Antidegradation Review Form

Part A: Applicant Information

Facility Name: Lila Canyon Mine

Facility Owner: UtahAmerican Energy, Inc. (UEI)

Facility Location: Lila Canyon, Emery County, Utah

Form Prepared By: UtahAmerican Energy. Inc. and HydroPlot

Outfall Number: 002

Receiving Water: Lila Canyon (ephemeral channel or dry wash) is tributary to Grassy Wash (ephemeral channel) which is tributary to Marsh Flat Wash (ephemeral channel) which is tributary to the Price River. Distance from discharge point over 12.9 miles.

What Are the Designated Uses of the Receiving Water (R317-2-6)?

Domestic Water Supply:	NONE
Recreation:	Low
Aquatic Life:	Nongame fish
Agricultural Water Supply:	Crop irrigation and Stock watering
Great Salt Lake:	NONE

Category of Receiving Water (R317-2-3.2, -3.3, and -3.4): Category 2. Classification 2B, 3C, and 4

UPDES Permit Number (if applicable): UT-G 040024

Effluent Flow Reviewed: 3,000,000 gpd - see Attachment A
Typically, this should be the maximum daily discharge at the design capacity of the facility. Exceptions should be noted.

What is the application for? (check all that apply)

- ☐ UPDES permit for a new facility, project, or outfall.
- ☐ UPDES permit renewal with an expansion or modification of an existing wastewater treatment works.
- ■ UPDES permit renewal requiring limits for a pollutant not covered by the previous permit and/or an increase to existing permit limits.
- ☐ UPDES permit renewal with no changes in facility operations.

Part B. Is a Level II ADR required?

This section of the form is intended to help applicants determine if a Level II ADR is required for specific permitted activities. In addition, the Executive Secretary may require a Level II ADR for an activity with the potential for major impact on the quality of waters of the state (R317-2-3.5a.1).

B1. The receiving water or downstream water is a Class 1C drinking water source.

☐ Yes A Level II ADR is required (Proceed to Part C of the Form)

■ No (Proceed to Part B2 of the Form)

B2. The UPDES permit is new or is being renewed and the proposed effluent concentration and loading limits are higher than the concentration and loading limits in the previous permit and any previous antidegradation review(s).

■ Yes (Proceed to Part B3 of the Form)

☐ No No Level II ADR is required and there is no need to proceed further with review questions.

B3. Will any pollutants use assimilative capacity of the receiving water, i.e. do the pollutant concentrations in the effluent exceed those in the receiving waters at critical conditions? For most pollutants, effluent concentrations that are higher than the ambient concentrations require an antidegradation review? For a few pollutants such as dissolved oxygen, an antidegradation review is required if the effluent concentrations are less than the ambient concentrations in the receiving water. (Section 3.3.3 of Implementation Guidance)

■ Yes (Proceed to Part B4 of the Form)

☐ No No Level II ADR is required and there is no need to proceed further with review questions.

B4. Are water quality impacts of the proposed project temporary and limited (Section 3.3.4 of Implementation Guidance)? Proposed projects that will have temporary and limited effects on water quality can be exempted from a Level II ADR.

☐ Yes Identify the reasons used to justify this determination in Part B4.1 and proceed to Part G. No Level II ADR is required.

■ No A Level II ADR is required (Proceed to Part C)

B4.1 Complete this question only if the applicant is requesting a Level II review exclusion for temporary and limited projects (see R317-2-3.5(b)(3) and R317-2-3.5(b)(4)). For projects requesting a temporary and limited exclusion please indicate the factor(s) used to justify this determination (check all that apply and provide details as appropriate) (Section 3.3.4 of Implementation Guidance):

☐ Water quality impacts will be temporary and related exclusively to sediment or turbidity and fish spawning will not be impaired.

Factors to be considered in determining whether water quality impacts will be temporary and limited:

a) The length of time during which water quality will be lowered:
b) The percent change in ambient concentrations of pollutants:
c) Pollutants affected:
d) Likelihood for long-term water quality benefits:
e) Potential for any residual long-term influences on existing uses:
f) Impairment of fish spawning, survival and development of aquatic fauna excluding fish removal efforts:

Additional justification, as needed:

Level II ADR

Part C, D, E, and F of the form constitute the Level II ADR Review. The applicant must provide as much detail as necessary for DWQ to perform the antidegradation review. Questions are provided for the convenience of applicants; however, for more complex permits it may be more effective to provide the required information in a separate report. Applicants that prefer a separate report should record the report name here and proceed to Part G of the form.

Optional Report Name: NA

Part C. Is the degradation from the project socially and economically necessary to accommodate important social or economic development in the area in which the waters are located? *The applicant must provide as much detail as necessary for DWQ to concur that the project is socially and economically necessary when answering the questions in this section. More information is available in Section 6.2 of the Implementation Guidance.*

C1. Describe the social and economic benefits that would be realized through the proposed project, including the number and nature of jobs created and anticipated tax revenues.

