

Level II Antidegradation Review

Great Salt Lake Phase 1 Lithium Extraction Project

In support of UPDES Permit and Great Salt Lake Mineral Extraction Facility Operator Certification

Waterleaf Phase 1 LLC

Box Elder County, Utah

~~July 23, 2026~~ September 22, 2026



Contents

1	Background	1
1.1	Purpose	2
1.2	Contents of Submittal	2
2	Proposed Project.....	3
2.1	Project Description	5
2.2	Influent and Discharge Characteristics	8
2.2.1	Flow-weighted, Optimal Period Analysis.....	10
2.2.2	Facility Mass Balance Analysis	11
2.2.3	External Influences on Commercial Plant Concentrations	13
2.3	Facility Scale-up and Changes from the Demonstration Plant	13
2.3.1	Upsizing of the Manganese Treatment System	13
2.3.2	Replacement of the Carbon Steel Tanks	14
2.3.3	Upsizing of the Groundwater RO Treatment Process.....	14
2.3.4	Recycling and Recirculation	15
2.3.5	Other Changes	15
3	Standards for Receiving Waters.....	16
3.1	Beneficial Uses.....	16
3.2	Water Quality Standards	16
3.3	Impaired Waters	17
3.4	Antidegradation Category of Receiving Water	17
4	Social, Environmental, and Economic Importance	17
4.1	Social, Economic, and Environmental Benefits	18
4.2	Social, Economic, and Environmental Losses	19
4.3	Supporting Information from Affected Communities on Preserving Assimilative Capacity.....	20
4.4	Structures or Equipment That Would Be Placed in or adjacent to the Receiving Water	20
5	Parameters of Concern	21
5.1	Potential Parameters of Concern – Water Quality Parameters	21
5.2	Ranking and Weighting of Parameters of Concern.....	22
6	Alternatives Analysis	22
6.1	Alternatives to the Proposed DLE Process	23
6.2	Alternatives to Proposed Manganese Treatment Process.....	24
7	Additional Alternative Analysis	25
8	Optional Public Notice	25
9	Optional Information	25
10	Summary and Conclusion	26
11	References	27

Tables

Table 1. Commercial Plant Influent and Discharge Characteristics.....	9
Table 2. Beneficial-use Classes for Gunnison Bay.....	16

Figures

Figure 1. GSL and the Proposed Project Site.....	4
Figure 2. Commercial Plant Facility Plan	5
Figure 3. Commercial Plant Process Schematic.....	6

Appendices

- A Final Monitoring Report, Waterleaf Resources Demonstration Project
- B Waterleaf Phase 1 Groundwater Well Quality Memorandum
- C Microbialite Survey

Abbreviations

303(d)	Section 303(d) of the Clean Water Act
ADR	Antidegradation Review
af/yr	acre-feet per year
DLE	direct lithium extraction
FFSL	Utah Division of Forestry, Fire and State Lands
gpm	gallons per minute
GSL	Great Salt Lake
IX	ion exchange
IXM	ion exchange media
mgd	million gallons per day
MMF	multimedia filter
MSL	mean sea level
NGVD 1929	National Geodetic Vertical Datum of 1929
No.	number
POC	parameter of concern
RO	reverse osmosis
TDS	total dissolved solids
UAC	Utah Administrative Code
UDWQ	Utah Division of Water Quality
UPDES	Utah Pollutant Discharge Elimination System
Waterleaf Resources	Waterleaf Phase 1 LLC
WSE	water surface elevation

1 Background

Waterleaf Phase 1 LLC (Waterleaf Resources) is proposing to extract lithium from the Great Salt Lake (GSL) by constructing and operating the Phase 1 Lithium Project (Commercial Plant). The Commercial Plant is a processing facility that will extract lithium using a proprietary ion-exchange (IX) direct lithium extraction (DLE) process. This proprietary IX technology is a nonconsumptive, nonevaporative process. This means that all GSL brine withdrawn will be discharged back into the GSL, and the open waters of the lake will not be depleted.

In September 2023, Waterleaf Resources submitted a Clean Water Act Section 402 Utah Pollutant Discharge Elimination System (UPDES) application (Waterleaf Resources 2023) to the Utah Division of Water Quality (UDWQ) for authorization to discharge effluent from the Demonstration Plant. In addition, the GSL Mineral Extraction Facility Operator Application was submitted to authorize operation of the Demonstration Plant by rule (Waterleaf Resources 2024). The UPDES permit was issued for the Demonstration Project on February 4, 2025 (UPDES Minor Industrial Permit No. UT0026280), which included the GSL Mineral Extraction Facility Operator Certification Approval by Rule.

Waterleaf Resources operated the Demonstration Plant for 28 weeks in 2025 to validate the IX DLE technology. In accordance with the UPDES permit and the GSL Mineral Extraction Facility Operator Application Approval by Rule, weekly influent and discharge flows were sampled, analyzed, and reported. In addition to compliance monitoring, Waterleaf Resources conducted a Demonstration Plant Biota Study (Baxter 2025) to examine the presence and abundance of North Arm biota (archaea, algae, bacteria, and fungi) in the influent and discharge flows. The data and information gathered during operation of the Demonstration Plant provide scientific evidence to support Commercial Plant discharge and operation permitting applications. Chemistry and biota monitoring are summarized in the *Waterleaf Resources GSL Demonstration Plant Final Monitoring Report* (see Appendix A).

This [September 2026](#) revised Level II Antidegradation Review (ADR) is submitted to provide additional [data information requested](#); the ~~initial~~ Commercial Plant ADR was submitted in October 2025 and revised in April [and July](#) 2026. This ADR is submitted to support a Commercial Plant UPDES Permit; an application modification was submitted in October 2025. The application was determined to be complete in November 2025. In addition to the UPDES Permit application, a GSL Mineral Extraction Facility Operator Certification Application (Operator Certification) for the Commercial Plant was submitted to UDWQ on November 3, 2025, and revised to provide requested information in February and April 2026. UDWQ determined the application to be complete in May 2026.

1.1 Purpose

Waterleaf Resources is submitting this revised Level II ADR to provide additional information ~~requested to support the Section 402 UPDES Permit and Operator Certification applications.~~

ADRs are required as part of the discharge permitting process for any action that has the potential to degrade water quality. The Level I ADR is completed as part of the UPDES application modification and requires a Level II analysis to document that the proposed operation of the Commercial Plant will maintain the recreation and wildlife beneficial uses of Gunnison Bay of the GSL and is consistent with the State of Utah's antidegradation policies.

What are beneficial uses?

Lakes, rivers, and other water bodies have uses to humans and other life. These uses are called beneficial uses.

1.2 Contents of Submittal

Waterleaf Resources has prepared this Level II ADR resubmittal to be consistent with the UPDES application for the Commercial Plant to demonstrate consistency with the State of Utah's antidegradation policy. The following topics are discussed in this submittal:

- Proposed project
- Standards for receiving waters
- Social, environmental, and economic importance
- Parameters of concern
- Alternatives analysis
- Public notice
- Certification

This submittal contains the following additional information:

- The data and information gathered during operation of the Demonstration Plant provide scientific evidence to support Commercial Plant discharge and operation permitting applications. Chemistry and biota monitoring data are detailed in the *Final Monitoring Report* (see Appendix A).
- Groundwater will be treated to remove salts and added to the IX process. The results of groundwater water quality testing are provided in Appendix B.
- The results of a microbialite survey for the lakebed where project infrastructure is located are provided in Appendix C.

