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BUTTE PRIORITY SOILS OPERABLE UNIT SILVER BOW CREEK/BUTTE AREA SUPERFUND SITE

Draft

Operation, Maintenance, and Monitoring (O&M) Plan for Butte Priority Soils Operable Unit

Volume IV
Butte Treatment Lagoon (BTL), and Chemical Addition Systems at Lower Area One (LAO)

Atlantic Richfield Company

January 27, 2011

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Volume IV Butte Treatment Lagoon (BTL), and Chemical Addition Systems at Lower Area One (LAO)

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1.0 INTRODUCTION

The *Draft Operation, Maintenance and Monitoring (O&M) Plan for Butte Priority Soils Operable Unit* consists of multiple volumes (I through V). Each volume is used to describe specific aspects of the Operations and Monitoring (O&M) Plan. This document, Volume IV, presents the Butte Treatment Lagoons (BTL) and Lower Area One (LAO) Systems Operation, Maintenance and Monitoring (O&M) Plan. The information is provided to allow proper operation and routine maintenance of the system.

Background information and characterization for Butte Priority Soils Operable Unit (BPSOU) is provided to allow proper operation and routine maintenance of the system. Ancillary information which is useful to this manual is provided in the appendices section of this manual. The following list of appendices is provided for additional reference:

- Appendix A System Design Drawings;
- Appendix B Equipment Inventory and Manufacturer's Data;
- Appendix C Butte Treatment Lagoon (BTL) Standard Operating Procedures;
- Appendix D Butte Treatment Lagoon (BTL) Performance Standards;
- Appendix E Butte Treatment Lagoon (BTL) Ops Report;
- Appendix F Butte Treatment Lagoon (BTL) Systems Operation Decision Tree;
- Appendix G Butte Treatment Lagoon (BTL) Systems Sampling and Analysis Plan (SAP);
- Appendix H Butte Treatment Lagoon (BTL) Weekly Operation Report; and
- Appendix I Sludge Production Estimate.

1.1 Purpose and Scope

This document, Volume IV, presents the BTL Systems at LAO System Operation, Maintenance and Monitoring (O&M) Plan located within the BPSOU. It contains key components for an O&M Manual as presented in the U.S. Environmental Protection Agency's (EPA) guidance Fact Sheet *Operation and Maintenance in the Superfund Program, OSWER 9200.1-37 FS* (EPA, 2001) and Section 3.5.2 of OSWER Directive 9355.0-4A, *Superfund Remedial Design and Remedial Action Guidance* (EPA, 1986). Figure 1 identifies the BTL-LAO related system sites, major features within LAO, and remote monitoring locations. Figure 2 identifies all components of the BTL systems. The following sections describe the treatment system, performance goals, routine and "transitional" situation operations, record keeping and reporting requirements, routine inspection and maintenance programs, emergency procedures, and site health and safety associated with the BTL systems. Activities associated with O&M of the BTL-LAO systems must be performed in accordance with the *BTL-LAO Site Specific Health and Safety Plan (SSHASP) for Operation and Maintenance Activities* (Pioneer, 2010). The SSHASP provides guidance for the appropriate mitigation and controls to eliminate or reduce identified hazards and/or risks associated with O&M activities.

1.2 System Background

The BTL system is a result of multiple demonstration projects implemented to determine the best method of treating the waste associated with BPSOU. Some demonstration projects were conducted in parallel to one another. As a result, multiple lagoon and cell systems were constructed. As additional influent flows were introduced into the system and a final remedy identified, the system utilized multiple lagoons and effluent cells as part of the final remedy.

The governing purposes of the BTL are to protect adjacent surface water systems (Blacktail and Silver Bow Creeks) through capture and treatment of impacted groundwater and effectively remove heavy metals (copper, cadmium, and zinc) and arsenic under a variety of anticipated conditions.

1.3 Design Theory

The BTL effluent system consists of multiple cells operating in parallel. Each system consists of 3 cells. The first cell is an unlined open water cell. The primary purpose of this cell is sediment collection. The additional cells are referred to as ponds. Each pond is also an open-water, unlined cell for the purpose of increasing residual time and allowing final pH adjustment.

The series of cells are separated by highly conductive earthen walls. Floating silt curtains are used to mitigate solids carry-over from the primary cell to downstream ponds.

The influent pumping station is designed to allow single pump operation during routine conditions, parallel pumping operation to meet increased capacity demand, and redundant pumping capability to ensure treatment capabilities can be met.

1.3.1 Remedial Action Objectives

The remedial action objectives (RAOs) established in order to meet the requirements of the Record of Decision (ROD) (EPA, 2006) for groundwater and surface water include:

"Groundwater

- *Prevent ingestion of or direct contact with contaminated groundwater that would result in unacceptable risk to human health.*
- *Prevent groundwater discharge that would lead to violations of surface water ARARs and remedial goals for the BPSOU.*
- *Prevent degradation of groundwater that exceeds current standards.*

Surface Water

- *Prevent ingestion or direct contact with contaminated surface water that would result in an unacceptable risk to human health.*
- *Return surface water to a quality that supports its beneficial uses.*
- *Prevent source areas from releasing contaminants to surface water that would cause the receiving water to violate surface water ARARs and remedial goals of the operable unit*

and prevent degradation of downstream surface water sources, including during storm events.

- *Ensure that point source discharges from any water treatment facility meet ARARs.*
- *Prevent further degradation of surface water.*
- *Meet the more restrictive of chronic aquatic life or human health standards for surface water identified in Circular DEQ-7 through the application of B-1 class standards."*

1.3.2 Capacity

Cell data are provided in Table 1. Maximum and minimum cell elevations are listed with the average storage capacity provided.

Residence time of the primary treatment system flow path is provided below. Routine flow of approximately 1,200 gallons per minute is distributed to the lagoons based on the following percentage of total flow. A-system cells receive approximately 50% of the total flow, and the remaining flow is split between the B and C Cells.

- Theoretical hydraulic residence time of the A system, based on an average flow rate of 600 gallons per minute (gpm), is approximately 10.5 days.
- The hydraulic residence time of the B system, based on an average flow rate of 300 gpm, is approximately 5 days.
- The hydraulic residence time of the C system, based on an average flow rate of 300 gpm, is also approximately 5 days.

Contingency water management operations are discussed as an independent item.

1.3.2.1 Chemical Addition System

The Influent Pumping Station (IPS) is designed to deliver up to a maximum flow rate of 2,200 gpm. The system is designed to accommodate steady-state flow of 1,880 gpm, and meet discharge performance standards referenced above. The normal expected flow rate is 1,200 gpm.

The lime storage silo capacity is 44,000 pounds of hydrated lime ($CaOH_2$).

The target lime feed rate is 130 milligrams (mg) of lime per liter of influent. The design flow and feed rate allows up to 15 days of continuous runtime.

1.3.3 Codes and Standards

The buildings were designed and reviewed under International Building Code (IBC), 2006 edition and International Energy Conservation Code (IEEC) 2003 edition as discussed in the following subsections.

1.3.3.1 CAS Building

International Building Code:

- Occupancy: F-1;
- Occupant Load: 100 ft^2/occupant, 1,273 ft^2 = 13 occupants (maximum);
- Construction Type: V-B;
- Maximum 8,500 ft^2 per 1 story;
- All walls must maintain 30 feet from property lines, no fire rating is required;
- Class C finishes at interior allowed;
- One exit required, 3 have been provided; and
- Class C roof allowed, Class B provided.

International Energy Conservation Code (2009):

- Per IECC: Silver Bow County is in Zone 16; ceilings require R-25, walls require R-11, minimum and less than 10% exterior wall windows or door glazing.

1.3.3.2 Operations Building

Operations Building, constructed adjacent to the existing CAS Building:

- Occupancy: F-1.
- Occupant Load: Industrial areas allow 100 square feet per occupant. With 1,054 square feet, the Operations Building can have 11 occupants.
- Construction Type: V-B.
- CAS and Operations Buildings are considered one building under 503.1.2. Total square footage of the combined building is 2,327. The maximum allowed is 8,500 square feet per one story.
- All exterior walls are 30 feet from property lines; no fire resistance rating is required.
- Class C finishes at interior allowed.
- One exit required, two have been provided.
- Class C roof allowed, Class B provided.
- Per IECC: Silver Bow County is in Zone 16; ceilings require R-30, walls require R-13, minimum, less than 10% exterior wall windows or door glazing.

1.3.3.3 Electrical

All electrical service components including the generator, panel board, pad-mounted transformer, double-throw safety switch, neutral assembly, automatic transfer switch, weather shields, lug kits, pull breakers, and safety switches have been selected/designed and are in compliance with National Electric Code (NEC) 2009 edition.

1.3.4 Control Theory

The BTL-LAO control system utilizes Allen-Bradley ControlLogix for the primary control and master polling programmable logic controller (PLC) located at the Operations Building. This PLC is considered the primary PLC which controls and monitors the lime addition process and associated systems and polls each remote site for data. Total polling time to contact and receive data from the remote sites does not exceed 30 seconds using a CalAmp Viper Federal Communications Commission (FCC) licensed Ethernet data radio operating in the 400MHz range. The encrypted FCC-licensed radio-to-radio communication is capable of transmitting data up to 128 kilobytes per second (kbps) at 10 watts of effective power.

Data that have been transmitted back to the Operations Building is displayed on the operators' human machine interface (HMI), Invesys Wonderware InTouch software, screen in the control room. The Wonderware software monitors all local statuses for the CAS and the status of all remote stations. The HMI also accepts operator set points and alarm set points. Graphical display screens with data trending capabilities are available for all process areas and show all process variables, equipment status or state, system set points, and alarm history.

A dedicated desktop computer located in the Operations Building control room has the HMI software installed. The computer has two monitors. One monitor is provided to display the lime addition process and local system instrument readings and set point. The additional monitor is dedicated for the remote sites. A hard drive capable of logging all system data for an extended time period is also provided. An optional client version of the Wonderware software is also installed directly in the CAS Building process area on the existing panel mounted BSI computer to allow operator monitoring of levels, flows, set points, and alarms for the lime process.

All remote sites are equipped with Allen-Bradley CompactLogix PLCs to monitor and control any of the remote sites process and/or monitoring equipment. The remote site PLCs, considered secondary PLCs, provide local control such as pump control logic or flow control logic, and monitor the local process for any alarm status such as loss of power, pump failure, instrument failure, and high/low level or flows. Data and site system status for all remote sites are collected by the CompactLogix PLCs. The Master PLC at the Operations Building then polls each site for the data. Polling intervals are programmable and can be set to meet data acquisition requirements.

1.4 BTL-LAO Owner and Contact Information

1.4.1 Owner and Contact Information

Atlantic Richfield Company (Atlantic Richfield) is a Potentially Responsible Party (PRP) of the BTL-LAO water treatment system. Operation and maintenance of the system is the responsibility of the PRP. Duties associated with proper O&M may be tasked to a contractor, or owner's representative.

1.4.2 Key Contacts / Emergency Information:

BP Incident Notification Center **1-800-831-8642**

Atlantic Richfield Co.	**Office (406)**	**Mobile (406)**	**Home (406)**
Trey Harbert	723-1816	498-5749	
Shannon Dunlap	723-1813	498-6630	
Kevin Murphy	630-836-7124	219-545-4725	
Pioneer Technical			
Dave Griffis	563-9371 ext. 306	490-4210	
Brad Archibald	497-8019	490-3032	494-6549
Pat Sampson	782-5797	490-0706	
Brad Hollamon	782-5797	490-7678	782-3243
Steve Lubick	563-9371	490-7680	782-1702
Ian St. John	782-5797	490-4900	
Tara Schleeman	497-8026	490-8272	533-0913
EPA			
Sara Sparks	782-3264	949-4149	
DEQ			
Joe Griffin		560-6060	

1.4.3 Additional Emergency Contact Agencies

Emergency Response	911
Disaster-Emergency	(406) 497-6295
NorthWestern Energy	
Emergency	1-888-467-2427
Electrical Emergency	1-888-467-2353

1.4.4 Non-emergency Services

Police	(406) 497-1120
Mt. Highway Patrol	(406) 494-3233
Fire Department	(406) 497-6481
Water Company	(406) 497-6500
Butte Silver-Bow County	(406) 497-6515
Public Works	
Metro Sewer Plant	(406) 497-6550
NorthWestern Energy	
Connect and Repair	1-888-467-2669

Qwest Comm.	1-800-954-1211
Underground Utilities	1-800-424-5555
MT Department of Highways	(406) 494-9600
St. James Hospital (Butte)	(406) 723-2500

Local Resources -- company names, contact name, phone numbers, description of resources
Oil Spill Response Contractors (OSROs)
ATLATL Inc. (406) 723-7980

1.5 Organization and Use of this O&M Plan

This O&M Plan contains information describing how to operate and maintain the lagoon treatment system. In addition, the plan provides (the operator) the necessary background and overview of the BTL, and how it is intended to function during various conditions. Detailed documentation and instructions are provided to establish the necessary procedures for both routine operations and special circumstances. Each section in the plan is described briefly in the following paragraphs:

- **Section 2.0: System Description** is presented in seven subsections. An initial overview describes each major component of the system and its function. The remainder of the section describes substantial detail for the design basis, technical features and capabilities of each facility. This section is designed to be the initial reference to the operator for optimization, and is intended to fit into and contribute to the entire system.

- **Section 3.0: Hydraulic Controls** describes the system components and operational parameters to control water flows and levels associated with the BTL to keep the system operating efficiently. It also describes how to use these components during various types of conditions in the BTL.

- **Section 4.0: Safe Operating Limits** describes the operating limits of the system components to prevent damage or failure of the system which could potentially impact worker safety of the environment. This system provides safe operating pressure, temperature, and concentration limits as applicable to system components.

- **Section 5.0: Performance Standards** are organized and presented so that the operator can clearly understand the performance requirements and how they must be addressed on a day-to-day basis. This section presents the O&M requirements relevant to maintaining high water quality performance. This section must be used in conjunction with Section 8.0 on monitoring requirements and Section 9.0 reporting requirements.

- **Section 6.0: Routine Operations** provides a description of routine system monitoring and oversight. Also provided are details for routine operational conditions for the various facilities and procedures for establishing, verifying or changing these settings. *Standard Operating Procedures will be referenced in this section as developed and subsequently appended following the Shakedown Period.*

- **Section 7.0: Operation During Disturbances** identifies various types of upset conditions that may occur in the lagoon treatment system. Alternative response/mitigation measures, approaches to identifying the cause of problems and sources of additional information and assistance are provided.

- **Section 8.0: Monitoring and Laboratory Testing** defines the measurements and observations required for the BTL. This includes both monitoring for operation and process control, and monitoring required by regulatory agencies. A method is provided for summarizing the data so that the operator can detect trends and respond with appropriate changes in operation. In addition, the operator must review the monitoring data for compliance with performance standards (see Section 4.0) and submit monitoring reports as required (see Section 9.0).