UEI must dewater the Lila Canyon Mine if it is to provide safe operating conditions for underground workers and remain viable. Two issues exist. First, as part of the development of the mine, a portion of the old Horse Canyon Mine must be crossed. These workings are known to be flooded and a portion of these workings needs to be drained to allow UEI to develop the Lila Canyon Mine. Second, the mine cannot function either operationally or within the terms of its Mine Safety Health Administration (MSHA) permit if normal groundwater inflows to the workings are simply allowed to collect underground. Thus, the groundwater discharge must occur regardless of production levels or types of mine operations, including periods of temporary mining cessation. Ensuring worker safety is a critical social benefit.

The Lila Canyon Mine operations create mining, distribution, and related service-sector jobs as well as indirectly support the local and regional economy through increasing the demand for non-mine related goods and services. The mine is located in Emery County and most workers come from adjacent Carbon County where coal mining is a major industry (Utah Department of Workforce Services 2015). The Lila Canyon Mine produced 349,570 thousand short tons of coal in 2015. During this time, UEI had 75 employees with wages and benefits paid totaling $7,984,019. In addition, associated goods and services were purchased in the amount of $7,146,911. UEI's total direct expenditure into the local economy in 2015 was $31, 598,929.

Because the mine is located in Emery County, it is normally assumed that this county would receive most of the economic benefits associated with the mine. However, most of the employees for the mine come from East Carbon, Price, and Wellington in Carbon County. The estimated county populations for these two counties in the year 2014 was 10,631 for Emery and 20,660 for Carbon Counties (Utah Department of Workforce Services 2015), down from 10,848 in 2010, a 2.0 percent decrease. Mining jobs make up 20.4 and 7.2 percent of the nonfarm employment in Emery and Carbon Counties. UEI is a significant employer in Carbon County. Carbon and Emery Counties currently holds the distinction of having some of the highest average monthly wage in the state at $3,337 and $3,764. Wages paid by the mining industry are an important component of Carbon and Emery County's economy.

Economic multipliers are used to describe the effects on the economy resulting from changes in the industrial sector. The U.S. Bureau of Economic Analysis has provided a list of United States Industry Employment Multipliers (http://www.contentfirst.com/multiplier.shtml). A direct effect employment multiplier is used to predict total changes in employment due to an initial direct change in a given sector or industry. The coal mining direct effect employment multiplier is 4.4; this indicates that for every new job in the coal mining sector, employment in other sectors goes up by 4.4 jobs.

Some of the coal mined at the Lila Canyon Mine is Federal coal. Federal coal leasing generates assorted revenues including: (1) a bonus paid at the time the coal is leased, (2) rental payments to hold the lease, and (3) royalties paid on the value of the coal produced per year. The State in which the coal is leased receives half of the bonus as well as half of the royalties. Every competitively issued lease requires a royalty rate of 8 percent for coal mined by underground methods. The Utah Legislature distributes Federal mineral lease funds to communities, counties, and other entities as part of the annual budget and appropriation process.

UEI's contribution to the rural economy in this area in turn provides a social benefit to residents. Further, the Lila Canyon Mine also provides important social and economic benefits on a regional/national scale by supplying coal for domestic energy production.

C2. Describe any environmental benefits to be realized through implementation of the proposed project.

UEI's discharge of intercepted groundwater will provide a short term important supplement to stream flows in Lila and Grassy Washes. The initial discharge will not be very beneficial due to the anticipated high TDS values from the stagnant Horse Canyon drainage. However, this initial discharge is anticipated to be of short duration until the stagnant waters from the old mine workings are drained. Following the initial flush the water quality of the discharged water is expected to improve and be significantly better and provide water of a suitable quantity and quality to be of benefit to a diversity of avian, reptilian, and mammalian species.

C3. Describe any social and economic losses that may result from the project, including impacts to recreation or commercial development.

None Projected – Currently there are only rare, ephemeral flows within the drainages.

C4. Summarize any supporting information from the affected communities on preserving assimilative capacity to support future growth and development.

The communities in Carbon and Emery Counties, who are the primary economic beneficiaries of the continued operations at the Lila Canyon Mine, are all located upstream of the UPDES discharge and thus would not be affected by any decrease in the assimilative capacity related to the mine discharge. Further, there are no downstream communities along or near Lila Canyon Creek, Grassy Wash or Marsh Flat Wash downstream of the Lila Canyon Creek confluence or Price River downstream of the Marsh Flat Wash confluence. Green River is the nearest downstream community and it is located more than 50 stream miles away at the confluence of Price River and the Green River. The intervening lands are remote, isolated, and topographically challenging; they are unlikely to be the subject of future growth or development that would require additional use of assimilative capacity.

C5. Please describe any structures or equipment associated with the project that will be placed within or adjacent to the receiving water.

Other than the sediment pond on the Left fork of Lila Canyon Creek, which is part of the current mine facilities, there are no structures or equipment that are planned for the project which will be located within or adjacent to any of the receiving waters.