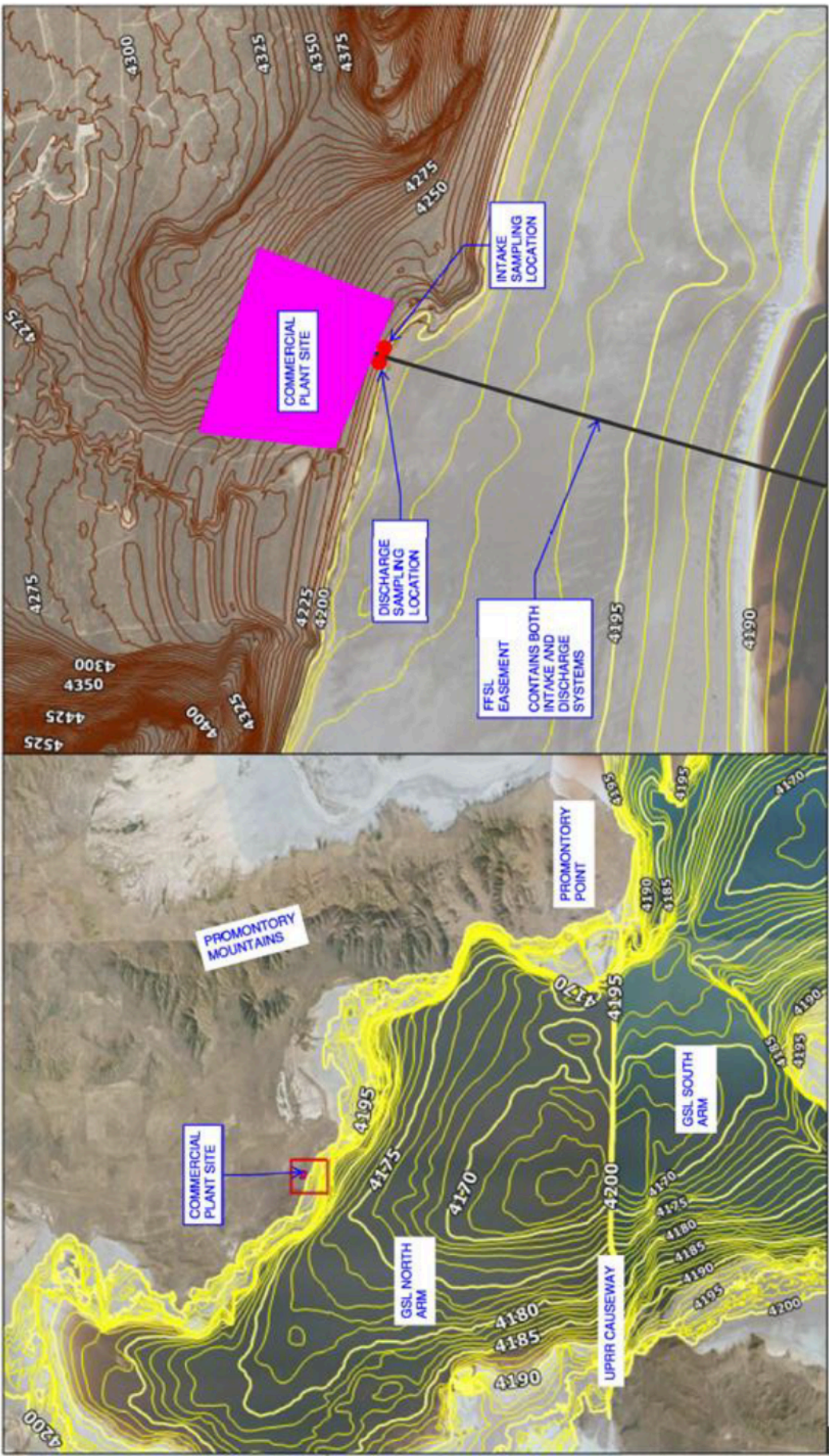
2 Proposed Project

Waterleaf Phase 1 LLC (Waterleaf Resources) is proposing to extract lithium from the North Arm brine waters of the Great Salt Lake (GSL) by constructing and operating the Phase 1 Lithium Extraction Project (Commercial Plant), which uses a proprietary ion-exchange (IX) direct lithium extraction (DLE) process to produce lithium carbonate for commercial sale. This proprietary technology is a nonconsumptive and nonevaporative process. The GSL brine that is withdrawn will be discharged back into the GSL with no brine depletion.

The Commercial Plant will be located adjacent to Gunnison Bay (North Arm) of the GSL on the western slopes of the Promontory Mountains in Box Elder County, Utah (Figure 1). The Commercial Plant IX process was validated by the operation of the Demonstration Plant from February through August 2025. No changes in the Commercial Plant's proprietary DLE IX process have been made due to the results of the chemical and biota testing during the Demonstration Plant's operation (see Appendix A). Ancillary facilities and systems will be added to the Commercial Plant due to higher process flow (scale-up) and the preparation of the final commercial product, lithium carbonate.

Commercial Plant process steps, influent and discharge characteristics, and facility scale-up information is provided below.

Figure 1. GSL and the Proposed Project Site



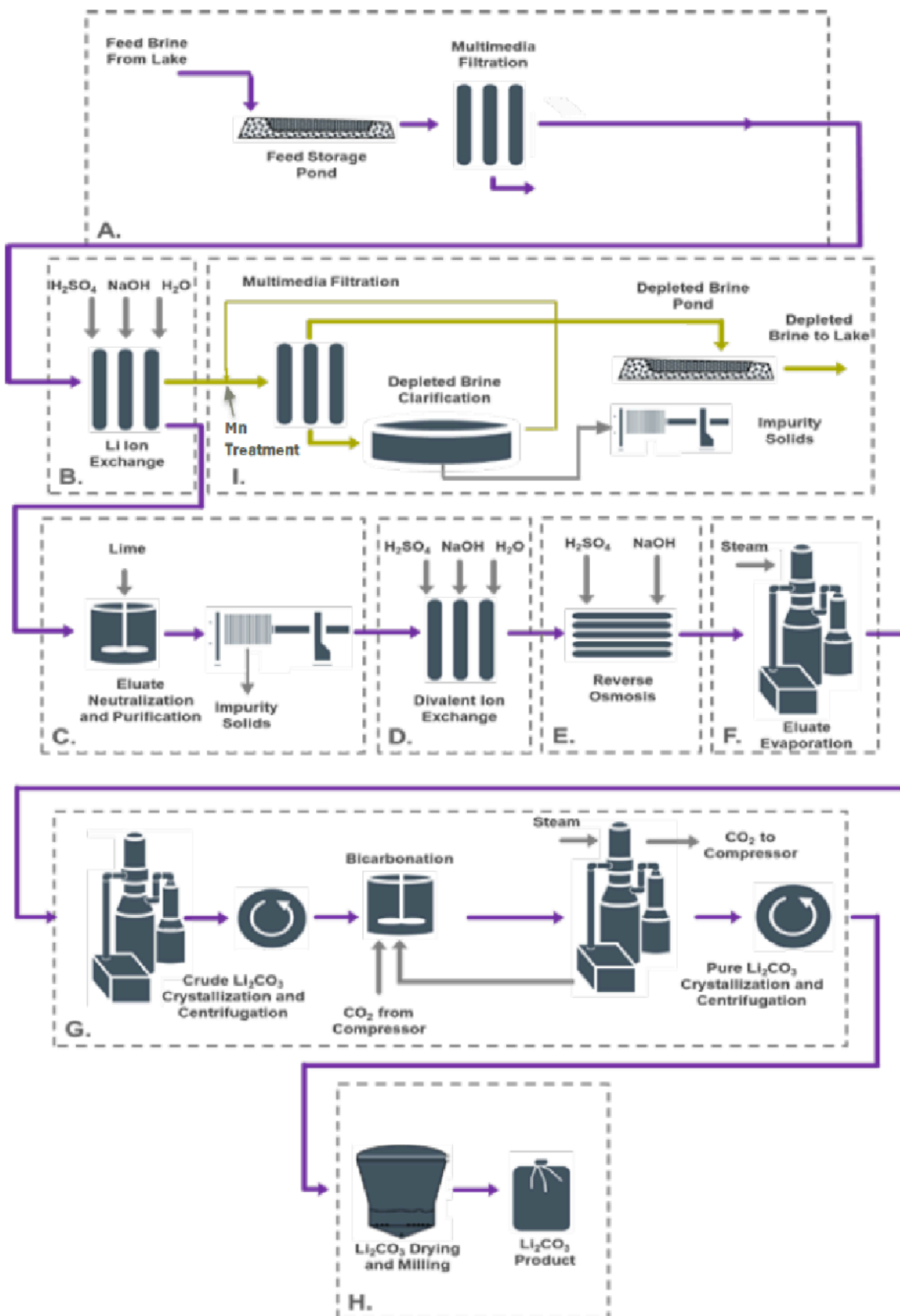
2.1 Project Description

The Commercial Plant will have an annual production capacity of up to 5,000 tons per annum of lithium carbonate, the final saleable lithium product. To meet this production goal, a maximum design flow of about 11,300 gallons per minute (gpm) or 16.27 million gallons per day (mgd) of brine will be withdrawn from Gunnison Bay. In addition, a maximum groundwater flow of about 124 gpm will be withdrawn and added to the process operation and subsequently discharged to Gunnison Bay with the lithium-depleted brine. In total, Waterleaf Resources assumes a designed discharge rate of 16.49 mgd. The UPDES modification will permit a maximum discharge rate of 20 mgd. The Commercial Plant will be designed to operate 24 hours a day, 7 days a week, and 52 weeks a year for 20 years. A facility plan and schematic of the process design are provided in Figure 2 and Figure 3.

