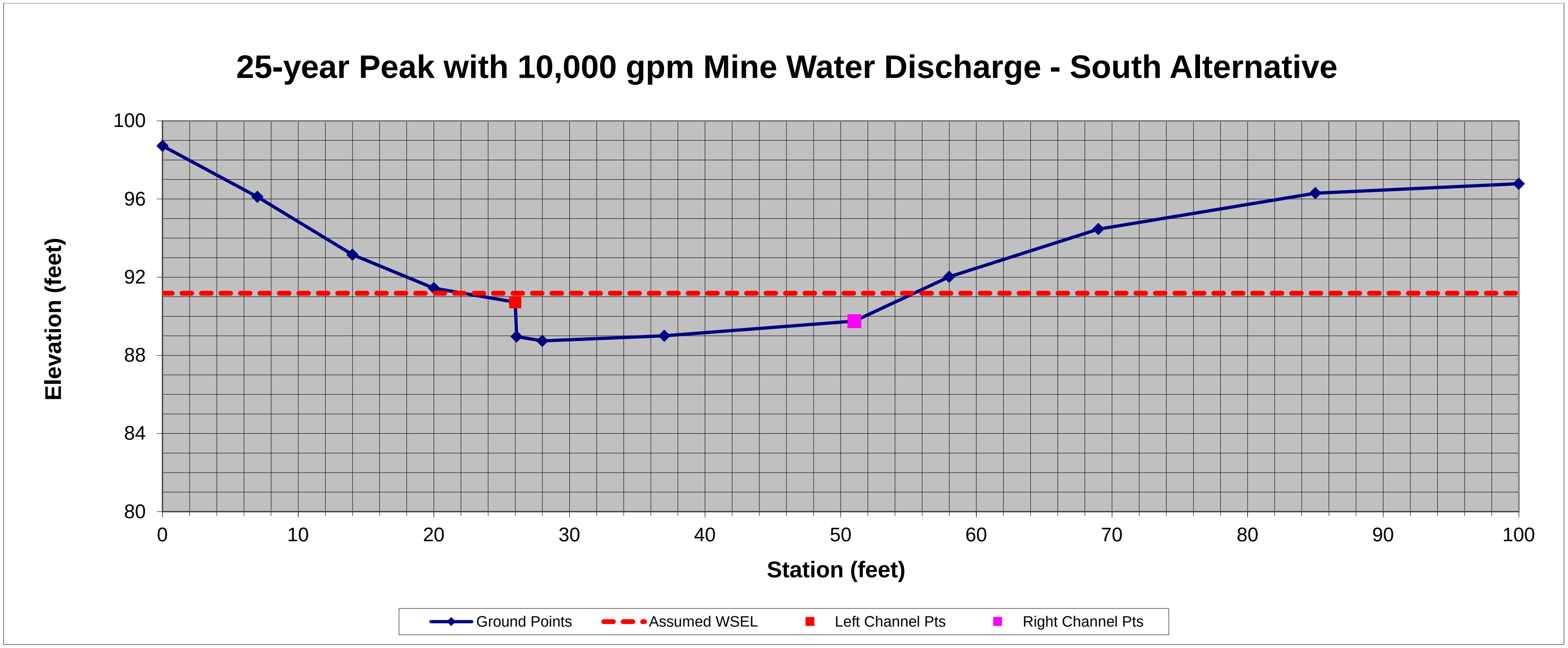
GOVERNING EQUATIONS:

$Q = VA$	n = Manning's roughness coefficient		D = flow depth
$R = A / P$	A = flow area		T = topwidth
$V = (1.49 R^{0.66} S^{0.5}) / n$	P = wetted perimeter		Q = discharge
$F = V / (g A / T)^{0.5}$	R = hydraulic radius		g = gravitational acceleration
	V = flow velocity		Δ = denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft²)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV²
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	98.7																	
0	7.0	96.1	0.035	0.0	0.0	0.0													
0	14.0	93.2	0.035	0.0	0.0	0.0													
0	20.0	91.4	0.035	0.0	0.0	0.0													
0	26.0	90.7	0.035	0.9	0.0	0.0	3.9			0.23	1.55	0.46			3.8			1.4	1
0	26.1	89.0	0.040	0.0	0.1	0.0		1.8					2.22			0.1			
0	28.0	88.7	0.040	0.0	4.4	0.0		1.9					2.44			1.9			
0	37.0	89.0	0.040	0.0	20.8	0.0		9.0					2.44			9.0			
0	51.0	89.8	0.040	0.0	25.3	0.0		14.0					2.18			14.0			
0	58.0	92.0	0.035	3.2	0.0	0.0	4.6			0.68	3.20	1.43			4.4			10.1	15
0	69.0	94.5	0.035	0.0	0.0	0.0													
0	85.0	96.3	0.035	0.0	0.0	0.0													
0	100.0	96.8	0.035	0.0	0.0	0.0													