Part D. Identify and rank (from increasing to decreasing potential threat to designated uses) the parameters of concern. *Parameters of concern are parameters in the effluent at concentrations greater than ambient concentrations in the receiving water. The applicant is responsible for identifying parameter concentrations in the effluent and DWQ will provide parameter concentrations for the receiving water. More information is available in Section 3.3.3 of the Implementation Guidance.*

Parameters of Concern:

Rank	Pollutant	Ambient Concentration	Effluent Concentration
1	Total Dissolved Solids	None	3,013 mg/l – Horse Canyon 2,214 mg/l – Mine water
2	Boron	None	1.08 mg/l – Horse Canyon 0.69 mg/l – Mine Water 1.12 mg/l – Mine Sump
3			
4			
5			

Pollutants Evaluated that are not Considered Parameters of Concern:

Pollutant	Ambient Concentration	Effluent Concentration	Justification
TSS	None	<5 mg/l	Less than Standard
Oil and Grease	None	< 5 mg/l	Less than Standard
Iron	None	3.43 mg/l – Horse Canyon <0.05 mg/l – Mine Water 0.33 mg/l – Mine Sump	After water is collected underground and allowed to stand in sump, prior to discharge, quality meets Standard
Ammonia	None	2.2 mg/l – Horse Canyon 2.3 mg/l – Mine Water 0.2 mg/l – Mine Sump	After water is collected underground and allowed to stand in sump, prior to discharge, quality meets Standard

Part E. Alternative Analysis Requirements of a Level II Antidegradation Review.

Level II ADRs require the applicant to determine whether there are feasible less-degrading alternatives to the proposed project. More information is available in Section 5.5 and 5.6 of the Implementation Guidance.

E1. The UPDES permit is being renewed without any changes to flow or concentrations. Alternative treatment and discharge options including changes to operations and maintenance were considered and compared to the current processes. No economically feasible treatment or discharge alternatives were identified that were not previously considered for any previous antidegradation review(s).

☐ Yes (Proceed to Part F)

■ No or Does Not Apply (Proceed to E2)

E2. Attach as an appendix to this form a report that describes the following factors for all alternative treatment options (see 1) a technical description of the treatment process, including construction costs and continued operation and maintenance expenses, 2) the mass and concentration of discharge constituents, and 3) a description of the reliability of the system, including the frequency where recurring operation and maintenance may lead to temporary increases in discharged pollutants. Most of this information is typically available from a Facility Plan, if available.

Report Name: See Attachment B

E3. Describe the proposed method and cost of the baseline treatment alternative. The baseline treatment alternative is the minimum treatment required to meet water quality based effluent limits (WQBEL) as determined by the preliminary or final wasteload analysis (WLA) and any secondary or categorical effluent limits.

E4. Were any of the following alternatives feasible and affordable?

Alternative	Feasible	Reason Not Feasible/Affordable
Pollutant Trading	Yes	Agree to participate in Colorado Salinity Project
Water Recycling/Reuse	Yes	Limited to Bathhouse, longwall, dust suppression, and road and coal pile watering
Land Application	No	No farming located near mine
Connection to Other Facilities	No	No other facilities located near by
Upgrade Existing Facilities	Yes	Upgrading existing facilities
Total Containment	No	Too large a quantity, limited containment area
Improved O&M of Existing Systems	No	No Alternative
Seasonal or Controlled Discharge	No	Not practical, year round operation
New Construction	Yes	Mine Expansion
No Discharge	No	Not Feasible due to large volume

E5. From the applicant's perspective, what is the preferred treatment option?

New construction of upgraded discharge structure with limited re-use for bath house, longwall, dust suppression, and road and coal pile watering.

E6. Is the preferred option also the least polluting feasible alternative?

☐ Yes

■ No

If no, what were less degrading feasible alternative(s)?

Constructing a total containment pond above ground and allowing the water to evaporate and percolate.

If no, provide a summary of the justification for not selecting the least polluting feasible alternative and if appropriate, provide a more detailed justification as an attachment.

There is no location underground to store the volume of water encountered during mining as the new entries connect to the old Horse Canyon workings. Also, above ground the size of a pond to contain the water would be larger than currently permitted within the permit area and larger than allowed by the adjacent land manager outside the currently permitted area.

Further, the discharge has been evaluated to determine the distance downstream that the mine water will flow. The distance from the point of discharge to the first intermittent or perennial stream is about 12.9 miles. Based on the calculations presented in Attachment F, the mine water will flow on the surface a distance of about 3 miles before the flow will be absorbed by the underlying sediments. This infiltrated water will then flow an additional 5.5 miles in the subsurface before the water moves into the underlying bedrock or adjacent fills. Therefore, the flows are not expected to reach any flowing water body of the State.

Part F. Optional Information

F1. Does the applicant want to conduct optional public review(s) in addition to the mandatory public review? Level II ADRs are public noticed for a thirty day comment period. More information is available in Section 3.7.1 of the Implementation Guidance.

■ No

☐ Yes

F2. Does the project include an optional mitigation plan to compensate for the proposed water quality degradation?

■ No

☐ Yes

Report Name:

Part G. Certification of Antidegradation Review

G1. Applicant Certification

The form should be signed by the same responsible person who signed the accompanying permit application or certification.

Based on my inquiry of the person(s) who manage the system or those persons directly responsible for gathering the information, the information in this form and associated documents is, to the best of my knowledge and belief, true, accurate, and complete.