Figure 2. Commercial Plant Facility Plan



Figure 3. Commercial Plant Process Schematic



The Commercial Plant's footprint will be about 5 acres and will consist of the following general process steps and infrastructure:

- **Intake.** GSL North Arm brine will be pumped from the GSL to a lined influent (feed) brine surge pond. The intake pipeline will extend from the Commercial Plant to the GSL meander line and then be located on the lakebed to a lakebed elevation of about 4,185 feet mean sea level (MSL) (NGVD 1929) within the Utah Division of Forestry, Fire and State Lands (FFSL) easement. The intake system will be driven by a skid-mounted suction pump station, which will have a design flow rate of 11,300 gpm and will be located near the open water shoreline. Influent flow and water quality monitoring will occur prior to the influent brine surge pond.
- **Filtration.** Influent brine will be piped from the feed brine surge pond and filtered through a multimedia filter (MMF) to remove suspended solids.
- **Ion Exchange.** After filtration, the brine will be sent to the IX DLE equipment, where lithium will be selectively exchanged with a hydrogen ion in the IX media (IXM), resulting in lithium-depleted brine. Groundwater (externally sourced groundwater treated by reverse osmosis [RO]) will be used as a washing agent in the extraction process. The IXM will be regenerated, producing eluate (lithium-rich water), which will be further purified and concentrated to produce lithium carbonate, the final commercial product. The eluate flow will not be discharged to the North Arm of the GSL.
- **Filtration.** The depleted brine will be treated to reduce manganese levels to be comparable to North Arm background levels, and pH will be adjusted prior to filtration. The depleted brine, including the groundwater, RO concentrate, and recirculated wash water, will be conveyed to the MMF and then into a depleted brine pond. Residual solids will be managed and disposed of off site. Depleted brine will be pumped from the depleted brine pond to the outfall infrastructure.
- **Discharge.** The outfall pipeline will extend from the Commercial Plant to the North Arm open water to the GSL lakebed to an elevation of about 4,190 feet MSL within the FFSL easement. Waterleaf Resources anticipates a design discharge rate of 11,450 gpm (when accounting for depleted brine plus the addition of groundwater). Discharge flow and water quality monitoring will occur at the outfall pipeline.

2.2 Influent and Discharge Characteristics

The Commercial Plant will intake brine from and discharge effluent to Gunnison Bay (North Arm) of the GSL. Gunnison Bay is classified as 5B waters of the state and is protected for beneficial uses of infrequent primary and secondary contact recreation, waterfowl, shore birds, and other water-oriented wildlife including their necessary food chain (Utah Administrative Code [UAC] R317-2-6.5). No numeric water quality standards have been developed for Gunnison Bay; state narrative standards apply.

The North Arm (Gunnison Bay) is a hypersaline bay of the GSL, with salinity over 25% (as compared to the other bays of the GSL with salinity ranges of 5% to 15%) (FFSL 2013). Inflows to the North Arm are currently being managed by FFSL through modifications of the GSL management berm to meet overall GSL management objectives. Due to management actions and the naturally occurring variation in the hydrologic cycles, the physical, chemical, and biological characteristics of the North Arm fluctuate. The Commercial Plant will withdraw North Arm brine over seasonal, annual, and decadal variations, resulting in comparable variations in the discharges back to the North Arm.

This section describes the average influent and discharge chemical characteristics of the anticipated constituents based on results compiled during the operation of the Demonstration Plant and from Waterleaf Resources mass balance analyses using Commercial Plant design targets.

Waterleaf Resources anticipates that the chemical characteristics of the Commercial Plant's influent and discharge will be comparable to the concentrations listed in Table 1. The basis for the concentrations shown in Table 1 is dual: (1) the flow-weighted average concentrations during the Demonstration Plant's optimal period of operation and (2) anticipated average discharge concentrations based on facility mass balance analysis.

Influent and discharge concentrations, shown in Table 1, are based on the flow-weighted optimal period analysis of the Demonstration Plant for most constituents [designated with footnote (a)]. For a limited subset of constituents, concentrations, shown in Table 1, are based on anticipated concentrations from the commercial facility mass balance analysis [designated with footnote (b)].

Table 1. Commercial Plant Influent and Discharge Characteristics

Constituent	Influent		Discharge	
	Average Concentration ^a (mg/L)	Min/Max	Average Concentration ^a (mg/L)	Min/Max
Alkalinity	572.6	526.0/599.0	294.6	119.0/492.0
Aluminum	1.65	ND (<1.20)/5.20	1.49	1.60/5.10
Arsenic	0.51	0.36/0.61	0.36	0.26/0.48
Barium	0.20	0.14/0.34	0.18	0.13/0.29
Bicarbonate	572.6	526.0/599.0	294.6	119.0/492.0
BOD	5.13	ND (<2.0)/12.0	7.42	ND (<2.0)/13.0
Boron	61.97	56.9/64.1	59.50	55.6/60.2
Bromide	177.9	140.0/201.0	166.2	139.0/186.0
Cadmium	ND (<0.0012)	NA	ND (<0.0012)	NA
Calcium	308.64	277.0/327.0	300.2 ^b	NA
Carbonate	ND (<0.2)	NA	ND (<0.2)	NA
COD	1,516.89	ND (<617)/2,800	1,096.63	ND (<617)/2,800
Chloride	183,942 ^b	NA	182,006 ^b	NA
Chromium	0.10	ND (<0.1)/0.25	0.10 ^b	NA
Copper	0.035	ND (<0.02)/0.080	0.035 ^b	0.030/0.060
Cyanide	ND (<0.022)	NA	ND (<0.022)	NA
Hardness	60,996.14	55,900/64,900	58,874.2	54,700/59,900
Hydroxide	ND (<0.2)	NA	ND (<0.2)	NA
Iron	ND (<0.57)	NA	0.567 ^b	NA
Lead	ND (<0.0087)	NA	ND (<0.0087)	NA
Lithium	68.0	61.9/70.9	14.2 ^b	NA
Magnesium	14,633	13,400/15,600	14,462 ^b	NA
Manganese	0.036	0.030/0.040	0.036 ^b	NA
Mercury	39.35 ng/L	21.8/211.0 ng/L	30.48 ng/L	24.9/51.0 ng/L
Molybdenum	0.14	0.11/0.22	0.13	0.050/0.31
Nickel	0.035	ND (<0.01)/0.110	0.035 ^b	NA
Nitrate	ND (<6.64)	NA	ND (<6.64)	NA
Nitrite	ND (<0.01)	NA	ND (<0.01)	NA
Oil and grease	ND (<5.0)	NA	ND (<5.0)	NA
Potassium	8,720.58	8,050/9,650	8,626 ^b	NA
Selenium	0.54	0.10/0.91	0.53	0.10/0.93
Silica	6.06	ND (<4.2)/7.70	7.01	ND (<4.2)/9.20

Table 1. Commercial Plant Influent and Discharge Characteristics

Constituent	Influent		Discharge	
	Average Concentration ^a (mg/L)	Min/Max	Average Concentration ^a (mg/L)	Min/Max
Silicon	2.69	ND (<2.0)/3.60	3.15	ND (<2.0)/4.30
Silver	ND (<0.008)	NA	ND (<0.008)	NA
Sodium	98,464.32	93,200/112,000	97,742 ^b	NA
Sulfate	26,975.6	24,300/28,100	27,202 ^b	NA
TDS	333,938.22 ^b	NA	330,782 ^b	NA
TSS	38.19	ND (<3.0)/395	35.3	6.00/175.0
Zinc	ND (<0.5)	NA	ND (<0.5)	NA

Definitions: BOD = biological oxygen demand; COD = chemical oxygen demand; kafd = thousand acre-feet per year; lb = pounds; MDL = minimum detection limit; mg/L = milligrams per liter; NA = not analyzed (influent and discharge concentrations are nondetect); ND = nondetect (not detected above MDL); TDS = total dissolved solids; TSS = total suspended solids

^a Average influent and discharge concentration based on flow-weighted concentrations during the Demonstration Plant's optimal period, weeks 16–28.