- **Section 9.0: Data Management** discusses the generation of automated monitoring equipment and transfer of data to the master database for storage.

- **Section 10.0: Operations Reporting and Record Keeping** outlines the reporting requirements, responsibilities and intervals.

- **Section 11.0: Routine Inspection and Maintenance** of all treatment facilities and earthwork structures are provided. A computerized scheduling and maintenance mechanism for the process equipment is provided so that scheduled activities automatically become part of the operator's daily activities. Procedures for inspecting and maintaining the earthwork facilities are also provided.

- **Section 12.0: Emergency Procedures** are established for response to various alarm conditions as well as the use of emergency/back-up equipment.

- **Section 13.0: Future Revisions and Updates** are foreseen and a mechanism is established for periodic review and issuance of such revisions on a controlled and properly documented basis.

- **Section 14.0: References** used to generate this O&M Manual are included in this section.

2.0 SYSTEM OVERVIEW

Volume I provides a system background and overview of the O&M Plan for the water collection, transfer, and treatment systems located within BPSOU and BMFOU.

Volume I includes the following:

- System Performance Standards (Section 3.0);
- The BTL-LAO *Site Specific Health and Safety Plan for Operation and Maintenance (O&M) Activities (*Pioneer, 2010) (Section 5.0 discussion); and
- Revisions and updates to the O&M Plan (Section 7.0).

Figures showing emergency routes to the hospital from each site are included in their own respective volumes as separate appendices.

This Volume contains information relevant to the O&M tasks associated with the BTL, CAS, and Automatic Sampling Building (ASB). Historical background information is provided in this Volume where it provides guidance for operating the system. System background and evolution of the system provided in Volume I, Overview. Major maintenance instructions are contained in Volume V, Maintenance Plan.

2.1 Objective

The objective of the BTL is to achieve the performance-based water quality discharge targets for BPSOU through a collection and lime treatment process. Influent sources are illustrated on Figure 3, LAO Flow Sheet**.** The BTL system treats impacted groundwater from West Camp, Metro Storm Drain (MSD), Butte Reduction Works (BRW) open areas, and within LAO, and discharges treated water to Silver Bow Creek. Several monitoring facilities are utilized to collect data associated with the entire BTL systems, therefore allowing performance to be optimized (see Figure 1).

2.2 General Facility

Various systems are located and operated within the BTL-LAO site. Facility upgrades were made to the LAO site under *Draft Final Butte Treatment Lagoons (BTL) and West Camp Pump Station (WCP-1) Upgrades Design Report/Work Plan* (Atlantic Richfield Company, 2010a).

2.2.1 Lower Area One

Lower Area One is an operable unit (OU), located within BPSOU where the treatment lagoons, CAS Building, hydraulic control channel (HCC), and ASB, and multiple open areas are located. Lower Area One is the lowest topographic elevation of the OU. All groundwater and surface flow is naturally directed to the LAO site.

2.2.2 Butte Treatment Lagoons

The treatment lagoon system consists of multiple unlined, open water cells. Effluent is directed into a set of three cells, referred to as A-Cells, B-Cells, and C-Cells. Each set contains three individual cells. The first cell in each set is referred to and utilized as a sediment collection basin. A silt curtain is deployed to mitigate sediment carryover to downstream cells.

The two following cells are referred to as ponds and used to increase retention time of the effluent water and "polish" or stabilize the pH prior to being introduced into Silver Bow Creek. The cells are separated by earthen berms with outlet structures in place to allow outflow to the next successive location.

Cell D4 is the lowest pond elevation of the lagoon system. All influent flow is conveyed through HCC, and discharged to Cell D4, ultimately for transfer to the treatment process.

2.2.3 Hydraulic Control Channel

The HCC is utilized as a groundwater boundary which directs groundwater to the IPS located within Cell D4. In addition, flow from all remote pumping stations is directed to the HCC. This flow is ultimately conveyed to Cell D4 and the IPS to be treated as influent flow. The HCC begins on the eastern boundary of LAO, immediately west of Montana Street, and continues to the western boundary of LAO, paralleling the northern site boundary.

2.2.4 Butte Reduction Works Open Areas

Previous remediation, and waste removal efforts have resulted in open areas and depressions in the landscape. These areas are susceptible to natural filling due to groundwater and precipitation events. Minor O&M tasks are associated with this area.

Butte Reduction Works open areas are utilized for drying bed locations with associated outlet structures and decant water routing to the HCC.

2.2.5 Chemical Addition System Building

The CAS consists of lime storage, feed, and slurry equipment, and associated automated controls. The CAS Building houses all lime feed, slurry tanks and associated equipment, monitoring and control equipment, and distribution tank. Additional detailed information is provided below.

The Operations Building is located on the east side of the CAS Building as an addition. The Operations Building is a 1,054-square foot building which houses all updated hardware, controls and monitoring equipment. The Operations Building also includes an operations room with a desk, computer, additional monitoring equipment, sample preparation room, and restroom. All system monitoring device signals are displayed and accessible to operators in this room.

2.2.6 Automatic Sampling Building

Effluent flow is monitored and automatically within the ASB through the ISCO® 3700 automatic sampler housed within the ASB. The ASB is an 11 by 13-foot engineered precast concrete building which houses sampling, equipment, effluent piping and associated valves, interior panel-mounted heaters, and exhaust fan.

2.3 Description of Treatment Processes and Controls

The BTL water treatment system is an active lime treatment system which utilizes a series of lagoons to precipitate metals. The BTL system treats Missoula Gulch base flow entering the HCC, West Camp Pumping System (WCP-1) groundwater, and groundwater collected and pumped from the MSD. The addition of lime, or an equivalent amendment, is the primary treatment. Lime product is added to the influent at the CAS Building. The targeted lime addition rate, which ranges from 80 to 180 mg of amendment for each liter of water, is based on lowering metal solubility in the water to form a low volume solid that is chemically and physically stable that will eventually settle out of the water. Immediately following the lime addition, optimal pH is 9.5 to 11.0.

Multiple treatment lagoons are used to allow variable functionality of the system and increase retention time as needed. The lagoon systems are made up of three parallel retention systems (A, B, C), each containing three lagoons (A1, A2, A3, etc.) located in series, resulting in a 3 by 3 array of cells. Outlet flow from the distribution tank is directed to the three primary lagoons in each system. Interconnecting piping and outlet structures are in place to allow water flow diversions throughout the array. The treatment lagoons are unlined allowing a small volume of treated water to infiltrate into native groundwater, while the majority of the water discharges to Silver Bow Creek as surface water. All water, whether infiltration or surface flow, is treated, metals precipitated, and eventually enters the Silver Bow Creek aquifer.

2.3.1 Chemical/Physical Treatment Processes

The basic treatment processes which remove metals from the influent water in the BTL systems are two-fold:

- Formation of $CaCO_3$ which then precipitates and falls through the water column, adhering with other solids and removing them from the treated water;
- Lime is added to the influent stream to adjust the pH level to a range between 9.5 and 11;
- Lagoon cells are used as settling facilities for $CaCO_3$ and metal precipitates resulting from pH adjustment through lime addition, thereby removing the metals from the water prior to discharge into Silver Bow Creek; and
- As treated water moves to subsequent cells in the series, the pH stabilizes, or lowers from its initial range, and additional retention time allows for additional physical (settling) treatment.

2.3.2 Primary Controls

The opportunities for controlling the treatment processes involve two basic elements:

- Quantity of lime added to the influent stream (and the resultant pH) can be adjusted.
- Outlet structures can be altered so that the water surface elevations and volumes of Treatment Systems A, B, and C are raised or lowered. In addition, these structures can be used to route flows differently between cells and/or Cells D2 and D3. Table 1 presents the average dimensions of each of the cells in the A, B, C, and D systems.

2.3.3 Secondary Controls

The following controls can be used to make minor adjustments to the system:

- Adjust the influent rates temporarily; and
- Move/re-route treated water through various cells using different routes.

The following were factored into the BTL systems design basis:

- Operation of the treatment system must accommodate removal of multiple metals.
- Mixing evenly distributes the lime throughout the influent stream thereby achieving the pH adjustment and precipitation reaction in the lagoon systems. This is facilitated by the mixing baffle located inside the Distribution Tank and the distribution channels. The mixing then continues in the first cell of Treatment Systems A, B, and C.
- Building of the precipitate into particles which will drop out of solution. This begins immediately following addition of lime and is facilitated by the mixing described above.
- Settling of the particles begins upon entry of the flow into Cells A1, B1 and C1. The other cells in the treatment systems provide additional polishing sedimentation. Under ideal conditions settling would depend simply on particle size, weight, and the upflow velocity (flow rate divided by surface area of the cell). Hydraulic barriers and flow patterns were designed to eliminate obvious short circuiting.

The following subsections present a detailed description of each of the facilities of the BTL.

2.4 Description of Remote Facilities/Influent Systems

All remote sites are equipped with Allen-Bradley CompactLogix PLCs to monitor and control any of the remote sites process and/or monitoring equipment. The remote PLCs provide local control such as pump control logic or flow control logic, and monitor the local process for any alarm status such as loss of power, pump failure, instrument failure, and high/low level or flows.

Data and site system status for all remote sites are collected by the CompactLogix PLCs and the Master PLC at the Operations Building then polls each site for the data.

2.4.1 Hydraulic Control Channel

The HCC shown on Figure 4 begins at the east side of LAO directly south of the BRW and flows west for approximately 5,000 feet to the west edge of the site where it discharges to Cell D4. The HCC was constructed during the Phase I LAO Expedited Response Action (ERA) construction to intercept the impacted alluvial groundwater in LAO. This channel currently functions as an interception trench to collect impacted alluvial groundwater from Butte Hill and Missoula Gulch flow, WCP-1, and MSD, and prevents groundwater from impacting the reconstructed Silver Bow Creek channel and floodplain. A high density polyethylene (HDPE) sheet pile terminates the HCC and prevents untreated flow to Silver Bow Creek. The crest of the sheet pile is at 5,417 feet above mean sea level (amsl). A staff gauge located in the HCC near the HDPE sheet pile provides direct indication of the HCC water level.

The flow in the HCC is affected by the groundwater discharge and by wet weather flow in the Missoula Gulch watershed and MSD groundwater site. Design flow within the HCC is a summation of flows from WCP-1, Missoula Gulch flow, MSD, BRW, and LAO groundwater. Groundwater flows may vary throughout the year. The base design flow of the HCC is 1,880 gpm.

2.4.2 South Hydraulic Control System (D-Cells)

The Groundwater Interception Areas (Cells D2 and D3), shown on Figure 4, function to create a gradient away from Silver Bow Creek. Cells D2 and D3 can also act as a recirculation route for water from Cells A2, B3, and C3 to be routed back to Cell D4.

In the event of a need to re-circulate water, Cells D2 and D3 can be utilized as a recirculation circuit:

- The C lagoons can be discharged to either D2 or A2 for increased retention time or back to D2 for recirculation and B lagoons can be diverted to A2 for increased retention time or from A2 to D2 for recirculation;

- Cell D2 will be used as a recirculation bypass to Cell D3 for water discharged from Cell C3; and

- Cell B3 and Cell D3 will be used as a recirculation bypass to Cell D4 for water discharged from Cell D2.

During routine operations, no flow from the Treatment Lagoons (treated water) will be discharged into D2; however, intercepted groundwater will be directed down gradient to Cell D3. No flow from the Treatment Lagoons will be discharged into Cell D3; however, flow from intercepted groundwater will be directed into Cell D4.

2.4.3 Missoula Gulch Discharge

Missoula Gulch drainage modifications were completed in the spring of 2004. The base flow (discharging groundwater) from the upper portion of the Missoula Gulch drainage exits the storm sewer system just south of Iron Street into the Missoula Gulch base flow diversion basin and pipe. The basin and pipe collect and convey base flow into the Missoula Gulch channel directly below Catch Basin (CB)-9 immediately north of Centennial Avenue (see Figure 1). This groundwater eventually discharges to the HCC (see Section 2.4.1) along with other BTL groundwater.

Storm events or abnormally high base flows fill CB-8 when water goes over the base flow spillway structure. During a high flow event, Missoula Gulch runoff first enters CB-8. When CB-8 fills completely, it begins to discharge to CB-9. After the high flow event, dewatering procedures for CB-8 and CB-9 may begin.

2.4.4 West Camp Pump Station

The WCP-1 is located directly north of Centennial Avenue adjacent to the BRW. The pump station and pipeline identified on Figure 1 transfers bedrock groundwater from the West Camp Complex to the BTL at an average flow of 0.26 million gallons per day (mgd) (180 gpm). Flow rates from the WCP-1 Groundwater Collection System range from a minimum of 0.23 mgd (160 gpm) to a maximum of 0.46 mgd (300 gpm). The primary Constituent of Concern (COC) from this source is arsenic, at an average concentration of 0.1 milligrams per Liter (mg/L). The WCP-1 is operated and maintained in accordance with the requirements of the Volume III, West Camp Pump Station (WCP) and Missoula Gulch. The pumping rate from WCP-1 is controlled through the use of a variable frequency drive (VFD) to **maintain the water level at approximately 5,425 amsl** under routine conditions. Operating WCP-1 in this manner minimizes the potential of the water level to rise above the required critical water level of 5,435 feet amsl.

2.4.5 Metro Storm Drain Groundwater Collection System

The MSD pump station and pipeline, constructed in the second quarter of 2004, is 1 of the 2 primary groundwater pumping stations to BTL-LAO. This system, shown on Figure 1, conveys captured groundwater to the BTL.

A pump in the vault at the bottom end of the MSD subdrain transfers impacted groundwater from the subdrain to the upper end of the HCC in LAO at an average flow of 0.65 mgd (450 gpm) and is expected to range from 0.32 mgd (225 gpm) and 1.18 mgd (820 gpm). The outlet of the MSD pipeline is located at the east end of the HCC where the discharged flow mixes with on-site ground and surface water collected within the BTL from the HCC, WCP-1, and Missoula Gulch groundwater flow. The operation of the MSD station is conducted in accordance with Volume II, Metro Storm Drain Collection System.

2.4.6 Silver Bow Creek Floodplain

The Silver Bow Creek floodplain is located on the southern most portion of LAO and was reconstructed in 1997 (see Figure 2). The original Silver Bow Creek was diverted around the tailings impoundment from the Colorado Smelter. During the initial cleanup of LAO in 1996-1997, the Silver Bow Creek floodplain was reconstructed to its original state by utilizing historical data for the design and flows were then directed back into the reconstructed Silver Bow Creek channel, which was constructed at an elevated gradient within the floodplain. The elevated channel minimizes the potential of Silver Bow Creek to collect impacted groundwater within LAO. The D-Cells and the HCC protect Silver Bow Creek from impacted groundwater by creating a gradient away from Silver Bow Creek and directing the flow of impacted groundwater to Cell D4.