Print Name: Karin Madsen

Signature: [signature]

Date: 6-20-16

G2. DWQ Approval

To the best of my knowledge, the ADR was conducted in accordance with the rules and regulations outlined in UAC R-317-2-3.

Water Quality Management Section

Print Name: DAVE Wham

Signature: [signature]

Date: 6-17-16

ATTACHMENT A

Discharge Description

Lila Canyon Mine is a coal mine in eastern Utah. The mine is applying to renew the UPDES stormwater permit UT-G 040024 and expand the discharge to cover mine water to be encountered underground to a maximum amount to 3,000,000 gpd.

With development of the Lila Canyon underground workings, the operation will intersect and cross a portion of the old Horse Canyon workings along the north side. These old workings are currently flooded and UEI will need to drain these workings to allow the current mining to safely cross the old workings. Normally, these waters would be allowed to rapidly drain, however, the facilities through the mine site and the downstream channel will not be able to handle a larger flow. Therefore, the old workings will be drained at a flow rate of about 2100 gpm of 3,000,000 gpd over a period of 2 to 6 months till the water in that portion of the Horse Canyon workings are drained. Following the temporary discharge, the mine flows will decrease. Over time these mine flows will again increase as the new mine workings expand.

This temporary discharge is expected not to reach the Price River, located about 12.9 miles from the point of discharge. An evaluation of the ephemeral washes from the point of discharge to the Price River was evaluated using the USDA transmission loss evaluation (see attached). Based on these calculations, the discharge is expected to stop flowing within approximately 3 miles of the discharge point and the subsurface flow is expected to drain into the surrounding bedrock within 8.5 miles of the discharge point.

Based on the anticipated short duration of the Horse Canyon mine draining and the anticipated transmission loss in the ephemeral channel, UEI is not anticipating any discharge reaching the Price River and therefore, having no effect on the receiving waters.

Table 1

Calculation of Extent of Surface and Subsurface Flow from Mine Discharge

	a		b					c		d	e	f	g	h	i	j	k	l
Discharge (gpm)	Discharge (ac-ft/day)	Reach ID	Channel Length (ft)	Channel Width (ft)	Valley Fill Depth (ft)	Valley Fill Width (ft)	Fill Porosity	Fill Storage Volume (ac-ft)	Infiltration Rate (in/hr)	Potential Infiltration to Storage (ac-ft)	Estimated Infiltration to Fill Storage (ac-ft)	Estimated Evaporation From Surface (ac-ft)	Excess Flow (ac-ft)	GW Movement Rate from Storage (in/hr)	Potential GW Movement from Storage (ac-ft)	Estimated GW Movement from Storage (ac-ft)	Total Loss from Channel (ac-ft)	
2080	9.19	1	6251	5	5	15	0.2	2.15	2	2.87	2.15	0.01	7.03	8.33E-03	0.72	0.72	0.72	Excess flow, Continue Simulation
	7.03	2	727	7.5	5	22.5	0.2	0.38	2	0.50	0.38	0.00	6.66	8.33E-03	0.11	0.11	0.83	Excess flow, Continue Simulation
	6.66	3	206	10	5	30	0.2	0.14	2	0.19	0.14	0.00	6.51	8.33E-03	0.04	0.04	0.87	Excess flow, Continue Simulation
	6.51	4	3760	12	5	36	0.2	3.11	2	4.14	3.11	0.01	3.40	8.33E-03	0.79	0.79	1.68	Excess flow, Continue Simulation
	3.40	5	5000	12	5	36	0.2	4.13	2	5.51	4.13	0.01	0.00	8.33E-03	1.06	1.06	2.75	Excess flow, Continue Simulation
	End of surface flow			15944 ft ~		3.02 mi												
	0.00	6	7000	15	5	45	0.2	7.23	2	9.64	7.23	0.02	0.00	8.33E-03	1.77	1.77	4.54	Excess flow, Continue Simulation
	0.00	7	10000	15	5	45	0.2	10.33	2	13.77	10.33	0.03	0.00	8.33E-03	2.53	2.53	7.10	Excess flow, Continue Simulation
	0.00	8	12060	20	5	60	0.2	16.61	2	22.15	16.61	0.06	0.00	8.33E-03	3.88	3.88	11.03	Total Outflow Loss > Discharge, Stop
	End of sub-surface flow			45004 ft		8.52 mi												
	0.00	9	11250	20	5	60	0.2	15.50	2	20.66	15.50	0.05	0.00	8.33E-03	3.62	3.62	14.70	Total Outflow Loss > Discharge, Stop
	0.00	10	12000	25	5	75	0.2	20.66	2	27.55	20.66	0.07	0.00	8.33E-03	4.68	4.68	19.45	Total Outflow Loss > Discharge, Stop
			68254															

Calculation Method: This estimate is based on the concepts presented in the U.S. Soil Conservation Service National Engineering Handbook Chapter 19 - Transmission Losses (1985).

Column

a Input discharge in ac-ft or transfer excess flow from previous reach.

b Enter Channel length and width and Valley fill depth and width

c Multiply valley fill width and depth and reach length by porosity of soil.

d Convert infiltration rate to volume in ac-ft. Assume that infiltration will occur across channel width and along reach length.

e Compare infiltration potential to available fill volume. If infiltration potential is less than available fill volume, then use infiltration potential. If infiltration potential is greter than available fill volume, then use available fill volume. However, if prior storage already filled, then available fill volume is limited to the flux out of storage by percolation.