^b Anticipated average concentrations based on facility mass balance analysis.

These two analytical methods, used to determine Commercial Plant influent and discharge concentrations and annual mass loadings, are further described below.

2.2.1 Flow-weighted, Optimal Period Analysis

Commercial Plant influent and discharge concentrations, as shown above in Table 1, are derived from a flow-weighted, optimal period analysis of the Demonstration Plant data. Waterleaf Resources has determined that the Demonstration Plant's operation during weeks 16 through 28 is the period when the plant's activities (operation and production) were most consistent (Waterleaf Resources 2026, Section 10). Waterleaf Resources selected flow-weighted average concentrations during the optimal period of the Demonstration Plant's operation as the primary analytical basis for estimating Commercial Plant discharge concentrations (Table 1). This method most accurately represents the true mass of constituents discharged from the Demonstration Plant to the receiving waters over time under optimal operating conditions.

The following calculation was used to determine flow-weighted, optimal period concentrations:

$$C_{\text{flow-weighted}} = \frac{([C_{16} * V_{16}] + [C_{17} * V_{17}] + \dots + [C_{28} * V_{28}])}{V_{16} + V_{17} + \dots + V_{28}}$$

Where: C_n = Concentration of constituent from weekly monitoring
 V_n = Weekly brine volume

Waterleaf Resources determined that weeks 16 through 28 of the Demonstration Plant's operation represented the "optimal period," during which process optimization, testing

conditions, and equipment were the most consistent. Flow-weighted averaging, over the optimal period, captures the most consistent influent and discharge concentrations with the corresponding flow rate, thereby directly linking concentration data to actual mass loading (Waterleaf Resources 2026, Section 4.1.2).

For the Commercial Plant application, flow-weighted concentrations derived from the Demonstration Plant's optimized performance period were selected as the most representative dataset because they reflect stable operations under conditions most like anticipated commercial performance.

In summary, the use of flow-weighted averages, over the optimal period, provides a technically robust, transparent, and environmentally protective basis for estimating discharge concentrations and allows Waterleaf Resources and UDWQ to more effectively evaluate potential impacts.

2.2.2 Facility Mass Balance Analysis

For several constituents (chromium, copper, iron, lithium, manganese, nickel, and salt constituents), the Commercial Plant's concentrations will vary from the Demonstration Plant's flow-weighted average discharge concentrations during the optimal period due to process changes, equipment scale-up, and manganese treatment (Waterleaf Resources 2026, Section 8).

These constituents' average Commercial Plant concentrations, shown in Table 1 [designated by footnote (b)], are based on the Waterleaf Resources facility mass balance analysis, which consider all process interactions (Waterleaf Resources 2026, Section 4 and Appendix J).

The Commercial Plant will include several processes to optimize performance that were not practical to incorporate at the Demonstration Plant's scale. Due to these processes, the performance of most unit operations in the plant will affect all other unit operations. The commercial facility mass balance is the tool used to predict how each of these changes will affect each other and the expected discharge composition while still adhering to the setpoints and collected data from the Demonstration Plant.

Below are descriptions of the predicted Commercial Plant discharge concentrations and the basis for that concentration.

1. The Commercial Plant's average discharge concentrations for manganese will be lower than the Demonstration Plant's flow-weighted average discharge concentrations. The depleted brine will be treated to reduce manganese concentrations in the depleted brine after passing through the IX process and prior to filtration. As a result, the Commercial Plant's average discharge concentrations will be comparable to its influent concentrations. The discharge concentration for manganese was determined based on testing and facility mass balance analysis and is shown in Table 1.
2. Discharge metal concentrations (chromium, copper, iron, and nickel), associated with carbon steel corrosion, were reported during the Demonstration Plant's operation to spike due to the use of carbon steel surge tanks and filter media tanks. These carbon steel tanks and filter media tanks will be replaced with high-density polyethylene (HDPE)-lined ponds and concrete basins, respectively, for the Commercial Plant's

operation to accommodate higher process flows and higher capacity requirements. As a result of eliminating the carbon steel tanks, the Commercial Plant's average discharge concentrations of chromium, copper, iron, and nickel will decrease when compared to Demonstration Plant data. The discharge concentrations are based on commercial-scale testing and facility mass balance analysis and are shown in Table 1.

3. The Commercial Plant's average discharge concentrations of salt constituents (calcium, chloride, magnesium, potassium, sodium, and sulfate) and total dissolved solids (TDS) will vary from the Demonstration Plant's flow-weighted average discharge concentrations due to three factors: (1) the upsizing of the groundwater RO treatment system, (2) the addition of recycle and recirculation systems, and (3) treatment for manganese reduction. The concentrate from the RO system will be added to the depleted brine discharge flow, filtered, and then discharged to the North Arm (see Figure 1 above). The recycle and recirculation systems will also alter the discharge concentrations of salt constituents and TDS when compared to the Demonstration Plant data. The manganese treatment will occur prior to filtrations (see Figure 2 above) and will affect the discharge concentrations of salt constituents and TDS. Waterleaf Resources anticipates that these three processes will alter the Commercial Plant's discharge concentrations of salt constituents (calcium, chloride, magnesium, potassium, sodium, and sulfate) and TDS compared to the Demonstration Plant's optimal period flow-weighted average salt discharge concentrations. The discharge concentrations for these constituents are based on commercial facility mass balance analyses and are shown in Table 1.
4. The Commercial Plant's average discharge concentrations for lithium will be lower than the Demonstration Plant's flow-weighted average discharge concentrations due to facility scale-up and additional processes that will be added to the Commercial Plant. These process changes include recirculation and recycle systems that will result in lower average concentrations of lithium in the discharge. The Commercial Plant's average lithium discharge concentrations are based on commercial-scale testing and facility mass balance analyses and are shown in Table 1.

In summary, based on compliance monitoring during the Demonstration Plant's optimal period of operation and the anticipated Commercial Plant operation, Waterleaf Resources expects that the Commercial Plant's influent and discharge flow characteristics will be comparable to the average flow-weighted concentrations shown in Table 1 for most constituents. For a subset of constituents, flow chemical characteristics will be comparable to concentrations based on facility mass balance analysis, due to changes in ancillary systems and facilities as shown in Table 1.

2.2.3 External Influences on Commercial Plant Concentrations

Waterleaf Resources does acknowledge that there are outside independent influences which may affect the Commercial Plant's influent and discharge concentrations. These independent influences include the following:

- Influent characteristics will fluctuate as the North Arm water surface elevation (WSE), volume, and salinity vary in response to natural hydrologic conditions and state management actions. This variation of North Arm characteristics is expected seasonally and annually, and surface flow to the GSL and North Arm will fluctuate.
- Laboratory analysis of the North Arm brine will have the same challenges as were experienced during the Demonstration Plant's compliance monitoring analyses. Waterleaf Resources anticipates that the same error and uncertainty considerations will apply to compliance monitoring of the Commercial Plant's influent and discharge flows (see Appendix A).
- Error and uncertainty (lab interference) need to be considered when reviewing the data. The heavy brine requires that samples are diluted to be analyzed effectively by equipment that normally processes fresh water samples. The dilution rates for analyses ranged from undiluted (rate of 1) to 6, 20, and 50 up to a high of 100. Also, all samples were analyzed independently, so the influent and discharge samples for the same day might be diluted differently. Laboratory method accuracy is measured by percent recovery, and these percent recoveries vary for the different methods used for this project. For example, salts generally have a $\pm 20\%$ recovery, while metals have a $\pm 15\%$ recovery. The Utah Geological Survey has estimated that, for most GSL data, a minimum error of about 10% could be attributed to the challenges of processing the brine, based on conversations with the analytical laboratory (see Appendix A).