2.4.7 Butte Reduction Works

The open areas of BRW can result in the accumulation of surface water mainly the by-product of precipitation events. Outlet structures are used to control outflow from BRW to the HCC. These open areas are unlined, therefore seepage from the open area infiltrates to the groundwater flow which ultimately is collected by the HCC and treated as influent flow.

This area is also utilized for sludge de-watering and drying beds. Free-standing water is decanted over the outlet structure and directed to the HCC through channel flow. Natural processes such as evaporation and infiltration are also utilized to dewater dredged material prior to solids being transported to the waste repository.

2.4.8 Additional Monitored Sites

Multiple sites identified on Drawing Sheet I&C-G-5 located in Appendix A are also equipped with monitoring equipment and data transmitted to the data logging system in the CAS via FCC radio.

2.5 Description of Butte Treatment Lagoon Facilities

2.5.1 Influent System

Historical operations of the Influent System have determined that the optimum operating level for Cell D4 is approximately 5,414.5 feet amsl. Short-term (up to 2 days) high flows may increase the operating level of Cell D4 to 5,417 feet amsl. Short-term high flows may result from construction dewatering or increases in pumping rates from storm water surges. Long-term fluctuations due to multiple storm water surges or snowmelt events may require the normal operating level to be raised for a longer period.

The influent system design flow rate is 1,800 gpm. The pumps described in Section 2.5.1.2 are sized to provide adequate capacity to maintain Cell D4 at or below the target water level during routine operating conditions. The maximum flow rate that can be produced with 1 pump in operation is approximately 3 mgd (2,200 gpm), when both pumps are in operation, the maximum flow rate expected through the Influent System is approximately 4.3 mgd (3,000 gpm). Additional storage or surge capacity is available, especially when water levels exceed 5,414 feet amsl in the lower end of the HCC.

2.5.1.1 Cell D4

Cell D4 is the main influent water collection area of the influent system, located at the west end of the site. This collection area, as stated in Section 2.4.2, is fed by the HCC and serves as the main influent water source. Cell D4 is designed to operate at an elevation of 5,414.5 feet amsl, with a minimum and maximum pool elevation of 5,413.5 feet amsl, and 5,417 feet amsl, respectively.

2.5.1.2 Influent Pump Station

The IPS is located in Cell D4. Pumping capabilities are provided by 2 electric driven 75 HP Godwin Dri-Prime® Model CD225M Automatic Self-Priming centrifugal pumps with 316 stainless steel pump-ends and two 75 HP VFDs which are designed to interact with one another for synchronized start and stop capabilities. The pump system is capable of pumping flows ranging from 800 gpm up to 2,100 gpm. A primary pump will operate at approximately 1,200 gpm with a back-up pump offering 100% redundancy. The pumps are skid mounted with a central lifting bracket and securely housed above grade in the IPS building.

Each pump is supplied by independent suction piping from the influent sump located in Cell D4. Suction piping consists of a 14-inch ductile iron piping vertical riser suspended into the sump. The riser makes a 90-degree turn into a 14-inch by 8-inch eccentric reducer. A 4-foot straight section of 8-inch ductile iron pipe feeds directly into the pump suction intake.

The D4 Pump Control Panel has a Local Stop Button that shuts down both pumps immediately. After the pumps stop operating, the operator must follow the pump startup procedure and restart the sequence with the pump-reset button. In the case of a power failure or outage at the D4 Starter Cabinet, the system will require an automatic pump start sequence to be initiated before starting pumps. Operating status of the west and east pump (ON or OFF) is displayed on the HMI monitor.

2.5.1.3 Influent Pipeline

Piping from the discharge flange of the influent pumps to the CAS system makes up the CAS system influent piping. Each pump has an independent discharge pipe with isolation valves and a tee pipe fitting which allows access to each pipe system from both pumps.

The original influent pipeline shown on Drawing IP-C-7 consists of 2,400 feet of buried 10-inch diameter standard dimension ratio (SDR) 26 polyvinyl chloride (PVC) pipeline, which transfers the untreated water from Cell D4 to the CAS Building. This piping remains in place for use as an emergency, alternative system.

The influent pipeline from the upgraded IPS contains parallel 14-inch SDR 17 HDPE lines which supply influent water from the IPS at Cell D4 to the CAS Building. Each pipeline is approximately 2,400 feet of buried pipeline. Pump discharge piping is 14-inch ductile iron pipe which exits the IPS Building below grade and transitions to 14-inch SDR 17 HDPE. The 14-inch HDPE influent lines will then follow the flood containment dike (FCD) road alignment and parallel the existing 10-inch PVC influent line en route to the CAS Building. Mueller resilient wedge gate valves and curb boxes will be installed on each of the 3 lines prior to entering the proposed CAS Building addition. The two 14-inch HDPE lines and the existing 10-inch line transition to a single, consolidated 14-inch ductile iron pipe immediately following the aforementioned gate valves. The 14-inch ductile iron pipe enters through the floor of the southwest corner of the proposed CAS Building addition and continues directly to the existing sluice box.

2.5.2 Chemical Addition System (CAS)

During routine operations raw influent water is directed to both slurry tanks through the 4-inch PVC feed water supply lines to the top of the slurry tanks. Flow is throttled using inline 4-inch butterfly valve (BFV-LAO-1037, or BFV-LAO-1044). Flow rate to each respective tank is provided from an UltraMag flow meter (FIT-LAO-1039, or FIT-LAO-1045) located upstream of the valves. A continuous flow of raw influent water is directed to each tank. The primary tank receives approximately 200 gpm of raw influent water, while the secondary tank receives approximately 50 to 100 gpm. Manual actuation of the tank discharge valves (BV-LAO-1038 or BV-LAO-1040) allows the liquid level in each tank to be adjusted to the desired level.

A liquid level is maintained in the secondary tank to allow seamless switching of slurry tanks as needed. Dry lime feed is switched through operation of the inline knife gate valves (FCV-LAO-1019 or FCV-LAO-1023) from the primary tank to secondary tank. Liquid is maintained in both tanks therefore no downtime is incurred when lime delivery is diverted between slurry tanks. Dry lime is added to the primary tank at the dosage described below. In general, the following operating ranges are expected to be seen in relation to the CAS:

Influent Water Flow Rate:

- Minimum = 0.58 mgd (700 gpm);
- Maximum = 2.59 mgd (1,800 gpm); and
- Average = 1.73 mgd (1,200 gpm).

Lime Usage Rate:

- Minimum = 1,095 pounds per day (lbs/day);
- Maximum = 3,440 lbs/day; and
- Initial Target = 1,877 lbs/day.

The continuously mixed slurry will then be constantly discharged from the active slurry tank and directed to the Sluice Box for initial mixing and transfer of raw influent water and lime slurry to the Distribution Tank located directly west of the CAS Building. Combined influent water and lime slurry is then discharged from the Distribution Tank (T-LAO-103) to the distribution channels, which then transfer the mixed slurry and influent water to the BTL.

The 22-ton lime silo, feed system, and associated equipment were installed during the spring of 2002. The operating instructions maintained within the CAS Building contain detailed information for this equipment (see Appendix A). The equipment documentation contains manufacturer's information, dimensions and capacities, electrical diagrams, and operating information for the silo and related equipment. A maintenance schedule for all operating equipment associated with the lime feeder system is located in Volume V, Maintenance Plan.

Based upon the range of operating conditions listed above, the lime silo (T-CAS-102) is expected to provide continuous lime feed to the system as described below.

Lime Consumption Rate:

- Minimum = 1,095 lbs/day; 40 days;
- Maximum = 3,440 lbs/day; 13 days; and
- Initial Target = 1,877 lbs/day; 23 days.

The distribution channels downstream of the CAS Building are cast-in-place utility trench boxes extending to the initial riprap aprons of each primary cell of the treatment lagoon system.

The distribution channels require little maintenance during routine operations. This maintenance will consist of annual removal of a small amount of precipitated calcium carbonate that accumulates within the channels (less than 50 cubic yards). In addition, Cells A1, B1, and/or C1 require sediment removal on a regular basis. Figure 2 shows the locations and alignments of the Treatment Lagoons and distributions channels.

2.5.2.1 Description of Chemical Addition System Components

General descriptions of the CAS components are outlined in the following paragraphs.

Lime Silo (T-CAS-102) – The lime silo consists of a 22-ton capacity silo with equipment and controls to transfer dry, hydrated lime to the lime transfer auger. In addition, the silo is fitted with a fill tube, bag house, and controls to accommodate filling the silo by a pneumatic truck, and monitoring equipment to determine the quantity of lime in the silo. The lime silo is positioned directly outside of the CAS Building, on the east side of the building. A skirt support structure allows access to the bottom of the silo, and houses lime feed components such as the lime hopper, Accurate Feeder® (U-CAS-106), knife gate valve and screw conveyor (U-CAS-102). These components and assemblies are discussed below.

Accurate Feeder® (U-CAS-106) and Screw Conveyor (U-CAS-102) – The Accurate Feeder® controls the amount of dry lime from the bottom of the lime silo that passes directly to the screw conveyor. The screw conveyor then transfers lime to either of the slurry tanks. Selection of which slurry tank is in operation during continuous feed operations and which tank is receiving lime from the screw conveyor is made on the lime silo control panel. Controls for this auger are incorporated in the lime silo controls. Lime is delivered at a dosage (mg/L) set by the operator, however mass delivery of lime is based on influent flow rate. The incorporated control system provides variable lime feed to accommodate the influent flow rate fluctuations.

Supply Water Feed Lines – These consist of two 4-inch PVC (SCH80) lines which connect the influent pipeline with the slurry tanks. Each supply water feed line is fitted with a butterfly valve to control the flow of water into the slurry tanks. These feed lines provide makeup water for the continuous dry lime addition operations.

Slurry Tanks (T-CAS-101, T-CAS-201) **–** The slurry tanks consist of 2 identical tanks, 5-foot diameter by 5-foot height, constructed of ⅜-inch, American Society of Testing and Materials (ASTM) A36 carbon steel rolled plate with a continuous seam weld, welded flat bottom, and fitted lid and 4 internal side baffles. Baffles are symmetrical within the tank, placed at 90-degree intervals. Each tank has 730-gallon liquid capacity designed for atmospheric pressure. The tanks are located in the west one-half of the CAS Building.

The tanks were originally designed to allow batch mixing capabilities of lime slurry, and are currently used for continuous addition of lime slurry. During batching operation, the south tank (Tank 1) will be operated as a mixing vessel during routine continuous dry lime addition. If desired, the north slurry tank (Tank 2) will provide storage for the backup batch of high concentration (approximately 20% by weight) lime slurry. Each tank is fitted with two discharge ports near the bottom of the tank and a 4-inch overflow port and discharge line near the top.

One 4-inch discharge port on each slurry tank is located at the invert of the tank. This port is generally reserved for completely draining the tank should maintenance of the tank or mixer become necessary or complete removal of debris or lime slurry from the tank is required. The second discharge port on each tank is located approximately 20 inches above the invert of the tank and is 4 inches in diameter. This is the port generally utilized during routine operation of the CAS. Each of the discharge ports is fitted with a pinch-valve and PVC line, which can discharge to the Sluice Box.

The overflow port, located approximately 50 inches above the invert of the tank is fitted with a discharge line to direct influent water and slurry to the Sluice Box should one or both of the tanks become over filled or if flow of influent water exceeds the flow rate of lime slurry through the discharge port(s).

Slurry Mixers (M-LAO1037 and M-LAO1046) – An APPCOR model CYB-100, elastomer-coated mixer with on-off controls, 1.5HP electric motor, and gear reducer is mounted on the top of each of the slurry tank. The S-M-Cycle Gear Reducer provides 20.8:1 gear reduction, and provides a final mixer speed of 84 revolutions per minute (rpm). Wetted components are made of ASTM A240, Type 316 stainless steel, and the mixer blades are chlorobutyl coated, ¼ -inch thickness. These mixers provide constant agitation to maintain thoroughly mixed lime slurry in each tank. The mixers are mounted vertically in the top center of the tank, bridge-supported, and provide continuous mixing of the fluid.

Sluice Box (T-LAO-5) – The 21-foot sluice box is made of 4 modular segments of uniform width (15½ inches), and varying lengths. The box is constructed of ¼-inch 316 stainless steel plate. The sluice box slopes at (-) 1% from the slurry tanks to the Distribution Tank. It is elevated above the CAS Building floor by ASTM A240, Type 316 stainless steel prefabricated rectangular channel supports to maintain the appropriate elevation for gravity open-channel flow to the distribution tank. The sluice box is capable of carrying the maximum influent flow of 1,880 gpm.

Modular segments of the sluice box are fastened using $^5/_8$-inch stainless steel ASTM A490, Type 3 bolts with nylon washers and bushings.

A diverter plate on the discharge end provides initial mixing and transfer of lime slurry and raw influent water from the CAS Building the Distribution Tank.

Distribution Tank (T-LAO-103) – The distribution tank is located just outside the CAS Building within the CAS Building West Addition. The tank is cast-in-place concrete. The tank has an inside radius of 6 feet, outside radius of 6½ feet, and a total wall height of 2¾ feet. Tank internal volume is approximately 2,300 gallons.

Three prefabricated Fontaine weir gates are installed on flush surfaces of the distribution tank. The weir gates are fabricated from ASTM A240, Type 316 stainless steel and act as downward opening rectangular weirs. The stainless steel weir gate frames are separated from the concrete surface by EPDM gasket. Each weir gate is capable of passing the maximum influent design flow of 1,880 gpm through the 14-inch wide by 15-inch deep openings. Each weir gate is furnished with pre-calibrated staff gauges for visual observation and electric displacement transducers networked to the instrumentation and control system. Four inches of freeboard allows up to 11 inches of useable weir height. Weir discharge flow rates are provided in Section 3.2.5.

Flow entering the distribution tank is mixed and distributed by a prefabricated modular baffle constructed of ¼-inch 316 stainless plate steel. The 5-foot diameter baffle, installed in the center of the Distribution Tank, has a total height of 2 feet 9 inches, making its height equal to that of the vertical walls of the distribution tank. The baffle is oriented in a position to promote equal distribution of influent flow toward each Fontaine weir gate and subsequent distribution channels.

Weir gates provide final mixing and flow control to direct the mixed influent water and lime slurry to each of the distribution channels.

Distribution Channels – Three independent concrete distribution channels extend from each Fontaine weir gate of the concrete distribution tank. The initial portion of each distribution channel is constructed as cast-in-place concrete, continuous with the Distribution Tank vertical walls, until they exit the CAS Building West Addition through the building's concrete footings. The initial cast-in-place portion of each distribution channel slopes away from the distribution channel at 2% until reaching the transition to precast rectangular channels (Distribution Channels A, B, and C). Type A riprap discharge aprons installed at the end of each channel dissipate flow energy in the primary cell to mitigate erosion effects.