44 inches/year = 0.010045662 ft/day

f Evaporation from the surface of the creek/wet area. Length of flowing area x width of flow area x daily evaporation rate. Daily evaporation rate

g Excess flow is the discharge (a) - infiltration (d).

h Groundwater movement rate includes movement of stored water into adjacent soils, bedrock, and consumption by plants and is estimated to be 5% of the infiltration rate.

i Convert groundwater movement rate to volume in ac-ft. Assume that 2 times depth plus width of valley fill estimate is the movement flux surface.

j Compare estimated infiltration to potential groundwater movement. If estimated infiltration is greater than potential groundwater movement, use potential movement. If not then use infiltration.

k Add up the outflow from each reach by summing the groundwater movement and evaporation outflows.

l Compare the total outflow versus the discharge to the channel. When the total outflow from the channel is equal to or greater than the discharge, then the flow will not continue downstream.

ATTACHMENT B

Alternative Descriptions

Preliminary Alternatives for Treatment – Initial treatment alternatives for Outfall 002 include:

Pollutant Trading: Currently, UEI has been attempting to operate the mine discharges without needing to conduct pollutant trading. It is understood that a program exists that will allow this practice to operate.

Water recycling/reuse/conservation: The primary uses of water at the mine are assisting with the long-wall operations, dust control, area cleanup, and potable water supply for the bath house. The discharges result from surface runoff and groundwater intercepted by the underground mine workings. Neither source of discharge is controllable. There are no practical options for further water conservation at the mine.

Land application: The facility is located in a relatively narrow canyon and property suitable for an effluent storage pond and land application sprays fields is not available.

Connection to existing wastewater treatment facilities: There are no Special Service Districts operating a wastewater treatment facility in proximity to the mine site.

Upgrade/hjgher treatment levels: Several options exist for different treatment levels. Ion exchange and reverse osmosis are demonstrated treatment processes for removing TDS from effluent. However, these processes concentrate the salt ions into a reverse osmosis membrane reject stream or an ion exchange resin regeneration brine, and do not reduce the mass of TDS requiring discharge to surface or disposal by other methods. Due the cost and complexity of managing reject and regeneration wastes, higher level treatment of this type of processes were not considered further.

A less costly option is the use of various filtration processes. These remove some pollutants to aid in meeting standards.

Total Containment: Options for total containment include above ground evaporation ponds, deep well injection, and thermal evaporation using a mechanical concentrator and crystallizer. Due to the location of the site in a narrow canyon, the use of above ground ponds is not practical due to the limited area available. Also, due to seasonal issues, the need to dispose of water year round, the climate is limited to 6 months of significant evaporation on a yearly basis. Deep well injection is also of limited use, due to the volume of water that needs to be disposed of. There is limited capacity to inject water into the shale strata underlying the site. A mechanical concentrator and crystallizer treatment system is being carried forward for evaluation as an alternative to the existing sedimentation pond.

Improved operation and maintenance of existing treatment systems: Not applicable. Outfall 002 relies on sedimentation in underground sumps to remove Ammonia and Iron, and does not have the capability to remove TDS and Boron.

Seasonal or controlled discharge options: Water cannot be stored within the mine. Small sumps to settle water prior to discharge are allowed, but no large structures are approved. Year-round discharges are required to maintain safe working conditions.

Use of alternative discharge locations or alternative receiving water bodies: The only receiving water body in proximity to the Lila Canyon Mine is Lila Canyon.

No Discharge: Water discharge is required for normal mine operations per MSHA rules.

Process changes or product or raw material substitution: The Lila Canyon Mine is an underground coal mine. No other product is available for substitution. Outfall 001 is required to manage surface runoff from the mine site. Outfall 002 is a mine water discharge point required to manage water levels within the mine and maintain safe working conditions.

Alternative Treatments Considered

Outfall 002 - Mine Discharge

• **Baseline Alternative:** The existing in-mine sedimentation sumps are the baseline alternative for comparison and evaluation of feasible treatment alternatives.

• **Alternative A - Alternative treatment:** Sand media filtration is carried forward for evaluation as an alternative to the existing in-mine sedimentation.

• **Alternative B - Higher treatment**: Sand media filtration followed by enhanced alumina adsorptive media is carried forward for evaluation as an alternative to the existing in-mine sedimentation.

• **Alternative C-Pollutant trading:** The discharge is located within the Colorado River basin, and is subject to the Colorado River Basin Salinity Control Forum's policies for TDS. The Forum policy allows permitting authorities to allow industrial sources of salinity to conduct or finance salinity offset projects. Purchasing salinity offsets is a potential alternative to reduce the TDS discharge from the facility.

• **Alternative D-Total Containment:** Options for total containment to be considered is a mechanical concentrator and crystallizer treatment system as an alternative to the existing in-mine sedimentation sump.