2.3 Facility Scale-up and Changes from the Demonstration Plant

As discussed above, the Commercial Plant's IX process is the same process that was validated by operation of the Demonstration Plant during 2025. Ancillary facilities and systems will be added to the Commercial Plant to support higher process flows and capacities to produce the final commercial product, lithium carbonate.

This section provides additional information about the upsizing of the manganese treatment system, replacement of carbon steel tanks with lined ponds, upsizing of the groundwater RO treatment process, recycling and recirculation, and other changes.

2.3.1 Upsizing of the Manganese Treatment System

Operation of the Demonstration Plant intermittently tested a manganese treatment process to reduce concentrations of manganese in the discharge. On further discussion with UDWQ, it was determined that manganese discharged to the North Arm should not exceed background concentrations. Waterleaf Resources conducted additional testing and data analyses to determine that manganese discharge concentrations could be further reduced, lower than Demonstration Plant discharge levels, so that discharge

concentrations from the Commercial Plant would be comparable to influent concentrations (background North Arm concentrations).

The Commercial Plant will include an upsized treatment process to reduce manganese in the depleted lithium brine to influent concentration (background) levels prior to filtration and discharge (see Figure 2) when compared to the Demonstration Plant's manganese treatment process. The manganese treatment process will precipitate soluble manganese by adding sodium hypochlorite prior to the MMF. The solids will be captured in the depleted brine waste solids and taken off site for disposal. Due to the use of sodium hypochlorite, residual chlorines and other potential disinfection byproducts may be generated and will be neutralized with sodium sulfite prior to conveying the depleted brine to the storage pond and discharging it to the North Arm. Continuous Residual chlorine and other disinfection byproduct monitoring will be conducted on the Commercial Plant's discharge, in accordance with UPDES requirements, to verify no negative impact to North Arm biota and chemistry.

The annual amount of chemicals anticipated to be used in the manganese treatment process are detailed in the facility mass balance analysis (Waterleaf Resources 2026, Appendix J).

Monitoring during the intermittent manganese treatment process operation indicated residual hypochlorite was nondetect in discharge flow due to complete reaction of the chlorine by sulfite addition. The same outcome from the Commercial Plant's process is anticipated because the oxidant dosing and sulfite treatment steps will follow the same reaction pathways.

2.3.2 Replacement of the Carbon Steel Tanks

The Commercial Plant will be constructed and operated to process higher annual volumes of North Arm brine than the Demonstration Plant (18,230 acre-feet per year [af/yr] vs. 3.35 af/yr, respectively), and the physical infrastructure elements and process facilities of the Commercial Plant will be scaled up accordingly. The Commercial Plant's facilities are discussed in Section 2.1.

The temporary carbon steel surge and mix tanks used during the Demonstration Plant's operation will be replaced with lined brine storage ponds and concrete basins. Therefore, Waterleaf Resources does not anticipate that the spikes of metal (chromium, copper, iron, and nickel) concentrations that were observed during the Demonstration Plant's operation will occur during operation of the Commercial Plant (see Appendix A). As a result, the anticipated discharge concentrations of chromium, copper, iron, and nickel from the Commercial Plant, as shown in Table 1, are different from the Demonstration Plant's flow-weighted average discharge concentrations and are determined based on the facility mass balance analysis (Waterleaf Resources 2026, Section 8).

2.3.3 Upsizing of the Groundwater RO Treatment Process

The Commercial Plant will include an upsized RO groundwater treatment system as compared to the Demonstration Plant's RO groundwater treatment system due to increased groundwater flows. The concentrate from the RO system will be added to the depleted brine discharge flow, filtered, and then discharged to the North Arm (see

Figure 2). In addition to the RO concentrate influence, discharge salt concentrations will be further influenced by the addition of recycling and recirculation systems and the manganese treatment process. These three process changes in the Commercial Plant's operations will vary the discharge of salt constituents (calcium, chloride, magnesium, potassium, sodium, and sulfate) and TDS compared to the Demonstration Plant's average salt discharge concentrations and TDS concentration (see Appendix A). The anticipated salt concentrations are calculated from the facility mass balance which accounts for all process interactions (Waterleaf Resources 2026, Section 4.1.2 and Appendix J).

2.3.4 Recycling and Recirculation

The Commercial Plant's lithium discharge concentration will decrease compared to the Demonstration Plant's flow-weighted concentration over the optimal period. Recirculation and recycling processes will be incorporated into the Commercial Plant, and these systems did not exist during operation of the Demonstration Plant. These systems will be piped to recycle flow to the influent (feed) brine system. Due to these systems, the Commercial Plant's anticipated lithium discharge concentration is 14.2 milligrams per liter (mg/L) (see Table 1), as calculated from the facility mass balance, which accounts for all process interactions (Waterleaf Resources 2026, Section 4.1.2 and Appendix J).

2.3.5 Other Changes

Other system changes anticipated due to sizing up supporting facilities and processes at the Commercial Plant include the following:

- Due to its temporary nature, the Demonstration Plant produced a liquid product that was transported for further processing off site. This processing resulted in about 4% total water loss during the plant's operation. The Commercial Plant will produce a solid lithium carbonate product, and this process will result in nonconsumptive use of brine water.
- Solids management will be required for the filtration systems. All solids generated will be managed and transported off site. In addition, salts may precipitate in the raw brine and depleted brine ponds; routine maintenance will remove the accumulated salts to maintain capacity. Salts removed will be managed and transported off site.
- The operation of the Demonstration Plant provided valuable data regarding the seasonal changes of the North Arm brine in relation to pH balancing. As a result, Waterleaf Resources has determined that continuously adjusting the pH of the influent brine may not be necessary, and pH will instead be adjusted as necessary based on influent characteristics.

These changes, as discussed above, will be made to the Commercial Plant to accommodate the higher volume of brine processed and product manufactured compared to the Demonstration Plant.

3 Standards for Receiving Waters

The Commercial Plant will discharge waters into Gunnison Bay of the GSL. The following beneficial use and water quality standards information is provided for the receiving waters.

3.1 Beneficial Uses

UDWQ has designated beneficial uses for the different named bays of the GSL. The Commercial Plant will be constructed and operated adjacent to Gunnison Bay (the North Arm of the GSL). Due to the location of the Commercial Plant and the nominal amount of North Arm flow to the South Arm of the GSL, the Commercial Plant will have *de minimis* impacts to Gilbert, Farmington, and Bear River Bays (located in the South Arm of the GSL). Therefore, Waterleaf Resources focused this analysis on the open waters of Gunnison Bay (Table 2).

Table 2. Beneficial-use Classes for Gunnison Bay

Class	Location	Beneficial Uses
5B	Gunnison Bay (the North Arm of the GSL excluding evaporation ponds)	Gunnison Bay is protected for infrequent primary and secondary contact recreation, waterfowl, shore birds, and other water-oriented wildlife, including their necessary food chain.
5E	Transitional waters along the shoreline of the GSL geographical boundary	Transitional waters along the shoreline of the GSL geographical boundary are protected for infrequent primary and secondary contact recreation, waterfowl, shore birds, and other water-oriented wildlife, including their necessary food chain.

Source: UAC R317-2, Standards of Water Quality for the State, as in effect September 22, 2025

3.2 Water Quality Standards

UDWQ applies numeric and narrative standards to waters of the state to protect designated beneficial uses. State water quality numeric standards refer to specific water quality criteria that are applied to each class of water to protect its beneficial uses. Gunnison Bay and transitional waters (Classes 5B and 5E) have no established numeric water quality standards (UAC R317-14, Numeric Criteria, as in effect September 22, 2025).

State water quality narrative standards apply to the GSL. Narrative standards prohibit the discharge of waste or other substances that result in unacceptable water quality conditions, such as visible pollution or undesirable aquatic life. If a water body does not meet numeric or narrative water quality standards, the beneficial uses of that water body are adversely affected.

3.3 Impaired Waters

In UDWQ's *2024 Integrated Report on Water Quality* (UDWQ 2024), which includes the list of impaired waters in the state, Gunnison Bay is listed as Category 3—having insufficient data to support a determination of impairment.

The list of impaired waters is referred to as the 303(d) list because the listing process follows the regulatory requirements of Section 303(d) of the Clean Water Act. Impaired waters are defined as those water bodies that do not meet their beneficial uses.