Air Compressors – Two Ingersoll Rand Model 2475N7.5FP electric driven (230-volt, 60-amp, single phase) two-stage compressors with integrated pressure switches will be installed in the storage room of the new Operations Building. The redundant compressors will provide compressed air to various components of the lime feed and distribution system located in and adjacent to the CAS Building. Each compressor has an 80-gallon vertical tank with 24 CFM capacity at maximum operating pressure of 175-pound force per square inch gauge (psig). Compressed air will travel to an Ingersoll Rand Model F71IG general purpose compressed air filter to remove any stream impurities prior to entering an Ingersoll Rand Model D72IN refrigerated dryer to remove any excess moisture from the process stream. A second Ingersoll Rand Model F71IG will be installed immediately following the refrigerated dryer to further purify the process air stream. Each F71IG general purpose filter has 42 CFM capacity at maximum operating pressure of 250 psig, and is capable of removing particulate matter to 1 Micron. The 115-volt, 60-amp, single-phase D72IN refrigerated dryer has a capacity of 42 CFM at a maximum operating pressure of 203 psig. The D72IN has an ISO Class 6 dew point at 50 degrees Fahrenheit (°F).

2.5.2.2 Description of Lime Feeder Systems Components and Controls

Located inside the equipment area of the lime silo, directly below the lime storage area, is the bin discharge, maintenance slide gate, Accurate Feeder®, screw conveyor, and air compressor (see Figures 6 and 7). The bin discharge vibrates at a specified interval and prevents any lime from clogging within the cone and assists in keeping the Accurate Feeder® supplied with lime. The time on and time off for vibration of the bin discharge can be adjusted by the operator depending on density and volume of the lime stored in the silo. The Accurate Feeder® then meters the lime into the screw conveyor at a regulated rate, which is adjusted according to influent flow rates, and current operating conditions. The screw conveyor, which has a constant speed, then transfers the lime into the lime slurry tanks shown on Figure 6. Routine tasks for the lime feeder system components are presented in Appendix B.

2.5.3 Lagoon System A

Lagoon System A, constructed during the 2004 modifications, consists of the following 3 cells: A1, A2, and A3 (see Figure 8). Cell A1 provides primary settling of solids for the treated influent flows that enter Lagoon System A. Treated influent water flows to the west end of the cell through a silt curtain. The silt curtain in Cell A1, manufactured by Gunderboom®, is approximately 50 feet wide and is used to filter the water and distribute the water over a greater area. The water is then discharged into Cell A2 by means of Outlet Structure (OS) 1. The outlet structures act as flow control devices for each cell; Section 3.1.1 presents a detailed description of their operation, components, and purpose. Cell A1 has a surface area of approximately 44,588 square feet (ft^2) at the average depth of 8.0 feet, and a full pool volume of 181,386 cubic feet (ft^3) at 5,423.5 feet amsl, the maximum operating water elevation (see Table 1).

Cell A2 is located directly downstream of Cell A1. Cell A2 has a surface area of approximately 120,150 ft^3, an average depth of 7.5 feet, and a full pool volume of 525,013 ft^3 at 5,422.75 feet amsl, the maximum operating water elevation. Once water from Cell A1 reaches Cell A2, it flows west to OS-4 located on the west end of the D2 Dike or OS-5 located on the west bank of Cell A2. Outlet structure 4 diverts water into Cell D2 and OS-5 has the ability to divert water to Effluent Line (EL) C or Cell A3. Diversion of flow to these different locations depends on volume of flow, lagoon water elevation and quality of water leaving Cell A2.

Cell A3 is the final cell in Lagoon System A. Water from Cell A2 is discharged on the east end of Cell A3 from OS-5 and flows west to OS-7. Here water is diverted to either Cell D4 if retreatment is necessary, or EL-D to be discharged to Silver Bow Creek. Cell A3 has a surface area of 157,440 ft^2, an average depth of 8 feet, and a full pool volume of 540,559 ft^3, at the maximum operating water elevation of 5,422.5 feet amsl.

2.5.4 Lagoon System B

The 3 original treatment lagoons, which make up treatment Lagoon System B, have been utilized for water treatment since their construction in 1997. Lagoon System B is located within the central portion of the treatment lagoon area directly west of the CAS Building (see Figure 8). During the 2001 improvements, Cell B1 was expanded to the east approximately 60 feet and the floor was excavated to approximately 5,416 feet in elevation. An additional 1 foot of depth was excavated on the eastern one-third of Cell A1 to create an accessible area for sediment collection and removal. The floors of Cells B2 and B3 remain in their original configurations, sloping from an elevation of 5,418 feet amsl on the north side of each cell to 5,416 feet amsl on the south side.

Treated water from the Distribution Tank flows through Distribution Channel B to Cell B1 and first enters Cell B1 on the east bank and travels west through a 120-foot silt curtain for approximately 200 feet until it reaches Treatment Wall (TW) B1, which separates Cells B1 and B2 and is constructed of 3- to 6-inch rock. The treatment walls act as filters for the suspended solids created from the chemical reaction of the hydrated lime once it mixed with the influent stream.

Water flows through and over the treatment wall. Once the water enters Cell B2, it travels west approximately 150 feet until it reaches TW-B2 where further filtration of any solids that may have migrated through TW-B1 occur. After water travels through TW-B2 it then enters Cell B3, which acts as the final polishing cell in Lagoon System B. Water travels west to OS-2 where it can be diverted to either Cell A2 located directly to the west or into Effluent Line B (EL-B). Maximum water elevations and full pool volumes for the B system can be found in Table 1.

2.5.5 Lagoon System C

Lagoon System C is constructed much like Lagoon System B and consists of 3 treatment lagoons operated directly south of Lagoon System B adjacent to the reconstructed Silver Bow Creek floodplain. The total volume of these lagoons is approximately the same as the Lagoon System B. This lagoon system has been utilized for water treatment since 2001.

Treated influent water enters Cell C1 on the east bank and travels west, through a 50-foot silt curtain for approximately 300 feet to TW-C1, these treatment walls aid in filtration of suspended solids much like the treatment walls in Lagoon System B, but are constructed of 6- to 9-inch rock.

After water filters through and over TW-C1 it enters Cell C2 and continues to travel west for approximately 200 feet until it reaches TW-C2, which was constructed the same as TW-C1.

Once water enters Cell C3, which is the final cell much like Cell B3, it flows approximately 175 feet to OS-3 located on the west bank of Cell B3. Outlet structure 3 has the ability to divert flows to either Effluent Line A (EL-A), Cell A2, or D2 depending on lagoon elevation, volume of flow, and water quality leaving Cell C3. Maximum water elevations and full pool volumes for the C System can be found in Table 1.

2.5.6 Effluent System

Original construction of the BTL Effluent System was completed during the fall of 2004. Detailed as-built drawings are available for the lagoons in Appendix A, and also *BTL Effluent System, in the Draft Final As-Built Drawings and Information for the Butte Treatment (BTL) Systems* (Atlantic Richfield Company, 2006). The Effluent Pipeline System and outlet structures have been designed to discharge the maximum flows through each series of treatment lagoons as described in Section 3.2.2 without overtopping any of the berms or dikes separating the treatment lagoon cells while utilizing gravity flow only.

As a contingency to operating the system with gravity discharge, electrical services, pumps, pump controls and the associated fittings, flow meters, and control valves are also installed. The location, size and maximum pump rate for each effluent pump within the BTL is presented in Table 2. The effluent pumps were installed to transfer treated water directly to the Effluent Pipeline System and ultimately Silver Bow Creek.

Treated water from the lagoons may be discharged to downgradient lagoon cells during differing operational situations as discussed in Section 6.0. During routine operations all effluent is discharged to Silver Bow Creek near sampling location CT-EFS-7, shown on Figure 1.

In addition to gravity discharge through the effluent pipeline and discharge of water by use of the effluent pumps, direct discharge pipes from each of the outlet structures shown on Figure 8 will allow water to be discharged into downgradient treatment lagoon cells or to Cells D2 and D3 by use of gravity. These direct discharge pipes will allow water to be routed to the next downstream treatment cell for additional treatment, increasing flow to downstream cells to maintain treatment effectiveness in these cells, or routing of treated water that does not meet discharge criteria to Cell D4 for retreatment through the entire BTL treatment system recirculation. Table 3 presents general location and operational information for each of the effluent pipelines within the BTL. Table 4 presents dimensional information for each discharge pipe within the BTL.

The ASB houses the ISCO® automatic sampler (U-ASB-101), peristaltic pump (P-ASB-101), Rosemount water level probe (LT-ABS-101), heater (U-ASB-102), and main electric box for the IPS (EL-ASB-103) (see Figure 9). This sampling point is located on the southeast end of Cell D4 (see Figure 4). The automatic sampler is placed in a 10 by 12-foot building. For maintenance and operation refer to the ISCO® owner's manual maintained in the CAS Building (Appendix B).

2.6 Electrical, Automation Control, and Monitoring Description

The following subsections provide a general description of the electrical systems at the BTL. Site dedicated back-up generators provide back-up power to the site. Back-up generators are located at the IPS and CAS Building to provide emergency power at each site.

2.6.1 Electrical Services Equipment Descriptions

NorthWestern Energy is the operating electric utility that supplies power to this area. The BTL system has a total of 5 electrical services all fed by NorthWestern Energy overhead distribution lines operating at 15,000 volts. The pole-mounted transformers are protected on the primary side by a set of distribution fuse cutouts. These cutouts are sized to protect the transformer from internal transformer faults. The utility company may manually cut out the fuses to isolate the transformer from the distribution circuit. The fuses will melt in response to abnormal current flow in the transformer coils.

Each service has a main breaker that controls/protects the electrical system at that location. The main breaker and subsequent breakers will be found in one of 3 positions: 1) ON, 2) OFF, or 3) TRIPPED. All breaker panels located within the BTL have panel schedules inside the door and indicate the load served and circuit breaker number.

2.6.1.1 Chemical Addition System (CAS) Building Service

A 3-phase bank of pole-mounted transformers rated 150 kilovolt-ampere (KVA) provide the CAS Building with 480Y/277-volt power. The underground service supplies the building with a 200-amp electrical service. A 480-volt breaker panel supplies power to the 100-amp filter press and to a 30 KVA 3-phase 480-volt to 240/120-volt transformer that feeds the building's 100-amp panel. All 240-volt and 120-volt loads in the CAS Building are fed from this 100-amp panel. Caution: this 100-amp 240/120-volt panel contains 208 volts from phase C to ground.

2.6.1.2 A1 Area Service

A 3-phase bank of pole-mounted transformers rated 26.1 KVA provide this area with 480-volt power. The overhead service supplies the A1 Area Service Rack with a 50-amp electrical service. The meter base service disconnect is located on a utility pole and the 50-amp main breaker controls power at all A1 Area locations via underground conduit. A 5 KVA transformer serves all 240/120-volt loads at this area.

A2 Area Service: A 3-phase bank of pole-mounted transformers rated 75 KVA provide this area with 480Y/277-volt power. The underground service supplies the A2 Area Service Rack with a 100-amp electrical service. The meter base service disconnect is located on the service rack and the 100-amp main breaker controls power at all A2 Area locations. A 5 KVA transformer serves all 240/120-volt loads at this area.

A3 Area Service: A 3-phase bank of pole-mounted transformers rated 75 KVA provide this area with 480Y/277-volt power. The underground service supplies the A3 Area Service Rack with a 100-amp electrical service. The meter base service disconnect is located on the service rack and the 100-amp main breaker controls power at all A3 Area locations. The ASB is located on the south end of A3 Area. The 480-volt service feeds the ASB where 240/120-volt loads at this area are served by a 7.5 KVA transformer.

2.6.1.3 D4 Area Service

A 3-phase bank of pole-mounted transformers rated 75 KVA provide this area with 480Y/277-volt power. The overhead service supplies the D4 Area Service Rack with a 100-amp electrical service. The meter base service disconnect is located on a utility pole and the 100-amp main breaker controls power at all D4 area locations via underground conduit. A 5 KVA transformer serves all 240/120-volt loads at this area.

2.6.1.4 Control and Monitoring Device Electrical Summary

The BTL/LAO control system utilizes Allen-Bradley ControlLogix for the primary control and master polling PLC located at the Operations Building. This primary PLC controls and monitors the lime addition process and associated systems and polls each secondary PLC located at remote sites for data. Total polling time to contact and receive data from the remote sites does not exceed 30 seconds using a CalAmp Viper FCC licensed Ethernet data radio operating in the 400MHz range. The encrypted FCC-licensed radio–to-radio communication is capable of transmitting data up to 128 kilobytes per second (kbps) at 10 watts of effective power.

Data that have been transmitted back to the Operations Building it is displayed on the operators' HMI, Invesys Wonderware InTouch software, screen in the control room. The Wonderware software monitors all local statuses for the CAS and the status of all remote stations. The HMI also accepts operator set points and alarm set points. Graphical display screens with data trending capabilities are available for all process areas and show all process variables, equipment status or state, system set points, and alarm history.

A dedicated desktop computer located in the Operations Building control room has the HMI software installed. The computer has two monitors, one for the lime addition process and local system and one for the remote sites, and a hard drive capable of logging all system data for an extended time period. An optional client version of the Wonderware software is also installed directly in the CAS Building process area on the existing panel mounted BSI computer to allow operator monitoring of levels, flows, set points, and alarms for the lime process.

The following information is a summary of the electrical devices for control and monitoring at the BTL:

1. CAS Building:
   a. Operator Interface: The following devices are located in the Treatment Control Panel located on the southeast corner of the CAS Building:

- HMI Computer and Screen;
- PLC;
- Master Radio Interface;
- Process Set Points and Alarms;
- System Trends and Historical Logging;
- Alarm Dialer;
- Uninterruptible Power Supply (UPS); and
- Surge Protection for Line Power and Analog Isolation.

b. Lime Feeder System Control Panel: The following devices are controlled by the Lime Feeder System Control Panel located on the northeast corner of the CAS Building:

- Accurate Feeder® Screw Motor;
- Accurate Feeder® Paddle Motor;
- Dust Collection Fan;
- Bin Discharge;
- Screw Conveyor;
- Tank Selector; and
- Air Compressor.

c. Slurry Tank Control Panel: The following devices are monitored or controlled by the Slurry Tank Control Panel located on the south side of the CAS Building:

- Tank 1 and 2 Levels; and
- Tank 1 and 2 Mixers

2. A1 Area Station:

a. 480-Volt Alternating Current (VAC) Distribution Breaker Panel;
b. Three Pump Hand-Off-Auto switches for local control of optional effluent 15 HP, 5 HP, and 5 HP pumps;
c. PLC;
d. Remote Radio Interface;
e. Surge Protection for Line Power and Analog Isolation;
f. NEMA 4 Enclosure and Panel Heater; and
g. 120-VAC Branch Circuit Breaker Panel.