Alternative Evaluations

Alternative 1

Existing Mine Sump Sedimentation
Sedimentation sumps within the mine are used to remove iron and ammonia before pumping to the surface and discharge via Outfall 002. A network of pumps and discharge pipes are used to intercept groundwater and control the water levels in the mine. UEI selects abandoned mine sections to provide adequate storage volume to allow for the settling and aeration of intercepted groundwater for at least 24 hours. This time frame allows sediment to settle prior to discharging to the surface drainage. All discharged groundwater is metered and recorded at Outfall 002.

Expected Pollutant Removal
Table 1 presents the estimated Pollutant of Concern (POC) removal by the sedimentation sumps within the mine. The POCs have been weighted to reflect removal as determined using EPA toxic weighting factors (TWFs).

Based on geology and groundwater conditions in areas with active mining operations and from flows from old flooded operations that will be connected to by the current workings the quantity and quality of water pumped from the mine will vary. Due to the need to maintain a generally dewatered mine to conduct safe mine operations, it is not possible to selectively pump differing TDS water sources. Due to the volume of water encountered, the in-mine sedimentation sumps are not sized to allow reduction of the TDS concentration in the mine drainage.

Cost Analysis
Table 2 presents the estimated costs for initial installation and annual operations and maintenance (O&M). The estimated capital costs for the in-mine pumping system is about $500,000. This includes pumps to transfer intercepted groundwater to the sumps, pumps connecting the sumps to the surface, and associated piping and ditching to Outfall 002. The primary operating cost of the system is electricity to operate the pumps and pump maintenance. The estimated annualized cost of system operation is approximately $125,000/year.

Alternative 2

Sand Filtration
Although Outfall 002 achieves the current ammonia and iron limits, sand filters are proposed to further reduce these effluent concentrations. Sand filter media promotes oxidation of dissolved iron and ammonia, and then removes the particulate iron. A Sand filter system includes the following equipment:

- Influent pumps
- Sand media filters
- Oxidant feed system
- Backwash holding tank

The filtration system would be installed at a location along the mine water discharge piping/flow network. A skid-mounted filter system with integral controls is possible, and would need to be installed in a building to provide freeze protection.

Expected Pollutant Removal
Table 3 presents the estimated POC removal provided by greensand filtration. Sand filtration is commonly used in industrial water treatment systems and is effective for iron and ammonia removal and meeting effluent limits. However, sand filtration will not remove TDS or Boron. With proper maintenance and operator training, the reliability of a filtration system is high.

Cost Analysis
Table 4 presents the cost estimate for a sand filtration system installation and annual O&M. The estimated total installed cost for an effluent sand filtration system is about $15,040,000. The treatment system is sized to a flow of 3.0 mgd.

Alternative 3

Sand Filtration and Adsorptive Media
Sand filters and enhanced alumina adsorption are proposed to reduce the effluent concentrations of ammonia, boron, and iron. Similar to a standard sand filter, the media promotes oxidation of dissolved iron and ammonia, and then removes the particulate iron. Enhanced alumina adsorption uses proprietary media that bonds trace metals to its active sites and removes the constituent from the effluent. A filter and adsorption system includes the following equipment:

- Influent pumps
- Sand media filters
- Oxidant feed system
- Enhanced alumina adsorption vessels
- Backwash holding tank

The filtration and adsorption system would be installed at the outlet of the existing mine discharge. A skid-mounted pressure vessel system with integral controls is possible, and would need to be installed in a building to provide freeze protection.

Expected Pollutant Removal
Table 5 presents the estimated POC removal provided by Alternative 3. As with Alternative 2, it is used in industrial water treatment systems and is effective for ammonia, boron, and iron removal and meeting effluent limits. However, neither sand filtration or enhanced alumina adsorption will remove TDS. With proper maintenance and operator training, the reliability of a filtration system is high.

Cost Analysis
The estimated total installed cost for an effluent sand filtration with enhanced alumina adsorption media system is about $29,212,000. The treatment system is also sized for a flow of 3.0 mgd. The cost estimate worksheet presented in Table 6 presents the estimated annual O&M costs and initial capital cost for the filtration alternative.

Alternative 4

Salinity Offset Credits

The Colorado River Salinity Control Forum has a permitting program that addresses situations where it is not practical to: (i) prevent the discharge of all salt from proposed new construction; (ii) reduce the salt loading to the Colorado River to less than one ton per day; or (iii) when the proposed discharge exceeds the 500 mg/L TDS definition of "fresh water" for the receiving stream. Salinity offsets would be based on the TDS mass exceeding a 1 ton per day discharge for the site. Using average TDS data for Outfall 002 and an effluent flow of 3.0 mgd a credit of 3.1 tons per day is needed to meet the 1 ton per day TDS criterion.

Expected Pollutant Removal

Table 7 presents the pollutant removal estimates. Salinity offset credits will not change the effluent quality discharged by the Lila Canyon Mine, but will reduce the salt discharge within the Price River basin. The proposed salinity offset is 38 tons per day, or 13,780 tons per year.