	FROUDE	A (ft²)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV²
Elmin = 88.7																	
Elmax = 98.7	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	4.0			8.5			0.47	0.00	1.43			8.2			11	0.0
CHNL 1 VALUES =	0.69		50.6			26.7		1.90	5.55		2.44			25.0		281	75.1
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.73			54.7			35.2		5.35			2.44			33.2	292	69.8
CRITICAL FLOW VALUES =															274.8	665	



25-year Peak with 10,000 gpm Mine Water Discharge - South Alternative
Elevation (feet)
100
96
92
88
84
80
0
10
20
30
40
50
60
70
80
90
100
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

50-year Peak, Natural Event	**Flood Event**
Skyline Mine Discharge to Huntington Creek - South Option	**Site**
RB White	**Preparer**

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	13	(min of 7, max of 100)
ASSUMED WSEL =	91.28	ft
CHNL SLOPE =	0.0095	ft/ft
COMPOSITE CHNL n =	0.040	dim
OVERBANK n =	0.035	dim

	CHNL 1	CHNL 2	
BANK STA LEFT =	26.0		ft
BANK STA RIGHT =	51.0		ft
DISCHARGE =	319		cfs

GOVERNING EQUATIONS:

$Q = V A$

$R = A / P$

$V = (1.49 R^{0.66} S^{0.5}) / n$

$F = V / (g A / T)^{0.5}$

n = Manning's roughness coefficient
A = flow area
P = wetted perimeter
R = hydraulic radius
V = flow velocity
D = flow depth
T = topwidth
Q = discharge
g = gravitational acceleration
Δ = denotes incremental value

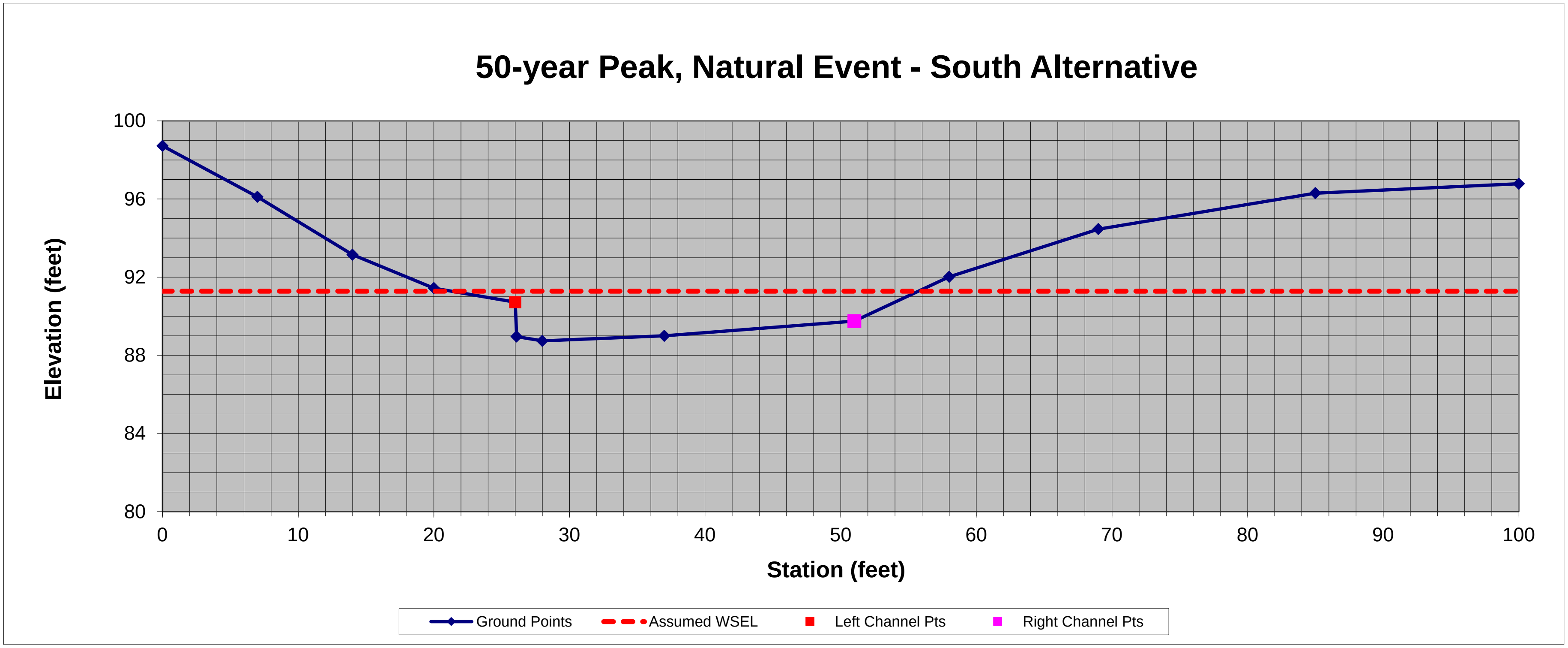
Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft²)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV²
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	98.7																	
0	7.0	96.1	0.035	0.0	0.0	0.0													
0	14.0	93.2	0.035	0.0	0.0	0.0													
0	20.0	91.4	0.035	0.0	0.0	0.0													
0	26.0	90.7	0.035	1.3	0.0	0.0	4.7			0.28	1.76	0.56			4.7			2.3	2
0	26.1	89.0	0.040	0.0	0.1	0.0		1.8					2.32			0.1			
0	28.0	88.7	0.040	0.0	4.6	0.0		1.9					2.54			1.9			
0	37.0	89.0	0.040	0.0	21.7	0.0		9.0					2.54			9.0			
0	51.0	89.8	0.040	0.0	26.7	0.0		14.0					2.28			14.0			
0	58.0	92.0	0.035	3.6	0.0	0.0	5.0			0.73	3.35	1.53			4.7			12.1	17
0	69.0	94.5	0.035	0.0	0.0	0.0													
0	85.0	96.3	0.035	0.0	0.0	0.0													
0	100.0	96.8	0.035	0.0	0.0	0.0													