3. A2 Area Station:

a. 480-VAC Distribution Breaker Panel;
b. Two Pump Hand-Off-Auto switches for control of optional effluent 15 HP pumps;
c. PLC;
d. Surge Protection for Line Power and Analog Isolation;
e. NEMA 4 Enclosure and Panel Heater;
f. Remote Radio Interface; and

g. 120VAC Branch Circuit Breaker Panel.

4. A3 Area Station:

   a. 480VAC Distribution Breaker Panel; and
   b. Two Pump Hand-Off-Auto switches for control of optional 15 HP effluent pumps.

5. ASB Station (at southern end of A3 Area):

   a. PLC;
   b. Remote Radio Interface;
   c. Surge Protection for Line Power and Analog Isolation;
   d. NEMA 4 Enclosure; and
   e. 120VAC Branch Circuit Breaker Panel.

6. D4 Area Influent Pumping Station:

   a. 480VAC Distribution Breaker Panel;
   b. Four Pump Hand-Off-Auto switches for local control of two 75 HP influent pumps; and
   c. 120VAC Branch Circuit Breaker Panel.

7. WCP-1:

   a. 480-VAC Distribution Breaker Panel;
   b. VFD Pump Control Panel;
   c. PLC;
   d. Remote Radio Interface;
   e. Surge Protection for Line Power and Analog Isolation;
   f. NEMA 4 Enclosure and Panel Heater; and
   g. 120-VAC Branch Circuit Breaker Panel.

8. MSD Pump Station:

   a. 240/120-VAC Single Phase Distribution Breaker Panel;
   b. VFD Pump Control Panel;
   c. PLC;
   d. Analog Interface Terminal for future analog points;
   e. Remote Radio Interface;
   f. Surge Protection for Line Power and Analog Isolation; and
   g. NEMA 4 Enclosure and Panel Heater.

2.6.2 Lime Addition Rate and Influent Pump Station Automation[1]

The lime addition rate and IPS controls are automated to accommodate changes in the system without requiring operator interface. In the event that the influent flow rate changes, the automation adjusts the lime addition rate to maintain the target lime rate, and if lime addition is interrupted for a set time period, the influent system will shut down to prevent flow of untreated water through the lagoon cells. Alarms and callouts are provided according to priority within the system.

The automation regulates the IPS and lime addition rate system during interruptions. To prevent influent water from receiving inadequate or zero lime addition during lime feeder system interruptions, the controls for the IPS shuts down the pumps. To prevent excessive lime addition to the slurry tank during influent flow rate interruptions, the lime system is brought offline automatically. All interruptions to the treatment system are monitored, alarmed, and the operator(s) automatically notified. Once the interruptions are corrected, the operator must manually restart the treatment system and perform the daily routine checks to ensure that the startup was successful and all initial system settings are appropriate. The following sections describe the equipment settings and operation of the lime addition and IPS automation equipment.

2.6.2.1 Interruption Interval

The control system is configured to shut down the lime feeder system when the influent pumps are interrupted for a period greater than 30 minutes. The influent pumps are shutoff when the lime feeder system is interrupted for a period greater than 30 minutes. The following is a system overview of components involved in the influent pump control and lime feeder system process:

- The CAS Building contains the primary PLC computer, multiple monitors, radio telemetry base station, and the lime addition system;
- The ASB contains a secondary PLC with a control program for operating the influent pumps and radio telemetry communication with the CAS Building;
- The Influent Pump Control Panel contains four operator interface switches for local pump control with wiring interface to the ASB and the influent pump Starter Cabinet; and
- The influent pump Starter Cabinet located on the D4 Electrical Service Rack contains the pump starter units and 480 VAC / 3 Phase power to operate the pumps. The starter unit for each pump contains a HAND-OFF-AUTO switch for operating the pumps in manual, off, or automatic configurations.

[1] Automated components under design revision at the time of this document being written. Revisions are TBD.

2.6.2.2 Lime Addition Rate Automation

The Accurate Feeder® lime rate HAND-OFF-AUTO (HOA) switch on the Lime Feeder System Control Panel controls the automation or manual adjustment of lime rate addition.

AUTO MODE

While the Accurate Feeder® lime rate switch is in the AUTO or automatic position, the rate of lime addition is controlled automatically. The WonderWare control screen allows the operator to enter a value to decrease or increase the lime rate. Once a value is set, the Accurate Feeder® motor speed determines the amount of lime that is fed into the system. Therefore, the amount of lime that enters the system is automatically increased or decreased in direct proportion to the influent flow rate.

HAND MODE

While the Accurate Feeder® lime rate switch is in the HAND or manual position, the operator manually controls the lime rate. In manual operation, the operator adjusts the feed rate knob on the Lime Feeder System Control Panel to change the speed of the Accurate Feeder® motor. A transducer mounted on the outside of the motor gear shaft sends a value to the digital panel meter display located on the front of the Lime Feeder System Control Panel. The panel meter displays the rpm of the motor shaft with a 9.25 gear ratio offset. While operating in the HAND position, the operator must manually measure and confirm the lime addition rate on a routine basis (see SOP-8 provided in Appendix C).

2.6.2.3 Influent Pump Station Automation Control

The CAS Building PLC has input parameters that are directly related to continued D4 pump operation. If the influent flow rate drops below 400 gpm for a period greater than 10 minutes, the CAS Building PLC program sends a signal to the IPS PLC to shut the pumps off. The D4 Pump Remote Stop Button is located on the Lime Feeder System Control Panel and is used to shut down the D4 pumps in an emergency situation. If there is a communication failure between the CAS Building and the IPS radios for a period greater than 10 minutes, the IPS PLC will shut the pumps off. The control system is configured to shut down the lime feeder system when the influent pumps are interrupted for a period greater than 30 minutes. The control system will also shut the influent pumps off when the lime feeder system is interrupted for a period greater than 30 minutes. The IPS PLC transmits a signal to the CAS Building PLC to indicate the status of the D4 pumps. When both pumps are off, the CAS Building PLC program will shut down the lime system.

2.7 Description of Monitoring Facilities

2.7.1 System Overview

The BTL facilities include an extensive and varied information collection system. Monitoring facilities include the following:

- Staff gauges and pressure transducers are installed at pond level at Cells A1, A2, A3, B1, B3, C1, C3, and D4;

- Monitoring of pump status (i.e., on/off) and flow rate is performed at Cells A1, A2, A3, B3 and C3 during pumping operations;

- Water quality monitoring/sampling facilities are installed within the Automatic Sampler Building and within the CAS Building; and

- Lime feeder system equipment/process status monitoring is done at the CAS Building.

Information developed by the above monitoring systems is used to provide:

- Input for control and adjustment of the lime feeder system;

- Activation of alarms to notify the operator of conditions that require attention and/or correction action;

- Informational displays that provide the operator with an instantaneous overview of system status;

- Supplemental information that can be accessed by the operator to troubleshoot a problem or examine an aspect of system status in more depth; and

- Record documenting system performance relative to applicable performance standards.

The following paragraphs describe the monitoring system measurement technologies and the nature and availability of the data produced. The information is presented from the broad scale to the more complex items in the following sequence:

- Water level and flow rate monitoring;

- Water quality monitoring; and

- Equipment/process status monitoring.

2.7.2 Water Level and Flow Rate Monitoring

The cell levels and flow rates are monitored at a number of locations on the site. Flow rates and cell levels can impact the effectiveness of the water treatment systems and therefore must be strictly monitored. In several locations, particularly relative to Lagoon Systems A, B, and C, electronic pressure sensors measure water surface elevation. Flow rates are monitored and recorded the effluent station, the CAS Building, WCP-1, and MSD pump station. The software then logs the input data at 30-second and 1-hour intervals into separate files. The measurement stations established for the system all report data back to the monitoring system located at the Operations Building. The systems are summarized below:

Metro Storm Drain flow is measured with a 10-inch McCrometer® UltraMag flow meter (MSD-FIT-6019) installed at the MSD pump station discharge.

West Camp flow is measured by the McCrometer UltraMag flow meter (FIT-WCP-5006) installed in WCP-1 discharge piping.

Lagoon Water Surface elevations are measured by an electronic pressure transducer installed in a round stilling well fastened to the wing wall of the primary outlet structure in Cells A1, A2, A3, B1, B3, C1, and C3. The stilling basin is provided to minimize the effect of wave action and ice formation on the cell. Typical stilling well construction is shown on Figure 10. Operating elevation and structure height schedule are also provided.

Influent Flow is measured with a 10-inch McCrometer® UltraMag (FIT-LAO-1059) flow meter installed on the influent pipeline within the CAS Building.

Effluent Flow is measured by a Greyline® Area-Velocity Flow Meter (AVFM) (FI-LAO-110) attached near the outlet to the invert of EL-A. The AVFM measures the depth and velocity of EL-A, and calculates a flow rate that is transmitted to the Allen-Bradley ControlLogix Master PLC and recorded.

2.7.3 Water Quality Monitoring[2]

Several approaches to water quality monitoring are used depending on the purpose of the data. The measurement stations and facilities that have been established and the parameters to be measured are described in the following paragraphs. Detailed sampling and analysis procedures are specified in Appendix G. Additional information regarding field measurements and routine calibration tasks are discussed in Section 8.4. Monitoring station locations are shown on Figure 4.

Influent water quality is monitored in order to provide baseline information for influent flows that enter the treatment facilities and to aid in determining lime addition rates for the CAS. The influent water sample point (Cell D4 Influent) is located within the CAS Building and utilizes an ISCO® automatic composite water sampler. In addition, the operator takes manual measurements of influent water temperature, pH, dissolved oxygen (DO), and specific conductivity (SC) on a daily basis. Measurements are recorded in the Field Parameter Logbook maintained in the ASB.

Effluent water quality is monitored at ASB (Sample Station CT-EFS7) to evaluate the effectiveness of treatment Lagoon Systems A, B, and C. A stilling well is constructed from the invert of EL-A at Station 0+60 (see Figure 10) for water sampling monitoring. An ISCO® automatic composite water sampler is installed inside the ASB located near the southeast corner of Cell D4.

[2] Water quality monitoring parameters are under review at the time of this documents being written.

2.7.4 CAS/Equipment Status

Following is a brief description of the specific data items available from monitoring of facilities/equipment at the CAS treatment facilities.

- **Influent flow.** The influent flow meter (FIT-LAO1059) is set to alarm when the flow is above or below set parameters.

- A **high flow alarm** indicates the amount of water being pumped is actually above the expected maximum flow. Electrical equipment malfunction is a probable cause for this alarm.

- A **low flow alarm** may be an indicator that there is a loss of power or mechanical failure with the influent pump.

- **Slurry Tank Levels**. Level transducers (LT-LAO1049 and LT-LAO1039) installed in Slurry Tanks 1 and 2 located within the CAS Building. When the liquid level in either of the tanks is above or below the set high and low level parameters, an alarm is activated.

- **High-level alarms** indicate there is a potential clog in the lime system preventing discharge from the tank.

- **Low-level alarms** provide indicators that adjustments to flows entering the slurry tanks are required, or a tank is running low on slurry and needs to be taken off-line and refilled.

- **Silo Level.** A Bindicator® GP-4 Yo-Yo® Meter (LT-LAO1000) installed in the lime silo. The meter indicates the volume of lime stored in the silo will activate an alarm if the level is above or below the set parameters.

- **Lime auger.** An on/off switch installed on the Accurate Feeder® (U-CAS-120) activates an alarm if the auger is not turning.

- **Air compressor.** Redundant skid-mounted air compressors provide service air to pneumatically actuated valves, and baghouse pulse jet system. A pressure switch located after the air filtering and drying unit activates an alarm if the pressure level is below the set parameters.

Various additional monitoring instruments provide real-time indication of system operational status such as lagoon levels, flows, and equipment run (ON/OFF) status.

3.0 HYDRAULIC CONTROLS

3.1 Description of Hydraulic Controls

Most hydraulic controls at the BTL are manually operated. These include:

- Weir gates;
- Canal gates – Waterman Canal Gates;
- Stop logs – Fiberglass Reinforced Polyester (FRP) Stop Logs; and
- Pumps.

The hydraulic controls have one routine operation setting, which is not to be changed by the operator until after consultation and approval from Atlantic Richfield Project Manager. Groundwater hydraulic gradients must be maintained to prevent impacted groundwater from discharging to Silver Bow Creek.

The HCC is passively operated and adjustments are not routinely required. The water level within each of the D Cells can be manipulated by installing or removing stop logs in their respective structures. The following subsections describe the components and areas associated with each hydraulic control.

3.1.1 Outlet Structures

The outlet structures are located on several cells throughout the treatment system, each (excluding OS-6 and OS-8) utilize a weir gate (downward opening slide gate) as the main flow control component (see Figure 8). These gates can be manually set at a desired position in order to maintain a target water elevation within each cell.

Outlet structures (OS-6 and OS-8) contain stop logs in place of weir gates, which are used to control water levels the same way by adding or removing the stop logs in order to achieve the desired cell water elevation. Figure 8 presents details of each outlet structure, including minimum and maximum operating levels, and an associated schedule of stop logs required to achieve the desired operating level.

3.1.2 Pumps

In addition to the influent station, auxiliary pumps stored within the site inventory location on-site and are used as a backup for the outlet structures. The pumps can be used as back-ups if an outlet structure or an effluent system line is blocked, clogged, etc. The pumps can also be used if an extremely high flow is being pumped through the system and the gravity flow system will not carry it. Figure 11 shows how they are integrated into the Effluent System and where they are located. Table 2 also gives a description of each pump for each installation location. Operation of these pumps is intended for use during upset, non-routine conditions.

3.1.3 Hydraulic Control Channel

The HCC as described in Section 2.2.3 is a groundwater collection channel, which runs nearly the entire length of the LAO site. As previously stated, the HCC is passively operated and adjustments are not routinely required. The HCC can be isolated from Cell D4 with a canal gate, which is installed at the west end of the 36-inch corrugated metal pipe (CMP) that connects the facilities. There are five weirs used to control flow in the HCC and are located throughout the HCC.

3.1.4 Groundwater Interception Areas

Cells D2 and D3, as described in Section 2.4.2, create a hydraulic gradient for groundwater away from Silver Bow Creek and also act as an alternate recirculation route for the Treatment Lagoons. Water levels in Cells D2 and D3 are controlled with outlet structures that utilize stop logs for flow control devices, as described in Section 3.1.1.

3.1.5 Metro Storm Drain Collection System

The MSD collection system, as described in Section 2.4.5, is one of the 2 primary groundwater pumping stations to the BTL-LAO system. This system conveys captured impacted groundwater from the MSD subdrain to the BTL systems. Flow rate is controlled via pump VFD to maintain a constant level in the MSD wet vault. However, flow cannot be redirected from MSD, or interrupted for a prolonged period[3].

3.1.6 West Camp Collection System

The WCP-1 collection system, as described in Section 2.4.4, is the primary pumping system to convey water from West Camp. The groundwater extraction system pumps water from the WCP-1 pumping well and conveys it through a discharge line to HCC conduit. The pump is equipped with a VFD which is used to control flow rate of the pump. West Camp flow can be interrupted for prolonged periods, up to 26 days due to available underground storage volume associated with the West Camp system.