Cost Analysis

Table 8 presents the costs for the salinity credit alternative. Based on prior discussions with DWQ staff, it is assumed that the cost of salinity offset credits is $50/ton. The salinity offset credit must be purchased for a five year UPDES permit duration at the beginning of the permit term. The cost of 38 tons per day salinity credit is $689,022 per year or $3,445,100 for 5 years

Alternative 5

Total Containment

Total containment can be provided using a system consisting of pretreatment media filtration, reverse osmosis (RO), and an evaporative crystallization. This process is a zero liquid discharge (ZLD) system; water from the filtration and RO unit is recovered for reuse or discharged, and the waste stream from the RO unit is crystalized and dried leaving salt. Salt cake is disposed of in an offsite landfill. The following processes are included in the ZLD system:

- Influent pumps
- Granular media pressure filters
- Reverse osmosis system
- Chemical feed systems
- Membrane clean-in-place systems
- Mechanical recompression brine crystallizer
- Salt cake filter press
- Brine equalization tank

Expected Pollutant Removal

Table 9 presents the pollutant removal estimates provided by a ZLD system. While a ZLD system provides the highest level of treatment and eliminates the liquid discharge from the facility, it is a very complex treatment system and has significantly higher capital and operating costs than other treatment options. These ZLD processes are reliable and have been used at other mines and electric generating facilities to manage high TDS streams. Also, a significant amount of power for operation and steam for start-up is required for these systems. ZLD systems are generally limited to use at sites where significant environmental issues exist and when surface water bodies would be critically adversely affected by the effluent discharge.

Cost Analysis

Table 10 presents the cost estimate for the pollutant control cost for a ZLD system sized for a 3.0 MGD discharge. The estimated total installed cost for a ZLD system is $128,812,500.

Preferred Treatment Alternative

Table 11 presents a comparison of the costs of the various total costs of the different alternatives. Based on the comparison of the four treatment alternatives for Outfall 002 against the Base Alternative, in-mine sumps, the cost of the treatment option for Alternative C, salinity offsets, had the lowest total cost. The cost of all alternatives were greater than the 20% threshold established by Utah regulation. Given that the other alternatives were greater than the Base Alternative it is recommended that the Base Alternative be continued. If an alternative is required, then the most cost-effective alternative, Alternative C (salinity offsets) should be considered as a treatment alternative for Outfall 002 at the Lila Canyon Mine.

Table 1
Estimated Pollutant Removal Baseline Alternative
Lila Canyon Mine Average discharge: 3.0 MGD

Parameter	Influent (mg/l)	Influent (lb/d)	Effluent (mg/l)	Effluent (lb/d)	Removal (lb/yr)	Removal (%)	TWF	Anticiated Removal (lb-eq/yr)
TDS	3016	75509.22	3016	75509.22	-	0%	0	0.0
Ammonia	2.3	57.58	0.2	5.01	19,190.3	91%	0.0025	48.0
Iron	3.43	85.87	0.33	8.26	28,328.5	90%	0.0056	158.6
Boron	1.12	28.04	1.12	28.04	-	0%	0.18	0.0
								206.6

Mass loads are based on average discharge value
Toxic weghting factors for UDWQ_ADR_Spreadsheet_Tools_V1.0

Table 2
Cost Analysis Baseline Alternative
Lila Canyon Mine

Item	Quantity (Value)	Quantity (Units)	Cost (Value)	Cost (Units)	Cost
Pumping System	500000	LS	1.00	$/hr	$ 500,000
Labor	730	hr/yr	50.00	$/hr	$ 36,500
Electricity	56	kW	436.67	$/hr	$ 24,454
Maintenance	25	% Cost	1.00	$/hr	$ 125,000
Cap & O&M Cost					$ 685,954

Table 3

Estimated Pollutant Removal Alternative A

Lila Canyon Mine Average discharge: 3.0 MGD

Parameter	Influent (mg/l)	Influent (lb/d)	Effluent (mg/l)	Effluent (lb/d)	Removal (lb/yr)	Removal (%)	TWF	Anticiated Removal (lb-eq/yr)
TDS	3016	75509.22	3016	75509.22	-	0%	0	0.0
Ammonia	2.3	57.58	0.05	1.25	20,561.0	98%	0.0025	51.4
Iron	3.43	85.87	0.05	1.25	30,887.2	99%	0.0056	173.0
Boron	1.12	28.04	1.12	28.04	-	0%	0.18	0.0
								224.4

Mass loads are based on average discharge value

Toxic weghting factors for UDWQ_ADR_Spreadsheet_Tools_V1.0

Table 4

Cost Analysis Alternative A

Lila Canyon Mine

Item	Quantity (Value)	Quantity (Units)	Cost (Value)	Cost (Units)	Cost
Filtration System	15,037,500	LS	1.00	$/hr	$ 15,037,500
Labor	730	hr/yr	50.00	$/hr	$ 36,500
Lab Analyses	12	Samples	216.67	$/hr	$ 2,600
Electricity	56	kW	436.67	$/hr	$ 24,454
Maintenance	3	% Cost	1.00	$/hr	$ 451,125
Cap & O&M Cost					$ 15,552,179

Table 5
Estimated Pollutant Removal Alternative B
Lila Canyon Mine Average discharge: 3.0 MGD