Elmin = 88.7

Elmax = 98.7

	FROUDE NUMBER	A (ft²)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV²
		OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	4.9			9.7			0.51	0.00	1.53			9.4			14	0.0
CHNL 1 VALUES =	0.69		53.1			26.7		1.99	5.73		2.54			25.0		304	83.3
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.74			58.0			36.4		5.49			2.54			34.4	319	76.6
CRITICAL FLOW VALUES =															274.8	665	



50-year Peak, Natural Event - South Alternative
Elevation (feet)
100
96
92
88
84
80
0
10
20
30
40
50
60
70
80
90
100
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

50-year Peak with 10,000 gpm Mine Water Discharge	Flood Event
Skyline Mine Discharge to Huntington Creek - South Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	13	(min of 7, max of 100)
ASSUMED WSEL =	91.36	ft
CHNL SLOPE =	0.0095	ft/ft
COMPOSITE CHNL n =	0.040	dim
OVERBANK n =	0.035	dim

	CHNL 1	CHNL 2	
BANK STA LEFT =	26.0		ft
BANK STA RIGHT =	51.0		ft
DISCHARGE =	341		cfs

GOVERNING EQUATIONS:

$Q = V A$

$R = A / P$

$V = (1.49 R^{0.66} S^{0.5}) / n$

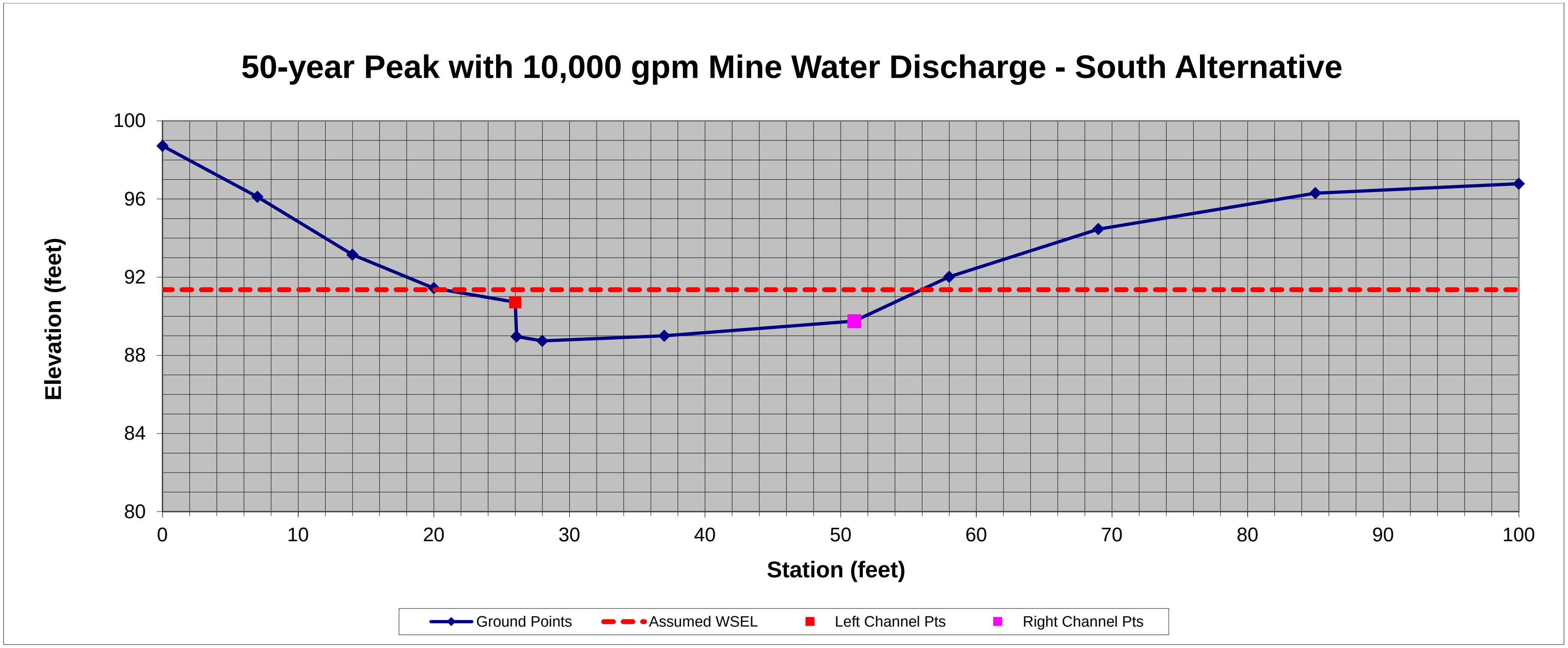
$F = V / (g A / T)^{0.5}$

n = Manning's roughness coefficient
A = flow area
P = wetted perimeter
R = hydraulic radius
V = flow velocity
D = flow depth
T = topwidth
Q = discharge
g = gravitational acceleration
Δ = denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft²)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV²