Typically, these waters exceed the specific numeric water quality standards associated with a specific class or beneficial use.

Gunnison Bay's water surface level has varied over the years. The water surface level has decadal, annual, and seasonal variations based on watershed hydrology and diversions, direct diversions from the GSL, and management of openings in the Union Pacific Railroad causeway that spans the GSL from Weber County to Box Elder County. This variation in water surface level results in corresponding changes in salinity, which also have decadal, annual, and seasonal variations. The State has not found any evidence of impairment of Gunnison Bay's beneficial use during past water surface level and salinity changes. The Commercial Plant will allow Gunnison Bay's water surface level to continue to vary and meet its beneficial uses because the plant will not deplete Gunnison Bay's brine or lower its WSE.

What is a Section 303(d) list?

When a lake, river, or stream fails to meet the water quality standards for its designated beneficial use, Section 303(d) of the Clean Water Act requires that the State place the water body on a list of "impaired" waters, which is also known as a Section 303(d) list.

3.4 Antidegradation Category of Receiving Water

UDWQ has a statewide antidegradation policy that protects water bodies from proposed project activities that could lower or degrade water quality. The policy requirements include reviews and analyses to protect the existing beneficial uses of the water bodies. The ADR provides a process to identify options if degrading a water's quality is necessary for social and economic development. To facilitate this policy, all waters in Utah are designated as Category 1, 2, or 3 waters. The GSL is considered a Category 3 water subject to ADRs (UAC R317-2-12, Category 1 and 2 Waters, as in effect September 22, 2025).

4 Social, Environmental, and Economic Importance

As provided in UDWQ's guidelines, this section provides details to facilitate UDWQ's concurrence that benefits associated with the Commercial Plant are socially and economically important. It describes the social, environmental, and economic benefits that will be realized by the proposed Commercial Plant to extract lithium from GSL brine using a nonevaporative and nonconsumptive proprietary DLE technology. This section also discusses the social, economic, and environmental losses associated with the Commercial Plant.

Section 4.1 discusses the social, economic, and environmental benefits associated with Commercial Plant, and Section 4.2 discusses the social, economic, and environmental losses. Section 4.3 discusses the supporting information from affected communities regarding preserving assimilative capacity, and Section 4.4 discusses the structures or equipment that will be placed in or adjacent to the receiving water.

4.1 Social, Economic, and Environmental Benefits

Social Benefits. Waterleaf Resources' Commercial Plant will maintain the recreational beneficial use of Gunnison Bay, a social benefit. This assertion is based on the technology being nonconsumptive, meaning that withdrawn brine will be discharged back into the GSL with no water depletion. The North Arm's WSE will not be lowered due to the Commercial Plant's operation. Commercial Plant discharge allows Gunnison Bay to maintain its naturally occurring variation in water surface levels and salinity. The State of Utah's legislative and executive offices increase management oversight for mineral leases, salinity, and water surface levels, and the Commercial Plant is consistent with measures to use innovative technologies to extract minerals while minimizing direct depletions of lake water. This goal, to minimize lake water depletion, is further supported by the continuous flow-monitoring data that were collected during operation of the Demonstration Plant, as discussed in the *Final Monitoring Report* (see Appendix A). Flow monitoring proved that the Demonstration Plant's influent volume was less than the discharge volume.

Economic Benefits. The Commercial Plant will operate DLE technology that can viably and economically extract lithium from GSL brine and produce battery-grade lithium products without depleting water from the GSL. Using a nonevaporative process will maintain beneficial uses and protect the GSL ecosystem. Waterleaf Resources plans to use the DLE technology to produce battery-grade lithium, which is a designated critical mineral necessary for economic and energy security.

The Commercial Plant is projected to provide substantial economic benefits to both the local community and the state of Utah. Excluding construction and auxiliary support positions, the plant will generate 61 new operational jobs with a median annual salary of \$86,110. Resulting increases in income and state sales tax revenues are expected to raise state tax receipts by about \$7.2 million per year. Additionally, commercial operations will enable Waterleaf Resources to establish a royalty agreement with FFSL for lithium extraction from the GSL, potentially contributing up to \$2 million in annual royalty payments to the State. Property tax revenues are also anticipated to increase significantly; Box Elder County currently collects about \$107 per year in property taxes on the parcel where the Commercial Plant will be located, and this assessment is estimated to rise to nearly \$2 million annually once the plant is completed and operational.

Environmental Benefits. The environmental benefits of the Commercial Plant include sustaining the North Arm's WSE, protecting the North Arm's beneficial uses, causing no impact to North Arm habitat, and maintaining the abundance and diversity of the biological community.

The Commercial Plant is consistent with state efforts to reverse historic declines in the GSL's volume by managing new mineral-extraction activities through encouraging using

innovative and nonconsuming technologies. The nondepletive DLE process that the Commercial Plant will implement will return all withdrawn brine to the GSL. Through use of this technology, North Arm WSE and volume will not be lowered.

The physical, biological, and chemical data obtained during operation of the Demonstration Plant provide evidence that the Demonstration Plant met UPDES permit requirements and therefore was protective of the North Arm's beneficial uses. Waterleaf Resources expects that the Commercial Plant will maintain these beneficial uses by meeting water quality standards similarly to the Demonstration Plant.

During the Demonstration Plant's operation, influent and discharge water samples were collected in three separate monitoring events and analyzed for the presence of biota (fungi, archaea, bacteria, and algae) by Dr. Bonnie Baxter of Westminster University (Baxter 2025). This biota study was designed to examine and characterize the microbial biomass and community in the influent and discharge of the Demonstration Plant during its operation. In addition, the study inoculated the discharge flows to examine whether biota would survive. In summary, the biota study found North Arm biological communities present and abundant in the influent and discharge flows of the Demonstration Plant. This scientific evidence supports Waterleaf Resources' assertion that the Demonstration Plant did not harm North Arm biota, which Waterleaf Resources anticipates will be the same for operation of the Commercial Plant. The biota study report is included in the *Final Monitoring Report* (see Appendix A).

The GSL area where the Commercial Plant infrastructure will be constructed and operated can be described as exposed GSL lakebed and North Arm hypersaline open waters. Mapping has identified the western, eastern, and southeastern shoreline areas in the North Arm that might contain microbialites (Wilcock and others 2021). Microbialite structures provide a food source for brine shrimp and brine flies (Baxter and Butler 2020). However, research has documented that, due to limited availability of nutrients, the North Arm microbialite structures have lower mass, productivity, and/or diversity compared to microbialites in the South Arm (Baxter and Butler 2020).

Waterleaf Resources conducted a microbialite survey of the lakebed intake and outfall construction area (FFSL easement area) to identify the existence of these important habitat structures in the project area. Microbialite structures were not found in the surveyed project area (see Appendix C).

Summary. The Commercial Plant will provide social, economic, and environmental benefits using innovative, nonconsumptive technology to withdraw GSL brine and discharge the same amount of brine back to the GSL. This technology also meets state policy objectives to protect the GSL's volume and to produce critical lithium products, which are a focus of national and global concerns.

4.2 Social, Economic, and Environmental Losses

Waterleaf Resources maintains that there will be no social, economic, or environmental losses from operation of the Commercial Plant. Operation of the Commercial Plant will use nondepletive proprietary extraction technology, recreational beneficial uses will be maintained, jobs and economic outputs will be realized, and North Arm habitat, biota, and water chemistry will be sustained.

The Commercial Plant will convey brine to the processing facilities and then discharge it back to the GSL. This nonevaporative process will not directly deplete GSL brine from Gunnison Bay; as a result, Gunnison Bay could respond to the annual variations in water surface level and in salinity based on hydrologic conditions and state management actions. The infrequent recreational and ecological uses of Gunnison Bay will continue to be provided within the range of water surface level fluctuation.

Beneficial uses will be maintained during the operation of the Commercial Plant, based on the physical, biological, and chemical monitoring and reporting conducted during the Demonstration Plant's operation. The protection of beneficial uses will not result in environmental losses.

The Commercial Plant will not interfere with nor affect the State's ability to manage Gunnison Bay's water surface level and salinity via the railway causeway management berm.