3.2 Description of System Hydraulic Operations

The BTL systems are designed to provide maximum flexibility during anticipated various flow conditions depending on current water levels, flow conditions, and influent water chemistry. The following sections describe scenarios of anticipated range of design flow conditions and how the system should be operated during each of those scenarios.

[3] Contingency options are under evaluation at the time of this document being written.

3.2.1 Routine Flow Path

The following scenarios describe routine effluent flow paths. Routine flow for the system indicate effluent flow meets established parameters for pH, at the lagoons, and criteria monitored at the ASB.

The routine flow path of water within the BTL will not require recirculation, retreatment, or series operation of the lagoon systems. Routine flows are defined as those that range from a low flow of 700 gpm to the expected maximum flow of 1,880 gpm. For the purpose of this operational scenario, three routine operating flows were selected. These flows include low flow, average annual flow, and the expected maximum flow. Figure 3 presents a flow diagram for routine flow conditions outlined for the treatment system. In order to get similar residence times in each lagoon system (i.e., A, B, and C Systems) the flows are be distributed as percentage of overall flow:

- Approximately 50% of the overall flow is diverted into Lagoon System A from the Distribution Tank.

- The remaining 50% is distributed between Lagoon System B and C from the Distribution Tank.

- Typically Lagoon System B and C each receive approximately 25% each.

- Flow exiting from Lagoon System B can be either diverted into EL-B or Cell A2. Flow will be diverted from Cell B3 into EL-B (i.e., water quality at or near discharge standards and target water levels are achieved in the treatment cells).

- Flow exiting from Lagoon System C can be either diverted into EL-A, Cell A2, or D2. Flow will be diverted from Cell C3 into EL-A (i.e., water quality at or near discharge standards and target water levels are achieved in the treatment cells).

- Flows entering Cell A2 can be diverted into D2 through OS-4, into Cell A3, or into the effluent line (EL-C) at OS-5. Flow will not be diverted into Cell D2 during routine conditions. Flows will be diverted through OS-5 to Cell A3 and will not be diverted to Cell D2 or EL-C. Water can be split between Cell A3 and EL-C if water quality permits, but a minimum of 400 gpm will be routed into Cell A3 to maintain required water levels and prevent exfiltration of impacted groundwater into this cell.

- Flows entering Cell A3 can be diverted into EL-D or Cell D4. All flows will be diverted into EL-D unless sample results at Cell A3 indicate water is not meeting discharge standards, then flows will be diverted into Cell D4. All flow will be discharged from Cell A3 into EL-D.

3.2.2 High Flow Path

High flows are those influent flow rates between 1,500 gpm and the designed maximum treatment system flow rate of 1,880 gpm. High flow situations could be related to high pump rates from WCP-1, MSD, or high rates collected from the HCC. High flow could also occur if a cell within the Lagoon System is drained and discharged in Cell D4. The large amounts of influent water created from any of these situations can be stored by allowing the water level to rise in Cell D4 until it can be pumped down and treated. Currently, the normal operating water level in Cell D4 is 5,414.5 feet amsl, and it can store inflow water by allowing the D4 level to rise to 5,417 feet amsl. During periods of high flow each lagoon system receives additional flow proportional to the overall flow. Additional provisions are not required

Short-term flows over the estimated 1,800 gpm designed maximum treatment system flow rate will be directed into Cell D4 where the water can fill the cell to 5,417 feet amsl and be stored until it can be pumped down.

3.2.3 Low Flow Path

During low flow conditions, or flows less than 700 gpm; routine operations are conducted with the following modifications:

- Minimum of 200 gpm is diverted into Lagoon System B from the Distribution Tank.
- Minimum of 200 gpm is diverted into Lagoon System C from the Distribution Tank.
- Remaining flow is diverted into Lagoon System A from the Distribution Tank.
- Flow from Lagoon System B is either diverted into EL-B or Cell A2. If influent flow to Cell A1 is below 300 gpm, then flow from Cell B3 and/or C3 should be discharged to Cell A2 to maintain water levels in Cell A2 and Cell A3.
- Flow from Lagoon System C is either diverted into EL-A, Cell A2, or Cell D2. If influent flow to Cell A1 is below 300 gpm, then flow from Cell C3 and/or B3 should be discharged to Cell A2 to maintain water levels in Cell A2 and Cell A3.

3.2.4 Alternate Flow Operations

Effluent flow can either be parallel/series flow in which flow is divided into A, B, and C lagoon flow as described above. Each lagoon utilizes three cells in series to complete treatment before discharge to Silver Bow Creek. Recirculation flow is attainable when additional treatment or retention time is required prior to discharge. The following sections describe these flow operations.

3.2.4.1 Operation in Series

An alternative flow path for routine conditions is the operation of the cells in series. By diverting flows from Lagoon Systems B and C into Cell A2, the water will be passed in series throughout the lagoon system and ultimately discharged to Silver Bow Creek from Cell A3. Figure 2 shows the available flow path alternatives.

3.2.4.2 Recirculation Flows

If water does not meet the discharge criteria (see Section 5.0) in one or any of the treatment cells, there are several locations (OS-3, OS-4, and OS-7) that allow water to be recirculated through the system for retreatment. Structures OS-3 and OS-4 can divert flows from Cells A2, B3, and C3 into Cell D2 and eventually to Cell D4 where it can be recirculated through the system. Structure OS-7 can be used to divert flows from Cell A3 into Cell D4 where it can be recirculated through the system. The decision tree BTL-DT-8, is located in Appendix F and provides decision making guidance when recirculation is considered.

3.2.5 Routine Operations

Routine operations of each component of the BTL systems are described in the following paragraphs. Table 1 presents the operating range and target operating levels of each cell in the treatment system. The BTL systems data for routine operations is summarized in the BTL Weekly Operations Report provided in Appendix H.

Distribution Tank (T-LAO-6). The weir gates on the Distribution Tank will be adjusted to maintain a minimum freeboard of 4 inches while still allowing flow to be distributed as necessary to each of the Lagoon Systems (A, B, and C). The Table 5 provides guidance when setting the weir height to establish flow into the cells.

Cell A1. Under routine conditions, a majority of flow regulated with Weir Gate A, which is located in the Distribution Tank, is diverted through Cell A1 to the outlet structure. *Initial target water level for this cell is 5,423 feet amsl and the weir gate in OS-1 can be adjusted accordingly to achieve this water level range of operations of 5,421 to 5,423.5 feet amsl*. From OS-1 there are two, 15-inch discharge pipes that extend from the bottom of OS-1 to the northeast corner of Cell A2 that allow flow to be dispersed into Cell A2.

Cell A2. Water levels in Cell A2 can be regulated with either OS-4 or OS-5. During routine conditions, OS-4 will be closed (raised to the full upright position) and all flows will be regulated with OS-5, which diverts water to Cell A3 or EL-C. Manual settings of the weir gate in OS-4 located in Cell A2 determine the water levels of the cell. The initial *target operating level of this cell is 5,421.25 feet amsl*. Water can be discharged either to Cell A3 through a 24-inch discharge pipe which extends from the bottom of OS-5 to the east edge of Cell A3 or to the effluent pipeline through EL-C.

Cell A3. Water levels in Cell A3 can be regulated with OS-7. Manual settings of the weir gate in OS-4 located in Cell A3 determine the water levels of the cell. _The initial target operating level of this cell is 5,420.5 feet amsl._ Water can be discharged either to Cell D4 through an 18-inch discharge pipe which extends from the bottom of OS-7 to the east edge of Cell D4 or to the effluent pipeline through EL-D.

Lagoon System B. Flow into Lagoon System B is regulated with Weir Gate B located in the Distribution Tank. Manual settings of the weir gate in OS-2 located in Cell B3 determine the water levels of Lagoon System B. _The initial target operating level of this system is 5,422.5 feet amsl._ Water can be discharged either to Cell A2 through a 12-inch discharge pipe which extends from the bottom of OS-2 to the east edge of Cell A2 or to the effluent pipeline through EL-B.

Lagoon System C. Flow into Lagoon System C is regulated with Weir Gate C located in the Distribution Tank. Manual settings of the weir gate in OS-3 located in Cell C3 determine the water levels of Lagoon System C. _The initial target operating level of this system is 5,422.5 feet amsl._ Water can be discharged either to Cell A2 through a 12-inch discharge pipe which extends from the bottom of OS-3 to the southeast corner of Cell A2 or to the effluent pipeline through EL-A.

Cell D2. During routine operations, _the initial target operating water level_, which should be checked visually, of _Cell D2 is 5,419.5 feet amsl_, and this pool elevation will be controlled with stop logs located in OS-6. The outlet structures will be checked and cleaned of debris, if any.

Cell D3. During routine operations, the initial _target operating water level_, which should be checked visually, of _Cell D3 is 5,417.25 feet amsl_ and this pool elevation will be controlled with stop logs located in OS-8. The outlet structures will be checked and cleaned of debris, if any.

Cell D4. Under routine conditions, the water level at _Cell D4 will be maintained at approximately 5,414.5 feet amsl_ with only _one influent pump will be in operation_.

3.2.6 System Flexibility and Adjustment

Provisions have been made to enable operation of the BTL systems to respond to varying conditions and optimize overall treatment performance. The possible adjustments are summarized in the following paragraphs with a brief description of the purpose and effect of each adjustment. Some possible reasons for operating cells at their minimum operating level might include anticipated increased flows into the system or maintenance of the system. The maximum operating level might be utilized for retention of treated water to facilitate maintenance of downstream components.

Cell A1. Cell A1 _water level may be changed by manually adjusting the weir gate in OS-1_. The **routine minimum and maximum operating levels of Cell A1 are 5,421 and 5,423.5 feet** amsl, respectively. In the event that lower operating levels are required, the auxiliary pump can be operated to lower the water level to approximately 5,416 feet amsl.

Cell A2. Cell A2 *water level may be changed by manually adjusting the weir gate in OS-5*. The **routine minimum and maximum operating levels of Cell A2 are 5,420 and 5,422.75 feet** amsl, respectively. Water levels also may be changed by manually adjusting the weir gate in OS-4. This structure will be used to divert water into D2 when necessary. In the event that lower operating levels are required, the auxiliary pump can be operated to lower the water level to approximately 5,416 feet amsl.

Cell A3. The **minimum and maximum operating levels of Cell A3 are 5,419 and 5,422.5** feet amsl, respectively. In the event that lower operating levels are required, the auxiliary pump can be operated to lower the water level to approximately 5,416 feet amsl.

Treatment System B. Treatment System B *water levels may be changed by manually adjusting the weir gate in OS-2*. The routine **minimum and maximum operating levels of Cell B3 are 5,421 and 5,423.5 feet amsl,** respectively. In the event that lower operating levels are required, the auxiliary pump can be operated to lower the water level to approximately 5,416 feet amsl.

Treatment System C. Treatment System C *water levels may be changed by manually adjusting the weir gate in OS-3*. The routine **minimum and maximum operating levels of Cell C3 are 5,421 and 5,423.5 feet amsl**, respectively. In the event that lower operating levels are required, the auxiliary pump can be operated to lower the water level to approximately 5,416 feet amsl.

South Hydraulic Control. Cell D2 *water level can be changed by manually removing or adding stop logs in OS-6*. The **minimum and maximum operating levels of Cell D2 are 5,414 and 5,420 feet amsl**, respectively. Cell *D3 water level can be changed by manually removing or adding stop logs in OS-8*. The minimum and maximum operating levels of **Cell D3 are 5,414 and 5,417.5 feet amsl**, respectively.

3.2.7 Lagoon Retention Times

The BTL retention times are provided in Table 6. Volumes are based on an average operating water elevation given in the table.

4.0 SAFE OPERATING LIMITS

The following provides maximum allowable limits of process conditions to prevent damage to process equipment, personnel, and subsequent release to the environment. Line classes are established by safe operating pressure and temperature based upon the pipe material and size. The BTL-LAO system operates under two distinct operating environments. The system is a pressure-rated system from IPS to the lime slurry tanks. From the discharge of the lime slurry tanks, the system operates as an open channel flow system.

4.1 Pressure

Maximum discharge pressure at the IPS is 60 pounds per square inch gauge (psig). System operating pressure will not exceed 60 psig. Low pressure will not be less than atmospheric. Pressure components are not rated to maintain vacuum, or pressure less than atmospheric.

The BTL operates as an open water system. Open channel flow and open water cells are subjected to atmospheric pressure and pressure head created by water depth.

4.2 Temperature

Ambient temperature for the region is acceptable for the BTL system. Temperature range is -40 to 100 degrees Fahrenheit (°F). Temperature of the groundwater is typically within the range of 42 to 47 °F.

4.2.1 Groundwater

Temperature of the groundwater is typically within the range of 42 to 47 °F.

4.2.2 Pumphouse

Temperature within the pump house is maintained in the range of 55 to 75 °F.

4.2.3 Ambient

Ambient temperatures range from -40 to 110 °F.

4.3 Flow Capacity

The maximum design flow for the influent system and associated components is 1,880 gpm.

4.4 Electrical

Electrical systems are rated for outdoor, wet, and dusty environment. Type 4 NEMA enclosures are generally acceptable for these applications.

4.5 Protective Safety Devices

The following protective safety devices (PSDs) are installed within the LAO and CAS systems.

Tag Number	Device	Purpose
LT-LAO3001	Level Transmitter	Low level alarm of Vault D-4 1, prevents pump damage
LT-LAO3002	Level Transmitter	Low level alarm of Vault D-4 2, prevents pump damage
PS-LAO1009	Pressure Switch	Low pressure alarm of compressed air supply, to actuated valves
LT-LAO1036	Level Transmitter	High/low level alarm of Slurry Tank # 2, protects lime supply to influent
LT-LAO1043	Level Transmitter	High/low level alarm of Slurry Tank #1, protects lime supply to influent
FCV-LAO1019	Flow Control	Controls lime feed to Slurry Tank # 2, protects lime supply to influent
FCV-LAO1023	Flow Control	Controls lime feed to Slurry Tank # 1, protects lime supply to influent
LT-LAO1000	Yo-Yo Meter	Indicates Silo lime level, ensure lime availability to treat influent flow

5.0 PERFORMANCE STANDARDS[4]

Performance standards established within the *Butte Mine Flooding Operable Unit Site Consent Decree, CV OZ-35-Bu-RFC* (EPA, 2002) or administrative order for BPSOU will be attained. These standards are included in this report as Appendix D. Evaluation of current performance is conducted in quarterly reports. Montana Numeric Water Quality Standards (DEQ, 2010) are shown in Table 7.