Parameter	Influent		Effluent		Removal		TWF	Anticiated Removal
	(mg/l)	(lb/d)	(mg/l)	(lb/d)	(lb/yr)	(%)		(lb-eq/yr)
TDS	3016	75509.22	3016.00	75509.22	-	0%	0	0.0
Ammonia	2.3	57.58	0.05	1.25	20,561.0	98%	0.0025	51.4
Iron	3.43	85.87	0.05	1.25	30,887.2	99%	0.0056	173.0
Boron	1.12	28.04	0.5	12.52	5,665.7	55%	0.18	1019.8
								1244.2

Mass loads are based on average discharge value
Toxic weghting factors for UDWQ_ADR_Spreadsheet_Tools_V1.0

Table 6
Cost Analysis Alternative B
Lila Canyon Mine

Item	Quantity		Cost		Cost
	(Value)	(Units)	(Value)	(Units)	
Filtration/Adsorption	29,212,500	LS	1.00	$/hr	$ 29,212,500
Labor	730	hr/yr	50.00	$/hr	$ 36,500
Lab Analyses	12	Samples	216.67	$/hr	$ 2,600
Electricity	56	kW	436.67	$/hr	$ 24,454
Replace Media	62.53	tons	10,000.00	$/ton	$ 625,300
Spent Media disposal	117.25	tons	100.00	$/ton	$ 11,725
Maintenance	3	% Cost	1.00	$/hr	$ 876,375
Cap & O&M Cost					$ 30,789,454

Table 7
Estimated Pollutant Removal   Alternative C
Lila Canyon Mine   Average discharge: 3.0 MGD

Parameter	Influent (mg/l)	Influent (lb/d)	Effluent (mg/l)	Effluent (lb/d)	Removal (lb/yr)	Removal (%)	TWF	Anticiated Removal (lb-eq/yr)
TDS	3016	75,509.22	3016.00	75,509.22	-	0%	0	0.0
Ammonia	2.3	57.58	0.2	5.01	19,190.3	91%	0.0025	48.0
Iron	3.43	85.87	0.33	8.26	28,328.5	90%	0.0056	158.6
Boron	1.12	28.04	1.12	28.04	-	0%	0.18	0.0
								206.6

Mass loads are based on average discharge value
Toxic weghting factors for UDWQ_ADR_Spreadsheet_Tools_V1.0

Table 8
Cost Analysis   Alternative C
Lila Canyon Mine

Item	Quantity (Value)	Quantity (Units)	Cost (Value)	Cost (Units)	Cost
Salt Loading	38	ton/day	365.00	day/yr	13,780
Salinity Credit	13,780	ton/yr	50.00	$/ton	$ 689,022
Pumping System	500,000	LS	1.00	$/hr	$ 500,000
Electricity	56	kW	436.67	$/hr	$ 24,454
Labor	730	hr/yr	50.00	$/hr	$ 36,500
Maintenance	25	% Cost	1.00	$/hr	$ 125,000
Cap & O&M Cost					$ 1,388,756

Table 9
Estimated Pollutant Removal Alternative D
Lila Canyon Mine Average discharge: 3.0 MGD

	Influent		Effluent		Removal		TWF	Anticiated Removal
Parameter	(mg/l)	(lb/d)	(mg/l)	(lb/d)	(lb/yr)	(%)		(lb-eq/yr)
TDS	3016	75509.22	25	625.91	27,332,411.2	99%	0	0.0
Ammonia	2.3	57.58	0	0.00	21,017.9	100%	0.0025	52.5
Iron	3.43	85.87	0	0.00	31,344.1	100%	0.0056	175.5
Boron	1.12	28.04	0	0.00	10,234.8	100%	0.18	1842.3
								2070.3

Mass loads are based on average discharge value
Toxic weghting factors for UDWQ_ADR_Spreadsheet_Tools_V1.0

Table 10
Cost Analysis Alternative D
Lila Canyon Mine

	Quantity		Cost		Cost
Item	(Value)	(Units)	(Value)	(Units)	
Filtration/Adsorption	128,812,500	LS	1.00	$/hr	$ 128,812,500
Labor	8760	hr/yr	50.00	$/hr	$ 438,000
Lab Analyses	120	Samples	216.67	$/hr	$ 26,000
Electricity	3280	kW	436.67	$/hr	$ 1,432,278
Membrane Replace	5	yr	44,000.00	$/yr	$ 220,000
Chemicals	12	Mo	17,340.00	$/ton	$ 208,080
Solids Disposal	2740	tons	75.00	$/ton	$ 205,500
Maintenance	3	% Cost	1.00	$/hr	$ 3,864,375
Cap & O&M Cost					$ 135,206,733

Table 11
Alternative Cost Comparison
Lila Canyon Mine

Alternative	Total Cost	Total Cost Increase	Pollutant Removal (lb-eq/yr)	Unit Cost ($/lb-eq/yr)	Unit Cost Increase
A	$15,552,179	2167%	224	$69,315	1987.8%
B	$30,789,454	4389%	1244	$24,746	645.4%
C	$1,388,756	102%	207	$6,721	102.5%
D	$135,206,733	19611%	2070	$65,307	1867.1%
Baseline	$685,954		207	$3,320	