4.3 Supporting Information from Affected Communities on Preserving Assimilative Capacity

The Commercial Plant will discharge depleted brine into Gunnison Bay within the requirements of a UPDES permit and GSL Mineral Extraction Facility Operator Certification rules. Waterleaf Resources notes that operating the nonconsumptive Commercial Plant, withdrawing brine from the GSL, and returning the removed brine to the GSL will maintain existing water surface and chemistry conditions and preserve assimilative capacity.

4.4 Structures or Equipment That Would Be Placed in or adjacent to the Receiving Water

The Commercial Plant will include constructing intake and outfall infrastructure within the GSL boundaries (below the meander line). Waterleaf Resources has submitted a request for an easement from FFSL for constructing and operating the intake and outfall structures that lie on state lands, below the meander line. The FFSL easement is in the same location as the Demonstration Plant's easement. The intake and outfall pipelines are described in Section 2.

The Commercial Plant will be placed upland on leased private land adjacent to the GSL above the GSL meander line. The intake and outfall infrastructure and associated maintenance activities will allow navigation and open-water inundation consistent with the fluctuating water levels of Gunnison Bay.

5 Parameters of Concern

Parameters of concern (POCs) are normally defined as water quality pollutants that are present in the applicant's discharge at concentrations greater than ambient concentrations in the receiving water or that exceed water quality standards. As mentioned in Section 3.2, there are no numeric water quality standards for Gunnison Bay. Narrative standards apply to all water bodies in the state. Waterleaf Resources intends to operate the Commercial Plant and monitor both influent and discharge water quality to show that UPDES permit compliance and GSL Mineral Extraction Facility Operator Certification rule requirements are met.

5.1 Potential Parameters of Concern – Water Quality Parameters

The Commercial Plant will withdraw brine, extract lithium from the brine, and discharge the lithium-depleted brine back to Gunnison Bay of the GSL.

In accordance with Section 4.0 of the *Utah Antidegradation Review Implementation Guidance* document (UDWQ 2019), the following considerations are provided to determine the POCs associated with the Commercial Plant:

- The ~~Demonstration Plant's~~ UPDES permit will authorize discharge from the Commercial Plant. The GSL Mineral Extraction Facility Operator Certification will approve operation of the Commercial Plant. The UPDES permit and Operator Certification applications identify water quality constituents for influent and discharge monitoring, ~~specifically alkalinity, aluminum, arsenic, barium, bicarbonate, biological oxygen demand, boron, bromide, cadmium, calcium, carbonate, chemical oxygen demand, chloride, chromium, copper, cyanide, density, dissolved oxygen, flow, hardness, hydroxide, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, nitrate, nitrite, oil and grease, pH, potassium, selenium, silver, silica, silicon, sodium, sulfate, temperature, total dissolved solids, total suspended solids, and zinc.~~
- Manganese was identified in the Demonstration Plant's UPDES permit because manganese has potential to be discharged by the DLE process above background concentrations. Waterleaf Resources will treat and reduce manganese during the Commercial Plant's operation, as discussed in Section 2. The manganese treatment—addition of sodium hypochlorite to the depleted brine stream prior to filtration—will reduce manganese in the depleted brine discharge to a similar concentration as what is present in the influent brine (background). Residual chlorines and other disinfection byproducts will be neutralized with sodium sulfite prior to discharge into the depleted brine pond (see Figure 3). ~~Continuous~~ Residual chlorine and other disinfection byproducts monitoring will be conducted on the depleted brine discharge to verify no impact to North Arm chemistry and biota. This intermittent treatment process and testing for residual chlorine (not detected) was conducted during the Demonstration Plant's operation, and similar results are expected to be achieved during the Commercial Plant's operation (Waterleaf Resources 2026, Section 8). During Commercial Plant operations, manganese treatment will be conducted, using the process validated during the Demonstration

Plant operations. As a result of the manganese treatment process, manganese, residual chlorine and disinfection byproducts will be monitored and reported in accordance with the Commercial Plant UPDES permit conditions.

- Groundwater will be added to the IX process, as discussed in Section 2. Groundwater quality of the source has been analyzed and determined to contain no POCs (see Appendix B).
- Effluent from the Commercial Plant will not be discharged into a Class 1C drinking water source receiving water.
- There are no numeric standards or existing impairment determination for Gunnison Bay. There is no ongoing or approved total maximum daily load (TMDL) analysis for Gunnison Bay or the GSL.

In summary, Waterleaf Resources determined that the POCs for the Commercial Plant are manganese, residual chlorine and potential disinfection byproducts.

5.2 Ranking and Weighting of Parameters of Concern

Manganese, residual chlorine and potential disinfection byproducts are equally ranked, because the ~~two~~ constituents are ~~fundamental in~~ associated with the DLE and manganese treatment processes.

As mentioned above, ~~continuous intake and~~ discharge monitoring for manganese, residual chlorine and other disinfection byproducts will be conducted, as required by the UPDES permit, to verify no negative impact to North Arm biota and chemistry.

~~Manganese influent and discharge monitoring will be conducted weekly, as required by the UPDES permit.~~

Other constituents monitoring during the Commercial Plant's operation are not considered POCs because they are present in both the influent and discharge at similar concentrations.

6 Alternatives Analysis

A Level II ADR requires an analysis of whether there are feasible, less-degrading alternatives to a proposed project. The Commercial Plant will require ~~an amended a~~ UPDES permit to discharge water to the GSL from the proposed lithium extraction DLE Commercial Plant.

The Commercial Plant will use the innovative technology proven by the Demonstration Plant to withdraw brine from the GSL, extract lithium from the brine, and return all withdrawn brine back to the GSL. The Commercial Plant is designed with a specific proprietary IX DLE process. ~~no alternative to this IX process is analyzed.~~

Conventional discharge alternatives, such as pollutant trading, reuse, land application, and containment, are not appropriate or feasible. This revised Level II ADR clarifies and expands on the alternative analysis conducted related to other mineral extraction technologies and the manganese treatment process alternatives.

6.1 Alternatives to the Proposed DLE Process

Waterleaf previously conducted an alternative analysis to determine that DLE was the least degrading feasible alternative, as stated in the July ADR. The information below expands and clarifies the DLE alternative analysis that was conducted.

Alternative 1 Evaluation: Evaporation-based Lithium Recovery

Conventional brine evaporation technology is a proven alternative for concentrating and recovering lithium from source brines. Evaporation technology requires the consumptive use of North Arm brine source water, large evaporation ponds, extended processing times, substantial land disturbance, and the management of large quantities of precipitated salts and residual brine. Its performance also depends on weather and seasonal evaporation conditions.

Evaporation technology would consume a substantial portion of the North Arm source water rather than returning the lithium-depleted brine to the Great Salt Lake. That outcome would be inconsistent with Waterleaf's project objective of recovering lithium, a critical mineral, while protecting the beneficial uses and the water and salt balance of the Great Salt Lake's North Arm. This alternative was eliminated as it would degrade North Arm water volume (by reduction) and water and salt balance (by consumptive use of brine).

Alternative 2 Evaluation: Aluminum-based Adsorbent Technology:

These technologies generally consist of using lithium selective aluminum-based media to adsorb lithium from brine, followed by washing and elution to recover the lithium and regenerate the media.

Aluminum-based adsorption is a proven DLE process for brine sources with specific chemical characteristics. However, given the low lithium and high magnesium concentrations present in the GSL North Arm brine these technologies could not be directly applied and would require a concentration step (evaporation) and a magnesium reduction step prior to the extraction process. Additional fresh water is also required for these technologies therefore adding considerable strain on freshwater sources. By comparison, Aluminum-based media technologies do not provide equivalent or better overall performance under the specific chemical characteristics of North Arm brine and would lead to degradation of the beneficial uses of the North Arm brine through consumptive use of both the North Arm brine and freshwater sources. This alternative was eliminated as it is not the least degrading feasible alternative.

Waterleaf selected its proprietary DLE process for the proposed Commercial Plant because it is the least degrading feasible alternative that has been operated and evaluated using Great Salt Lake brine and has demonstrated selective lithium recovery under the high-salinity conditions applicable to the proposed project. The proposed process does not rely on evaporating the source brine and is designed to return lithium-depleted brine following extraction and treatment. Therefore, the proposed DLE process is the least degrading feasible lithium extraction alternative, protecting the beneficial uses

and maintaining water volume of the Great Salt Lake North Arm while extracting a critical mineral in a sustainable process.