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	98.7																	
0	7.0	96.1	0.035	0.0	0.0	0.0													
0	14.0	93.2	0.035	0.0	0.0	0.0													
0	20.0	91.4	0.035	0.0	0.0	0.0													
0	26.0	90.7	0.035	1.7	0.0	0.0	5.4			0.32	1.93	0.64			5.3			3.3	2
0	26.1	89.0	0.040	0.0	0.2	0.0		1.8					2.40			0.1			
0	28.0	88.7	0.040	0.0	4.8	0.0		1.9					2.62			1.9			
0	37.0	89.0	0.040	0.0	22.4	0.0		9.0					2.62			9.0			
0	51.0	89.8	0.040	0.0	27.8	0.0		14.0					2.36			14.0			
0	58.0	92.0	0.035	4.0	0.0	0.0	5.2			0.77	3.46	1.61			5.0			13.8	19
0	69.0	94.5	0.035	0.0	0.0	0.0													
0	85.0	96.3	0.035	0.0	0.0	0.0													
0	100.0	96.8	0.035	0.0	0.0	0.0													

	FROUDE	A (ft²)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV²
Elmin = 88.7 Elmax = 98.7	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	5.7			10.6			0.54	0.00	1.61			10.3			17	0.0
CHNL 1 VALUES =	0.70		55.1			26.7		2.06	5.87		2.62			25.0		324	90.3
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.75			60.8			37.3		5.60			2.62			35.3	341	82.2
CRITICAL FLOW VALUES =															274.8	665	


50-year Peak with 10,000 gpm Mine Water Discharge - South Alternative
Elevation (feet)
100
96
92
88
84
80
0
10
20
30
40
50
60
70
80
90
100
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

100-year Peak, Natural Event	Flood Event
Skyline Mine Discharge to Huntington Creek - South Option	Site
RB White	Preparer