6.0 ROUTINE OPERATION AND MAINTENANCE TASKS

The purpose of this section is to define the routine conditions and operator activities for the BTL systems. The definitions given are a starting point based on available design information and experience gained during the previous treatability studies. Routine operations are described as readily identifiable, planned tasks that must be performed on a known interval. Standard operating procedures are a set of written instructions which provide detailed instructions to perform a specific task following a specified method, have been risk assessed, controls identified to mitigate risks, and allow repeatable performance of the task. Routine operations regularly incorporate one or more SOPs. Appendix C contains SOPs for the BTL-LAO systems. In addition, Appendix F contains several troubleshooting and decision trees to return systems back to routine status.

6.1 Routine Operations Tasks

The operator's normal routine will include several standard tasks. These tasks include:

- As described in SOP-1, *CASB Initial Arrival*, located in Appendix C, start-of-day status check for the controls, outlet structures, lime feed area and Cell D4;
- Check of WCP-1 (*SOP-4; West Camp Check*) twice per week; and
- Daily check of MSD Pump Station and discharge.

The specific subtasks and activities in each of these routine tasks are detailed in the following subsections. Checklists provided in Appendix D identify routine tasks performed by the operator on weekly, monthly, bi-monthly and quarterly intervals.

Daily monitoring of cell levels, pH and flows are conducted by the operator. Instantaneous field data measurements and recordings are transferred to a computer system at the end of each work day. Daily recordings are used to verify lime feed rates, and influent flow rates. These field data are also used to generate a daily operations report as described in Section 10.0.

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[4] Final performance standards are pending agency agreements and the Final Consent Decree. Until the final performance standards are established, Montana DEQ-7 standards will be met.

6.1.1 Controls, Outlet Structures, Lime Feed Area, and Cell D4

Upon arrival at the project site each weekday, the operator will check alarms and current monitoring data on the HMI screen (EL-CAS-112). This is to provide the operator with a quick overview of the facility and operating conditions so he/she can give immediate attention to major problems, if any. The Daily Ops Report presents an initial checklist for this task.

The operator will review the previous day's monitoring data. As described in Section 8.0, graphical records are to be developed that plot daily summary/indicator data for the following categories of information:

- Lime Operations (daily use, average mg/L);
- Hydraulics (daily flow rates of influent and effluent and water levels); and
- pH (daily readings of influent and effluent).

These data will be reviewed to detect trends (within the previous 1 to 2 weeks) and seasonal variations (over the past several months as compared with previous year or "typical" years). Some operational modifications may warrant making operating adjustments due to subtle changes in the treatment system performance that the operator detects during this review. Circumstances may occur when quick response is required. However, it will be much more usual for changes to develop over several days, which may warrant consultation between the operator and Atlantic Richfield prior to performing any modifications to current operations.

During daily routine monitoring, the operator will complete a tour of inlet area facilities to check potential problem areas and critical facilities. The items have been listed in a convenient order intended to facilitate an efficient step-by-step status check. Although the checklist contains more detail, in essence the operator must observe and document the following:

- Lime Addition - Correct quantity of lime is being delivered into the influent stream (i.e., the feeder is working correctly, mixers operating, discharge lines open and flowing freely);
- Water Flow - There is no obstruction to the flow of water through the lagoon systems; and
- Monitoring Systems - Monitoring and warning systems are functioning properly.

At the end of the operators "Start-of-Day Status Check" the operator should be confident that each of these components is operational and functional.

6.1.2 Missoula Gulch Groundwater System

The operator will perform a daily status check of the Missoula Gulch groundwater system which includes the following tasks:

- Ensure Base Flow Bypass Pipeline is free flowing and free of debris.

- Appropriate action has been taken or scheduled to resolve any problems. Typical problems may include debris on the Bypass Pipeline inlet screen, vandalism (including closed valves, broken pipe, missing weir plates, etc.) or damage resulting from unusually large high flow events.

Observations and actions are noted on the operators log sheet. Observations and areas of concern regarding Missoula Gulch and associated catch basins will also be directed to BSB Director of Public Works for remedy.

Periodic inspection of catch basin outlet structures is required to ensure hydraulic controls are set properly (orifice plates at catch basin outlets are in place or bypass pipeline valves are open). These inspections coincide with seasonal maintenance activities. Refer to Volume V, Maintenance Plan, for additional information.

6.1.3 West Camp Pump Station

The operator will perform a check of the WCP-1 twice per week. Pump operating status, and flow are available at the main panel in the Operations Building. Refer to Volume III, West Camp Pump Station (WCP) and Missoula Gulch Discharge Systems for additional information. This provides the operator with firsthand knowledge that includes:

- West Camp pump is operational;

- Well levels are within minimum and maximum operating limits; and

- Site security and integrity is maintained.

6.1.4 Metro Storm Drain Pump Station

The operator will perform a daily status check of the MSD pump station. Refer to Volume II, Metro Storm Drain (MSD) Collection System for additional information. Pump operating status, and flow are available at the main panel in the Operations Building. This provides the operator with real-time system status that includes:

- MSD pumps are operational; and

- Water levels in the pumping vault are within the operating range.

In addition to the daily status check, the following items will be inspected on a monthly basis:

- MSD channel is free of debris and vegetation is in good condition; and

- MSD subdrain cleanout pipes are free of debris and end caps are intact.

6.1.5 Weekly Reporting

At the end of each week, a completed Weekly Operation Report is submitted to Atlantic Richfield. This report will contain information regarding water elevations, influent and effluent flow rates, lime rates, and lagoon cell field water quality parameters (see Table 8). Any changes to routine system O&M issues related to potential performance upsets are also noted within this report. The specific approach and format for these reports is outlined in Section 9.0.

6.2 Lime Treatment at the CAS Building

6.2.1 System Overview

The following description outlines the routine operational tasks to be used at the CAS Building. This brief system overview is provided to complement the subsequent Description of Control Settings in Section 6.2.4. Figure 2 presents an overall site view depicting the expected path of flow during routine operating conditions.

1. Untreated influent water enters the CAS Building from the IPS (P-LAO D41, or P-LAO D42) at Cell D4.

2. The influent flow rate is monitored with a 14-inch McCrometer® UltraMag flow meter (FIT-LAO-1059).

3. A portion (50 to 250 gpm) of the influent stream is diverted into a slurry tank (T-CAS 101, or 201) to be mixed with lime from the screw conveyor (SC-LAO-1) and discharged back into the main influent stream.

4. Lime is fed from the silo (T-CAS 102) via a rotary vane feeder and the screw conveyor (SC-LOA-1) to either slurry tank. The rotary vane feeder is manually adjusted according to influent flow rate and current lime addition rate. In the slurry tank, lime is mixed with influent water and then discharged into the main influent stream.

6.2.2 Lime Addition Control Mechanism

As described in Section 2.5, the lime feed facility is designed to allow easy adjustment to the lime addition rate to meet treatment objectives established by the EPA, State of Montana Department of Environmental Quality (DEQ), and agreed upon by responsible parties. The primary control system is set up to relay various outputs back to the control screen. The two most important factors for control of lime addition are influent flow rate and Accurate Feeder® helix rpm. The helix rpm will be set in accordance with the influent flow rate in order to maintain pH levels to a minimum of 9.5 standard units (su), but not exceed 11.0 su. The pH is also monitored manually after lime addition.

As indicated on the BTL-LAO Weekly Operations Report provided in Appendix H, pH is monitored daily for influent and effluent flow. Sample locations are also listed on the Weekly Operations Report. Additional, more frequent readings may be required following significant changes in flow rate and/or lime addition rate adjustments, in order to maintain general understanding of how pH is changing as water flows through the Lagoon Systems A, B, and C and of how the BTL systems are performing.

6.2.3 Chemical Addition System Criteria

The lime treatment facilities located in and around the CAS Building are the primary components for managing the water treatment process. Figure 6 provides a detailed schematic of the lime treatment facilities. The design criteria of the CAS Building and lime treatment facilities were based on two major factors:

- Lime addition is to be sufficient to maintain pH levels in to a minimum of 9.5 su, but not exceed 11.0 su, and the target inflow pH is 10.2 when measured in the distribution tank; and

- Lime addition is to be effective at both minimum and maximum design flows.

Target lime rate is based on treatability studies and historic data on cell performance and may be adjusted based on experience gained, and any changes in influent water quality. Lime dosage ranges from 130 to $180^{mg}/_{L}$.

6.2.3.1 Lime Dosage

At the current dosage of $130^{mg}/_{L}$, lime is delivered rate is approximately 1.5 pounds of dry lime per day per gpm influent flow (lb/day/gpm).

Assume a Lime Rate = $130\ ^{mg}/_{L}$
Assuming a Routine Flow = 1,200 gpm
Known Silo Capacity = 22 tons

Theoretical lime usage calculation is as follows:
$130\ ^{mg}/_{L} * 0.001\ ^{mg}/_{g} * 1/(454\ ^{lb}/_{g}) * 1200 \text{ gpm} * 3.785\ ^{L}/_{gal} * 60\ ^{min}/_{hr} * 24\ ^{hr}/_{day} = 1{,}877\ ^{lb}/_{day}$

44,000 lbs * 1 day/1,877 lbs = 23.4 days

Lime feed and actual usage is verified through computer a spreadsheet-based calculation which uses field data and the difference in lime storage over a given period of time. Calculations provide operators reliable projection of lime storage at current operating levels.

6.2.3.2 Lime Delivery

Lime deliveries are anticipated at a routine frequency of 5 to 7 days after placement of orders. Deliveries are made in 24 to 30-ton trucks with pneumatic unloading capabilities. Do not allow lime delivery personnel to unload more than the required amount of lime to fill the silo.

NOTE: Overfilling the silo will create operational difficulties.

****Operators must re-order lime from the lime provider before lime level reaches 5 feet on the level indicator (LI-CAS-101).****

Lime order contact information:

Graymont Western US Inc.
"Indian Creek Plant"
P.O. Box 550 (4.12 miles west Indian Creek Road)
Townsend, Montana 59644

Phone: 406-266-5221

Contact: Cindy Howard
Alternate Contact: Carla

Corporate office:
Graymont Western US Inc.
Suite 301
3950 South 700 East
Salt Lake City, Utah 84107

6.2.4 Description of Control Settings

This section of the O&M lists the electrical and control requirements for operation of each item of the lime treatment equipment. This information provides an example of routine operations. Information for each item is presented in the following categories:

- Conditions required for the equipment item to start manually;
- Conditions required for the equipment item to start automatically;
- Conditions under which the equipment item will automatically stop operation; and
- Settings for routine mode of control.

Where appropriate, additional information pertinent to understanding of the control mode, or necessary auxiliary piping or valve alignment conditions is provided.

Supplemental information regarding the use of standby/redundant equipment, the alarm conditions/response is presented in Section 12.0, Emergency Procedures. Section 2.6 provides additional understanding/description of the process function of the control system and the conditions under which alternative modes of control should be employed.

6.2.4.1 Auto Sampling

1. Influent Sample Pump:

a. The influent automatic sampler will start automatically when all of the following conditions are satisfied:

- Breaker is not tripped;
- The ON/OFF key is in ON position;
- The programmed sampling start time is set appropriately (initially set at 10:00 a.m.);
- The START button is depressed; and
- The sampling pump is operating properly.

2. Effluent Sample Pump:

a. The effluent automatic sampler will start automatically when all of the following conditions are satisfied:

- Breaker is not tripped;
- The ON/OFF key is in ON position;
- The programmed sampling start time is set appropriately (initially set at 10:00 a.m.);
- The START button is depressed;
- Peristaltic pump is turned on the day prior to sampling day; and
- The sampling pump is operating properly.

3. Lime Feeder:

a. Lime is fed to the screw conveyor and finally to the slurry tanks automatically when all of the following conditions are satisfied:

- Locate operator interface terminal panel (EL-CAS-112) in the Operations Building at LAO;
- Position the lime feeder switch in Gravimetric position;
- Push the green start icon on the OP1 screen; and
- Set the appropriate dosage in mg/L, indicated on the screen display.

b. Locate the Main Silo Control Panel:

- Set the screw conveyor switch to HAND, the ensures the screw conveyor is operating; and
- Set Silo Vibrator to Gravimetric.

4. Bin Discharge:

a. The lime feed system will be operated manually when all of the following conditions are satisfied.

b. To operate in HAND (Volumetric) mode:

- Enter the Lime Silo and manually force the knife gate valve to the open position and lock the valve in the open position;
- Locate the HMI panel and push STOP on the screen;
- Move the feeder control switch to the Volumetric (Manual) position;
- Locate the Silo control panel;
- Move the Vibrator control switch to Volumetric;
- Push the green Start Button on the OP1 Panel;
- Push the red Auto Start button on the Silo Panel;
- Set the Feed Rate on the OP1 Panel by turning the dial to the appropriate rate, verify the rate displayed on the screen;
- Verify channel pH and adjust lime dosage as needed; and
- The routine setting for the Accurate Feeder® is when the local panel control switch is in AUTO position and will run on a continuous basis.

c. The routine setting for the Bin Discharge cycle is set to run for 15 seconds and then stop for 90 seconds before starting again.

5. The Accurate Feeder® will stop when any of the following conditions are satisfied:

- Local panel control switch is in OFF position.
- Breaker switch is tripped.
- Main silo control panel and interlocked/associated equipment is in correct state (running or stopped, dependent on piece of equipment).

6. Screw Conveyor:

a. The screw conveyor will start manually when all of the following conditions are satisfied:

- Local panel control switch is in HAND position; and
- Breaker switch is not tripped.

b. The screw conveyor will start automatically when all of the following conditions are satisfied:

- Local panel control switch is in AUTO position;
- Auto Start button on the Local panel is depressed;
- Breaker switch is not tripped; and
- Main silo control panel and interlocked/associated equipment is in correct state (running or stopped, dependent on piece of equipment).

c. The screw conveyor will stop when all of the following conditions are satisfied:

- Local panel control switch is in OFF position;
- Breaker switch is tripped; and

– Main silo control panel and interlocked/associated equipment is in correct state (running or stopped, dependent on piece of equipment).

d. The routine setting for the screw conveyor is when the local panel control switch is in AUTO position and the rotation direction toggle is in the FORWARD position. The screw conveyor will run continuously.

7. Slurry Mixer 1:

a. The slurry mixer will run when all of the following conditions are satisfied:

– Local panel control switch is in ON position;
– Breaker switch is not tripped; and
– Slurry level is detected within the specified range (11-inch minimum, 48-inch maximum.)

b. The slurry mixer will not run when the following conditions are satisfied:

– Local panel control switch is in OFF position;
– Breaker switch is not tripped; and
– Slurry level is outside the specified range (below 9 inches).

c. The routine setting for Slurry Mixer 1 is to run continuously.

8. Slurry Mixer 2:

a. The slurry mixer will run when all of the following conditions are satisfied:

– Local panel control switch is in ON position;
– Breaker switch is not tripped; and
– Slurry level is detected within the specified range (11-inch minimum, 48-inch maximum).

b. The slurry mixer will not run when all of the following conditions are satisfied:

– Local panel control switch is in OFF position;
– Breaker switch is not tripped; and
– Slurry level is outside the specified range (below 9 inches)

c. The routine setting for Slurry Mixer 2 is to run continuously.