6.2 Alternatives to Proposed Manganese Treatment Process

As described in the UPDES permit application and supporting documents, manganese is associated with Waterleaf's patented, proprietary, and business-confidential DLE process. The proposed DLE process enables the non-consumptive extraction of lithium, a critical mineral, from source waters. Below is a discussion on the alternatives evaluated to substitute manganese in the DLE process and various manganese treatment alternatives.

Manganese is a component of the proposed DLE process that was validated during the Demonstration Plant operation. Its increased presence in the depleted brine discharge flow was previously identified in Waterleaf's permit materials. Waterleaf's proposed Commercial Plant design includes treatment process to return manganese concentrations in the discharge to approximately the existing North Arm background concentration.

Waterleaf evaluated whether the manganese could be substituted or eliminated without compromising the demonstrated lithium-extraction process. No technically feasible substitute or process modification has been identified that would maintain the demonstrated lithium selectivity, recovery performance, media stability, and operating reliability of the selected process under the high salinity and high magnesium conditions of North Arm brine. Eliminating or materially reducing manganese would therefore require replacement or substantial redesign of the core DLE process rather than a practicable operating adjustment. Such an alternative has not been demonstrated to provide equivalent lithium recovery or a less degrading discharge under North Arm conditions. Therefore, manganese substitution or elimination is not a viable alternative and provides the least degrading DLE process.

As manganese cannot be substituted, Waterleaf then evaluated alternative treatment methods for reducing manganese concentrations in the depleted-brine discharges to the North Arm. The evaluation described below clarifies and expands the evaluation alternatives treatment processes investigated including; physical filtration, manganese-removal media, air oxidation, ozone, and sodium hypochlorite oxidation followed by sodium sulfite quenching.

Desk top and demonstration plant assessments of the alternative manganese treatment process options included:

- Physical filtration methods — Ultra filtration followed by filter press and multi-media filtration was tested during Demonstration Plant operations. These filtration methods were unsuccessful in reducing manganese concentrations because the dissolved manganese flowed through the filters and was not captured. This method was eliminated.
- Various manganese-based medias for catalytic oxidation with subsequent media filtration. Waterleaf evaluated Filox/Greensand/Oxidative media options for manganese treatment. These media were not considered viable due to the neutral pH of depleted

brine stream which would cause media dissolution and reduction ineffectiveness. Greensand technical advisors recommended adding trace sodium hypochlorite into the stream as a method to aid oxidation. Additional process steps would be required to recharge the media, using concentrated sodium hypochlorite and filtration. These alternative media are not as effective in higher saline brines like the GSL North Arm brine for the removal of manganese and were eliminated as not feasible.

• Alternate oxidants: air, ozone, sodium hypochlorite. Based on previous test work with other brine sources, air oxidation is only effective at elevated pH's (typically 9 and above), requiring additional pH adjustment process. This condition is not acceptable due to the UPDES permit limit on pH. The use of air oxidation creates excess waste solids which would require increased solids management and disposal processes. Air oxidation was eliminated for these reasons. Ozone was evaluated and dismissed as this process requires higher pressure systems, significantly more power and liquid oxygen transportation via trucks. These process requirements were considered unacceptable due to worker safety concerns and high level of mechanical complexity and considered not the least degrading feasible alternative.

Waterleaf selected the proposed manganese treatment process of controlled sodium hypochlorite oxidation, solids separation, and sulfite quenching because it provided the most reliable and controllable manganese removal under the depleted-brine conditions while allowing residual chlorine and potential disinfection byproducts to be neutralized before discharge to the North Arm. This proposed process is determined to be the least degrading feasible manganese treatment alternative.

7 Additional Alternative Analysis

No additional alternative analysis has been performed due to the unique and proprietary nature of the DLE process.

8 Optional Public Notice

Because the proposed project will go through a public comment period associated with the amended UPDES permit, Waterleaf Resources requests that the optional public review is not held.

9 Optional Information

The following information is provided to support the determination that the Commercial Plant will be consistent with antidegradation policy and will not impair or degrade water quality.

The Commercial Plant will operate consistent with state antidegradation policy and will protect the beneficial uses of the North Arm of the GSL. This assertion is supported by the water quality, flow, and biota monitoring that was conducted during the operation of the Demonstration Plant, and this monitoring validated the proprietary, nonconsumptive IX DLE technology. The Commercial Plant will operate in a similar manner as the

Demonstration Plant with the same processes and with comparable discharge flow characteristics.

The Demonstration Plant's monitoring included influent and discharge water chemistry, continuous flow, and biota presence and abundance. The results of these monitoring efforts are summarized in the *Final Monitoring Report* (see Appendix A).

10 Summary and Conclusion

This Level II ADR is submitted to demonstrate compliance with the State of Utah's antidegradation policy in fulfillment of information requests by UDWQ to support the modified UPDES permit application for the proposed GSL Phase 1 Lithium Extraction Project (Commercial Plant).

Waterleaf Resources anticipates that the Commercial Plant will operate similarly to the Demonstration Plant, with similar discharge characteristics as compared to influent characteristics. As shown in Table 1, influent and discharge concentrations are based on Demonstration Plant compliance monitoring results and Waterleaf Resources facility mass balance. The POCs are manganese, residual chlorine and potential disinfection byproducts~~residual chlorine~~, because they are fundamental in the DLE process and the reduction of manganese in the depleted brine flows. Monitoring of these constituents will be conducted to meet UPDES requirements.

The Demonstration Plant operated for 7 months, from February through August 2025; its discharges to the GSL were authorized by UPDES Permit No. UT0026280 and GSL Mineral Extraction Facility Operator Certification Approval by Rule. The compliance monitoring conducted during the operation of the Demonstration Plant included influent and discharge water quality and continuous flow. In addition, the Demonstration Plant's influent and discharge flows were sampled and tested to examine the presence and abundance of biota (archaea, algae, bacteria, and fungi). This monitoring provided quantitative data and scientific data that showed compliance with the UPDES permit and GSL Mineral Extraction Facility Operator Certification Approval by Rule. The *Final Monitoring Report* (see Appendix A) details compliance monitoring results and biota monitoring report.

Waterleaf Resources notes that influent characteristics (North Arm chemistry) will fluctuate over the operation of the Commercial Plant in response to varying WSEs due to hydrologic conditions and state management actions. Therefore, the discharge characteristics will fluctuate accordingly. The comparative analysis (discharge concentrations to influent concentrations) will provide data to support compliance with permit and certification requirements and consistent with antidegradation policy. For these reasons, operating the Commercial Plant using the proprietary nonconsumptive technology that was validated by operation of the Demonstration Plant is consistent with the State's antidegradation policy and will not exceed the GSL's water quality standards nor impair the GSL's beneficial uses.

11 References

Baxter, Bonnie

2025 Demonstration Plant Biota Study. July 28.

Baxter, Bonnie, and Jaimi Butler, eds.

2020 Great Salt Lake Biology. Switzerland: Springer Nature.

[FFSL] Utah Division of Forestry, Fire and State Lands

2013 Final Great Salt Lake Comprehensive Management Plan and Record of Decision. March.

[UDWQ] Utah Division of Water Quality

2019 Utah Antidegradation Review Implementation Guidance. Version 2.1. January 29.

2024 2024 Integrated Report on Water Quality. <https://lf-public.deq.utah.gov/WebLink/ElectronicFile.aspx?docid=87957&eqdocs=DWQ-2024-003593&dbid=0&repo=Public>.

Waterleaf Resources

2023 Waterleaf Demonstration Plant UPDES Permit Application. September 6.

2024 Waterleaf Resources Demonstration Plant GSL Mineral Extraction Facility Operator Application. October 16.

2026 Waterleaf Resources Phase 1 Lithium Extraction Project GSL Mineral Extraction Facility Operator Application. Revised April 2, 2026.

Wilcock, Laura, Carie M. Frantz, and Michael D. Vanden Berg

2021 Use of Remote Imagery to Map Microbialite Distribution at Great Salt Lake, Utah: Implications for Microbialite Exposure. *Geosites* 51 (January), 1–26.