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

NBR GROUND PNTS =	13		(min of 7, max of 100)
ASSUMED WSEL =	91.45		ft
CHNL SLOPE =	0.0095		ft/ft
COMPOSITE CHNL n =	0.040		dim
OVERBANK n =	0.035		dim
	CHNL 1	CHNL 2	
BANK STA LEFT =	26.0		ft
BANK STA RIGHT =	51.0		ft
DISCHARGE =	367		cfs

GOVERNING EQUATIONS:

$Q = V A$

$R = A / P$

$V = (1.49 R^{0.66} S^{0.5}) / n$

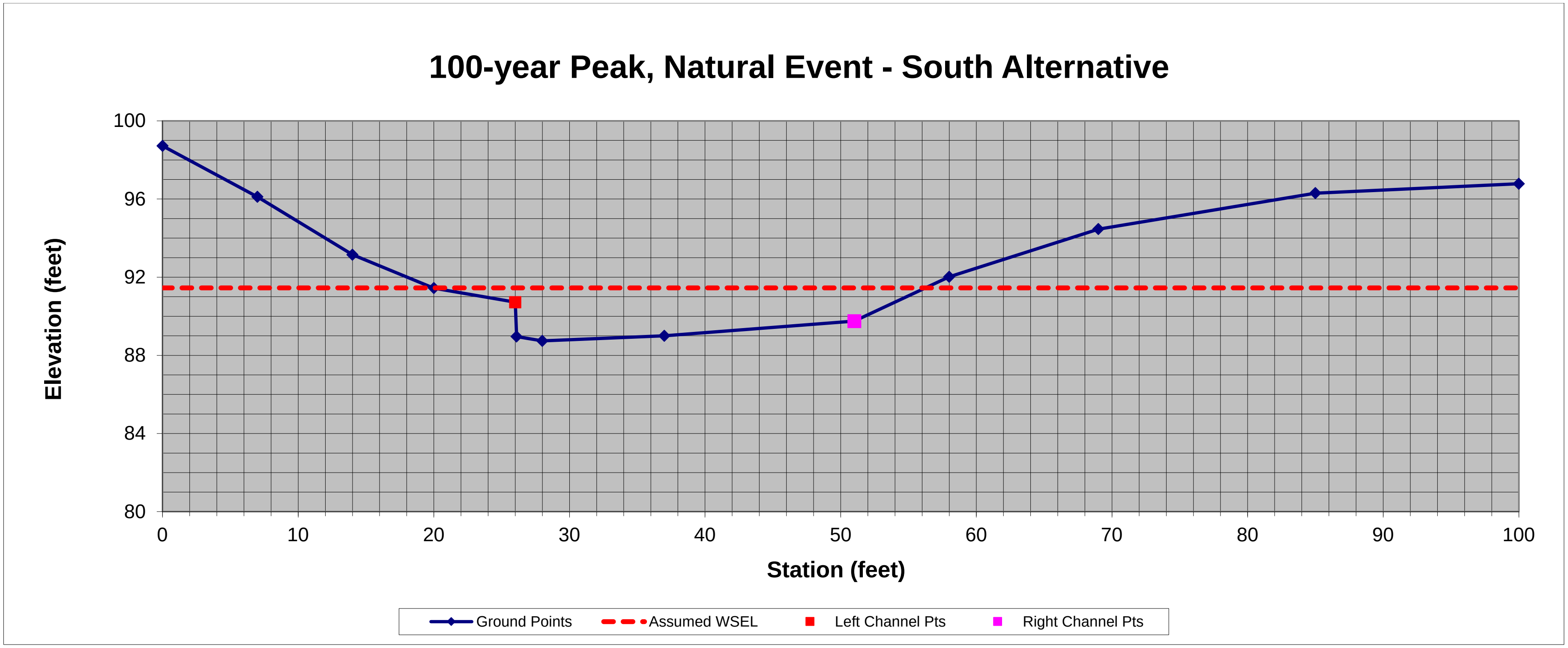
$F = V / (g A / T)^{0.5}$

n = Manning's roughness coefficient
A = flow area
P = wetted perimeter
R = hydraulic radius
V = flow velocity
D = flow depth
T = topwidth
Q = discharge
g = gravitational acceleration
Δ = denotes incremental value

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft²)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV²
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	98.7																	
0	7.0	96.1	0.035	0.0	0.0	0.0													
0	14.0	93.2	0.035	0.0	0.0	0.0													
0	20.0	91.4	0.035	0.0	0.0	0.0	0.0			0.00	0.12	0.01			0.0			0.0	0
0	26.0	90.7	0.035	2.2	0.0	0.0	6.0			0.37	2.12	0.73			6.0			4.7	3
0	26.1	89.0	0.040	0.0	0.2	0.0		1.8					2.49			0.1			
0	28.0	88.7	0.040	0.0	4.9	0.0		1.9					2.71			1.9			
0	37.0	89.0	0.040	0.0	23.2	0.0		9.0					2.71			9.0			
0	51.0	89.8	0.040	0.0	29.1	0.0		14.0					2.45			14.0			
0	58.0	92.0	0.035	4.5	0.0	0.0	5.5			0.81	3.59	1.70			5.2			16.0	22
0	69.0	94.5	0.035	0.0	0.0	0.0													
0	85.0	96.3	0.035	0.0	0.0	0.0													
0	100.0	96.8	0.035	0.0	0.0	0.0													

		A (ft²)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV²
Elmin = 88.7	FROUDE																
Elmax = 98.7	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	6.7			11.6			0.58	0.00	1.70			11.3			21	0.0
CHNL 1 VALUES =	0.70		57.4			26.7		2.15	6.03		2.71			25.0		346	98.5
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.76			64.0			38.3		5.72			2.71			36.3	367	88.8
CRITICAL FLOW VALUES =															274.8	665	



100-year Peak, Natural Event - South Alternative
Elevation (feet)
100
96
92
88
84
80
0
10
20
30
40
50
60
70
80
90
100
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

NORMAL FLOW DISCHARGE USING MANNING'S EQUATION

100-year Peak with 10,000 gpm Mine Water Discharge	**Flood Event**
Skyline Mine Discharge to Huntington Creek - South Option	**Site**
RB White	**Preparer**

Discharge calc for an ASSUMED WSEL & CHNL SLOPE. Up to two chnls may be defined for an IRREGULAR section by providing BANK STA LEFT, RIGHT. Manning's equ is not subdivided w/i defined chnl(s), where COMPOSITE CHNL n is used. Roughness coeff (n) automatically entered in purple based on BANK STAs & COMPOSITE / OVERBANK n; this may be overwritten by preparer, but equations in purple area are then lost.

Select approproate button to set up geometry & nbr of ground pnts. IRREGULAR button expands spreadsheet to nbr of gnd pnts, which may then be entered in blue-shaded area. Other buttons develop gnd pnts & bank sta for simple cross sections. Then enter CHNL SLOPE, n & vary WSEL to get desired normal flow DISCHARGE. CRIT FLOW button is effective once desired normal flow DISCHARGE is established, & applies to entire cross section.

	CHNL 1	CHNL 2	
NBR GROUND PNTS =	13		(min of 7, max of 100)
ASSUMED WSEL =	91.52		ft
CHNL SLOPE =	0.0095		ft/ft
COMPOSITE CHNL n =	0.040		dim
OVERBANK n =	0.035		dim
BANK STA LEFT =	26.0		ft
BANK STA RIGHT =	51.0		ft
DISCHARGE =	388		cfs

GOVERNING EQUATIONS:

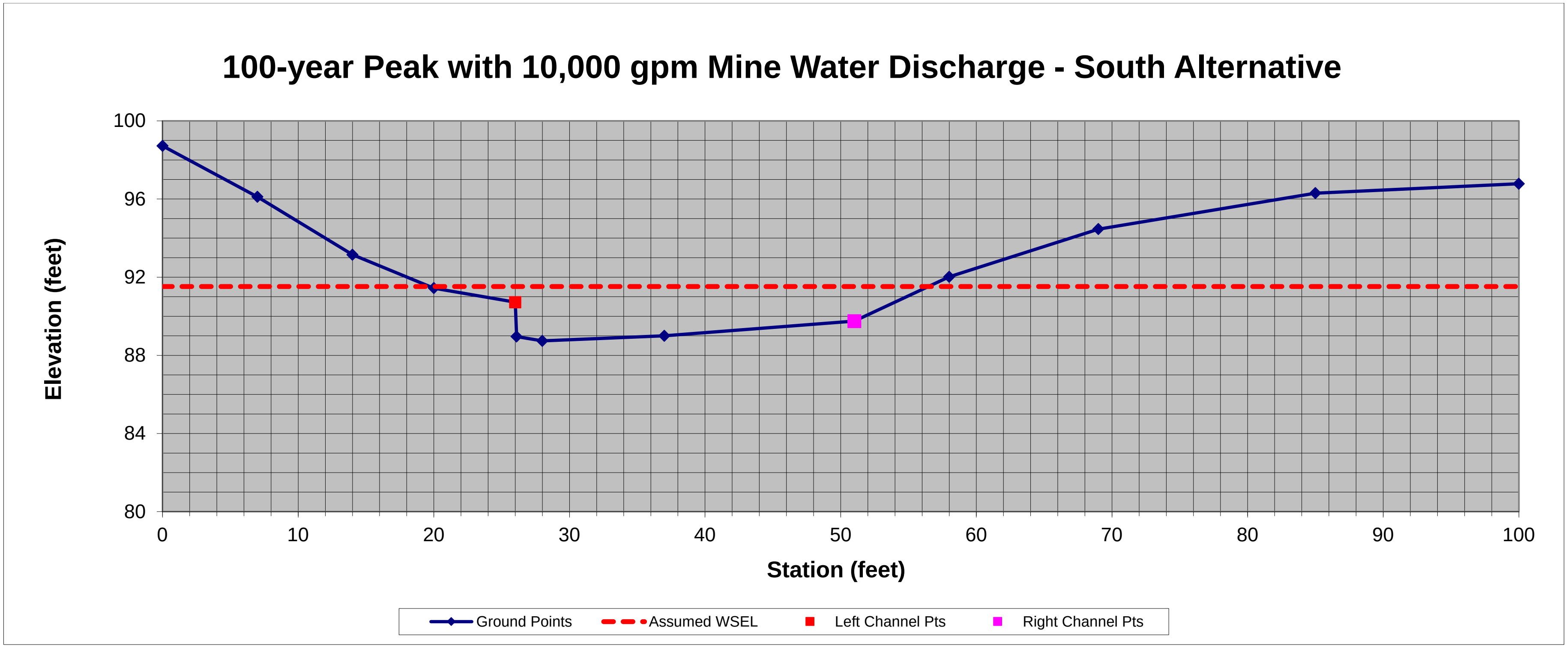
- $Q = V A$
- $R = A / P$
- $V = (1.49 R^{0.66} S^{0.5}) / n$
- $F = V / (g A / T)^{0.5}$

n = Manning's roughness coefficient	D = flow depth	A = flow area	T = topwidth
P = wetted perimeter	Q = discharge	R = hydraulic radius	g = gravitational acceleration
V = flow velocity	Δ = denotes incremental value		

Tuesday, September 8, 2020

PNT	STA (ft)	ELEV (ft)	n (dim)	Δ A (ft²)			Δ P (ft)			ΔR (ft)	V (ft/s)	D (ft)			Δ T (ft)			Δ Q cfs	DV²
				OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB	OB	CH 1	CH 2	OB	CH 1	CH 2	OB	OB
0	0.0	98.7																	
0	7.0	96.1	0.035	0.0	0.0	0.0													
0	14.0	93.2	0.035	0.0	0.0	0.0													
0	20.0	91.4	0.035	0.0	0.0	0.0	0.3			0.04	0.47	0.08			0.3			0.0	0
0	26.0	90.7	0.035	2.6	0.0	0.0	6.0			0.44	2.38	0.80			6.0			6.3	5
0	26.1	89.0	0.040	0.0	0.2	0.0		1.8					2.56			0.1			
0	28.0	88.7	0.040	0.0	5.1	0.0		1.9					2.78			1.9			
0	37.0	89.0	0.040	0.0	23.9	0.0		9.0					2.78			9.0			
0	51.0	89.8	0.040	0.0	30.0	0.0		14.0					2.52			14.0			
0	58.0	92.0	0.035	4.8	0.0	0.0	5.7			0.84	3.69	1.77			5.5			17.8	24
0	69.0	94.5	0.035	0.0	0.0	0.0													
0	85.0	96.3	0.035	0.0	0.0	0.0													
0	100.0	96.8	0.035	0.0	0.0	0.0													

Elmin = 88.7	FROUDE	A (ft²)			P (ft)			R (ft)	V (ft/s)	MAXIMUM D (ft)			T (ft)			Q (cfs)	DV²
Elmax = 98.7	NUMBER	OB	CH 1	CH 2	OB	CH 1	CH 2			OB	CH 1	CH 2	OB	CH 1	CH 2		
OVERBANK VALUES =	0.00	7.5			12.1			0.62	0.00	1.77			11.7			24	0.0
CHNL 1 VALUES =	0.70		59.1			26.7		2.21	6.15		2.78			25.0		364	105.2
CHNL 2 VALUES =				0.0			0.0	0.00	0.00			0.00			0.0	0	0.0
AVG SECTION VALUES =	0.76			66.6			38.8		5.82			2.78			36.7	388	94.2
CRITICAL FLOW VALUES =															274.8	665	


100-year Peak with 10,000 gpm Mine Water Discharge - South Alternative
Elevation (feet)
100
96
92
88
84
80
0
10
20
30
40
50
60
70
80
90
100
Station (feet)
Ground Points
Assumed WSEL
Left Channel Pts
Right Channel Pts

ATTACHMENT D

Results of Pipe Discharge Analyses

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions*:* *Enter values in blue boxes. Calculations in yellow*

ELECTRIC LAKE *NORTH* DISCHARGE ALTERNATIVE

Inputs

Pipe Diameter, **D** =	18	in
Depth of flow, **y** =	11.78	in
(must have y ≥ D/2)		
Full Pipe Manning roughness, $\mathbf{n_{full}}$ =	0.012	
Channel bottom slope, **S** =	0.090	ft/ft

Calculations

$\mathbf{n/n_{full}}$ =	1.1727777	
Partially Full Manning roughness, **n** =	0.014	

Calculations

Pipe Diameter, **D** =	1.5	ft
Pipe Radius, **r** =	0.75	ft
Circ. Segment Height, **h** =	0.518	ft
Central Angle, **q** =	2.51	radians
Cross-Sect. Area, **A** =	1.23	ft^2
Wetted Perimeter, **P** =	2.8	ft
Hydraulic Radius, **R** =	0.43	ft
Discharge, **Q** =	22.29	cfs
Ave. Velocity, **V** =	18.19	ft/sec
pipe % full [(A/A_{full})*100%] =	69.3%	

Source: https://www.engineersedge.com/fluid_flow/partially_full_pipe_flow_calculation/partiallyfullpipeflow_calculation.htm

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

ELECTRIC LAKE *SOUTH* DISCHARGE ALTERNATIVE

Inputs

Pipe Diameter, **D** =	18	in
Depth of flow, **y** =	11.94	in
(must have $y \geq D/2$)		
Full Pipe Manning roughness, $\mathbf{n_{full}}$ =	0.012	
Channel bottom slope, **S** =	0.086	ft/ft

Calculations

$\mathbf{n/n_{full}}$ =	1.1683333
Partially Full Manning roughness, **n** =	0.014

Calculations

Pipe Diameter, **D** =	1.5	ft
Pipe Radius, **r** =	0.75	ft
Circ. Segment Height, **h** =	0.505	ft
Central Angle, **q** =	2.48	radians
Cross-Sect. Area, **A** =	1.24	ft^2
Wetted Perimeter, **P** =	2.9	ft
Hydraulic Radius, **R** =	0.44	ft
Discharge, **Q** =	22.29	cfs
Ave. Velocity, **V** =	17.92	ft/sec
pipe % full [(A/A_{full})*100%] =	70.4%	

Source: https://www.engineersedge.com/fluid_flow/partially_full_pipe_flow_calculation/partiallyfullpipeflow_calculation.htm

ATTACHMENT E

Riprap Apron Design Calculations

RIPRAP APRON DESIGN

Method: Thompson, P.L. and R.T Kilgore. 2006. Hydraulic Design of Energy Dissipators for Culverts and Channels. Hydraulic Engineering Circular No. 14, Third Edition. Federal Highway Administration. Arlington, VA.

Equation:

$$D_{50} = 0.2D\left[\frac{Q}{\mathrm{SQRT}(g)*D^{2.5}}\right]^{4/3}\left[\frac{Q}{TW}\right]$$

Where

D_{50} = median riprap diameter (ft)
D = culvert diameter (ft)
Q = design discharge (cfs)
g = acceleration due to gravity (ft/s^2)
TW = tailwater depth (ft)

Client:
Site:
Proj. No.:
Designer:

Calculations:

D = 1.5 ft
Q = 22.3 cfs
g = 32.2 ft/s^2
TW = 0.982 ft

D_{50} = 0.74 ft
= 8.8 in

Use a D_{50} of 9 inches.

Typical Apron Dimensions (from pg. 10-18 of HEC-14)

Class	D_{50} (mm)	D_{50} (in)	Apron Length	Apron Depth
1	125	5	4D	$3.5D_{50}$
2	150	6	4D	$3.3D_{50}$
3	250	10	5D	$2.4D_{50}$ ←
4	350	14	6D	$2.2D_{50}$
5	500	20	7D	$2.0D_{50}$
6	550	22	8D	$2.0D_{50}$

D = culvert diameter