6.2.5 Control and Monitoring Device Summary

The following information is a preliminary description of the control and monitoring devices at the BTL. Additional information will be provided when instrumentation and controls (I&C) upgrades are finalized.

1. CAS Building:

   a. Operator Interface:

      – HMI Computer and Screen;
      – PLC;
      – Master Radio Interface;
      – Process Set Points and Alarms;
      – System Trends and Historical Logging;
      – Alarm Dialer;
      – Uninterruptible Power Supply; and
      – Surge Protection for Line Power and Analog Isolation.

   b. Instrument Monitoring Definition (name, monitoring point, device and identifier):

– Influent Flow	GPM	McCrometer®	FIT-LAO1059
– Lime Auger Status	On/Off	Switch	TBD
– Silo Level	Feet	Yo-Yo® Meter	LT-LAO1000
– Tank 1 Level	Inches	Ultrasonic	LT-LAO1049
– Tank 2 Level	Inches	Ultrasonic	LT-LAO1039
– Tank 1 Mixer Status	On/Off	Ultrasonic	ZX-LAO-1048
– Tank 2 Mixer Status	On/Off	Ultrasonic	ZX-LAO-1038
– Slurry Tank 1 Feed Water	gpm	Flow Meter	FIT-LAO1049
– Slurry Tank 2 Feed Water	gpm	Flow Meter	FIT-LAO1043
– A-Cells Level	Feet	Level Transducer	LI-LAO-2000, 2003, 2006
– B-Cells Level	Feet	Level Transducer	LI-LAO-2015, 2016, 2017
– C-Cells Level	Feet	Level Transducer	LI-LAO-2021, 2022, 2025

   c. Lime Silo Control Panel:

      – Accurate Feeder® Screw Motor;
      – Accurate Feeder® Paddle Motor;
      – Dust Collection Fan;
      – Bin Discharge;
      – Screw Conveyor;
      – Slurry Tank Select; and
      – Slurry Tank Level.

2. Cell A1 Station:

   a. 480VAC Distribution Breaker Panel;

b. Three Pump Hand-Off-Auto switches for local control of 15 HP, 5 HP, and 5 HP pumps;
c. Programmable Logic Controller;
d. Analog Interface Terminal for the following analog points (name, monitoring point, and device);

   – A1 Level Feet
   – B3 Level Feet
   – C3 Level Feet

e. Remote Radio Interface;
f. Surge Protection for Line Power and Analog Isolation;
g. NEMA 4 Enclosure and Panel Heater; and
h. 120VAC Branch Circuit Breaker Panel.

3. Cell A2 Station:

   a. 480VAC Distribution Breaker Panel;
   b. Two Pump Hand-Off-Auto switches for control of 75 HP and 15 HP pumps;
   c. Programmable Logic Controller;
   d. Analog Interface Terminal for the following analog points (name, monitoring point, and device);

      – A2 Level Feet

   e. Surge Protection for Line Power and Analog Isolation;
   f. NEMA 4 Enclosure and Panel Heater;
   g. Remote Radio Interface; and
   h. 120VAC Branch Circuit Breaker Panel.

4. Cell A3 Station

   a. 480VAC Distribution Breaker Panel; and
   b. Two Pump Hand-Off-Auto switches for control of two, 75 HP influent pumps.

5. ASB (at southern end of Cell A3):

   a. Programmable Logic Controller;
   b. Analog Interface Terminal for the following analog points (name, monitoring point, and device);

      – A3 Level feet
      – CT-EFF Flow gpm
      – Cell D4 Level feet

   c. Remote Radio Interface;
   d. Surge Protection for Line Power and Analog Isolation;

e. NEMA 4 Enclosure; and
f. 120VAC Branch Circuit Breaker Panel.

6. Cell D4 Influent Pump Station:

   a. 480VAC Distribution Breaker Panel;
   b. Two Pump Hand-Off-Auto switches for local control of 75 HP pumps; and
   c. 120VAC Branch Circuit Breaker Panel.

6.2.6 System Glossary

HAND. Hand or manual position of a Hand-Off-Auto control or selector switch. When in this position, the device is under manual control.

OFF. Off position of a control or selector switch. When in this position, the device is turned off.

AUTO. Auto position of a Hand-Off-Auto control or selector switch. When in this position, the device is under automatic control by the control system.

ON. On position of a control or selector switch. When in this position, the device is turned on.

OPERATOR INTERFACE. This is a personal computer running an industrial control software package which acts as HMI. It allows the operator to view the process, status, and alarms of the entire system. It allows graphic depiction of the system and provides access to all required set points and operator adjustable values and alarms. Table 8 provides a list of instruments, alarms and set points for LAO systems.

6.3 Normal Start-Up

The IPS start-up is dependent upon CAS system status. If CAS slurry equipment is off-line for longer than 30 minutes, IPS enters auto-shutdown status.

6.3.1 IPS Start-Up (SOP-6)

1. The IPS control panel located near the Cell D4 electrical service controls the 75 HP IPS pumps, and provides control to the auxiliary temporary pump when needed. For each pump a HAND-OFF-AUTO switch controls the status of each pump. The pumps do not operate in the OFF position. The IPS pumps can be operated in two different configurations (Manual or Automatic). Below describes the procedures to start pumps in both configurations.

   a. Manual Startup Position.

   For operation of the influent pumps in manual mode the operator must have the switch in the HAND position. To avoid pumping system problems, the pumps must not be started simultaneously. Therefore, in the manual operation mode, the operator must ensure that both pumps are not started simultaneously.

b. Automatic Startup Position.

For operation of the influent pumps in the automatic mode the operator must have the switch in AUTO position and use the D4 Pump Control Panel for pump startup. The D4 Pump Control Panel contains a local emergency stop button, reset button, east pump start, and west pump start.

For pump start up sequence, the operator must first depress the pump-reset button on the D4 Pump Control Panel. The pump-reset button's function is to start the PLC program and the automation. After resetting the pump sequence, the operator must depress either the D41 or D42 Pump Start Button to start the pump. The IPS PLC program will begin a 30-second timer that will not allow the second pump to start until 30-seconds have elapsed. After 30 seconds have passed, the operator can depress the second pump that needs to be started if necessary. To avoid pumping system problems, the PLC 30-second timer programming prevents the operator from starting both pumps at the same time.

6.3.2 CAS Start-Up

Proper CAS start-up requires multiple procedures to be followed. The following provides specific instructions to perform start-up. In addition, refer to the references SOP for HSSE, personal protective equipment (PPE), drawing, etc. references to fully perform the procedure. Operating personnel must also complete procedure training and demonstrate a full understanding of the process and steps.

6.3.2.1 Lime Addition (SOP-28)

1. Ensure screw conveyor is operating properly by visual inspection through the port in the screw conveyor cover or manually checking the switch located on the system control panel. Two switches control the screw conveyor. One will operate screw conveyor in forward or reverse. The second switch will operate the screw conveyor in automatic or manual mode and the third position will turn it off. Proper operation of the screw conveyor requires the two switches to be in the forward and manual positions.

2. Ensure the 10-inch Salina Vortex pneumatic knife valve is in the open position. This valve is located inside the silo above the Accurate Feeder®. If in the closed position, the valve must be opened using the manual override button on the far south end of the valve. By pressing this button, the valve manually opens, thus ensuring continuous lime flow.

3. The operator will then restart both pumps located at the D4 pumping station by using steps described in SOP-6, Influent Pump Station Start Up (Appendix C).

4. Once the influent water has reached the CAS Building, press the auto start button located on the System Control Panel to open the desired tank's 4-inch drop tube pneumatic valve. This

will ensure that any lime distributed through the screw conveyor will be discharged into the desired tank (Tank 1 or Tank 2).

5. Using the OP1 Gravimetric Controller, press the green "Start" button located on the OP1 Controller hand controls. This step turns on the Accurate Feeder® helix and paddle motors. The speed of the agitation paddle motor can be manually adjusted using the "Agitation" variable control knob located on the right side of the OP1 Controller. The helix speed can be controlled using the "Manual" variable control knob located on the left side of the OP1 Controller.

6. To ensure the hopper within the Accurate Feeder® receives proper lime flow, the operator must operate the "Silo Bin Discharge" (Silo Vibrator) on a timer. This is enabled by adjusting the hand control knob in the top left corner of the Silo Control Panel to the "on" or "volumetric" position. This timer can be adjusted as required by using the hand control knob within the silo. Two knobs control the following:

   a. Time the vibrator is "off" between cycles; and
   b. Time the vibrator is "on" during cycles.

7. After enough time has been allowed for thorough lime addition throughout the mixing tank, the operator must test the A1 channel for the current pH. Depending on the "Channel" pH, the operator must adjust the "Manual" variable control knob until a desirable "Channel" pH is achieved.

6.3.2.2 Slurry Feed Water (SOP-7)

1. Adjust the 10-inch main valve (CAS-GV-101) on the main influent pipe (pipe number to be provided when finalized). Closing the valve will create pressure on system to allow for flow into the online slurry tank.
2. Direct flow to primary slurry tank under normal operating conditions. The secondary mixing tank will be used when maintenance is required on the primary tank.
3. Balance the pressure and flow of the feed water and main influent for maximum efficiency and range of flow.
4. Ensure range of flow into slurry tank feed water (150 to 250 gpm).

6.3.2.3 Slurry Mixers

1. Verify Tank 1 or Tank 2 being filled.
2. Allow tank level to fill to (5 feet). This point is beyond location of mixer impellers.
3. Energize mixer motor locally by depressing the start button of the associated tank/mixer.

Note: Operating the mixer below the minimum level will result in damage to the mixer impeller or shaft.

6.4 Normal Shutdown

Under normal operating conditions, the CAS system will remain operating. Normal shutdown sequences require redundant equipment to be brought on-line following established SOPs (Appendix C). Once redundant equipment is operational, flow must be diverted from primary systems to the back-up systems. After flow is established through redundant equipment, primary equipment can be taken off-line and maintenance performed.

6.5 Routine Maintenance of IPS

Operational maintenance of the IPS inlet screens is necessary to prevent large diameter solids from being passed through, or sufficient blockage that could lead to lowered pump performance or impeller damage. Screens will be cleaned daily using a plastic toothed rake. The rake will be manually lowered to the screen and raked against the screens in an up and down motion across the entire width of the screen to remove accumulations of solids from the screen surface. Influent Pump Station inlet screens will be maintained daily.

The screens must be removed periodically for a more thorough cleaning. To remove the screens wall-mounted articulated jib crane will be used.

****Refer to the** *Site Specific Health and Safety Plan for Butte Treatment Lagoons (BTL) and Lower Area One (LAO) Operation and Maintenance (O&M) Activities* **for any lifting operations protocol that must be adhered to prior to any lifting exercise.****

1. The hoist hook will be secured to the eye-bolt of the screen;
2. Remove the debris screen stabilizer clip and pin (REF: Drawing: IP-C-2, IP-D-4);
3. Utilize the hoist to lift the screen from the grating support structure; and
4. Rotate the jib crane to allow placement of the screen at grade level.

Once appropriate cleaned, the screen can be replaced by reversing sequence listed above.

6.6 Sludge Management

Sludge produced from lime addition and metals precipitation is managed using a dredging operation. A dredge is used to remove the sediment for the floor of each primary cell, and then the sediment is pumped to a drying bed area located within the BRW area. Dredging operations are conducted up to 3 events per calendar year. Each event takes approximately 30 to 40 working days to complete. The material is allowed to naturally dewater before it is transported to the mine waste repository for long-term disposal. Dewatering time is dependent on the efficiency of the dredging operation, but can take between four to six weeks.

The volume of material pumped during dredging activities is dependent upon operator skill and the dredging practices followed. Sludge production is estimated based on influent flow rate, lime feed rate, and retention time. Estimated sludge calculations are provided in Appendix I to assist operations personnel in planning sludge removal.

A floating dredge system consisting of a 4-inch submerged pump, 8½-foot wide cutter-head, and multi-directional hoist/winch system is capable of removing sludge deposits up to 12 inches deep and 7½ feet wide per pass. The overall cutting depth range is from 1 foot above water level to 16 feet below water level.

Dredged material is pumped through a 6-inch SDR 17 HDPE pipeline to the multi-cell drying bed facility. The drying facility is designed with a storage capacity of 3,378,000 gallons total dredged material. This allows multiple sludge management activities to occur simultaneously.

6.7 Site Vegetation and Access Maintenance

All vegetation and access routes within LAO must be routinely checked and maintained throughout the year to ensure safe, unobstructed access to the operating BTL equipment and provide an attractive, aesthetic site appearance. Operator attention to the health of the site vegetation is essential to maintain the quality of the site appearance. In addition, the operator must ensure that the site access routes are maintained to efficiently complete the other routine tasks necessary to maintain the BTL systems. The following paragraphs discuss the site access and vegetation items which require periodic maintenance.

6.7.1 Site Vegetation Monitoring and Maintenance

The following routine site vegetation monitoring and maintenance tasks will be used to ensure the site vegetation remains healthy and continues to grow. This brief task list is provided to guide the operator in maintaining the site vegetation on a routine basis. Additional tasks and/or vegetation replacement may be necessary following unusual conditions or damage due to heavy equipment or other.

1. The operator will note on a daily basis the overall health and appearance of the site vegetation.

2. The operator will document any site erosion or vegetation damage due to storm events or mechanical work associated with the BTL. Minor erosion will be documented and monitored for progression. Major erosion or progressively eroded areas will require soil and vegetation replacement unless the site vegetation grows in and protects the existing soil from further damage.

3. The operator will coordinate, oversee and document weed control such as herbicide application and hand-pulling. Weed control tasks should be performed annually within LAO. Additional guidance regarding weed control and vegetation areas within LAO is provided in Volume V, Maintenance Plan.

4. Reseeding and/or fertilizer application may be required if the appearance or health of the site vegetation declines. Seeding and fertilizer application may also be necessary following any mechanical disturbance of site soils due to process modifications or improvements. Seeding

and fertilizer application should be conducted to be consistent with the timing of application, fertilizer types and rates, and vegetation species already established with LAO.

6.7.2 Site Access Maintenance

Site access maintenance will be required periodically to ensure efficient and unobstructed access to the O&M equipment associated with the BTL. Primarily access maintenance tasks will be performed as follows:

1. Spring, summer and fall maintenance will consist of periodic road grading along the main entrance road to the CAS Building, the ASB, and the IPS at the southwest corner of Cell D4. Generally grading of the access routes will be conducted following large storm events or snow melt events.

2. Winter maintenance will consist mainly of plowing and removing snow to provide obstructed access to the same site locations. Winter maintenance will also provide safer access to these sites by minimizing operator exposure to cold conditions and increasing visibility of the access routes.

7.0 OPERATION DURING DISTURBANCES

This section addresses operational responses to potential upset conditions that may develop during operation of the BTL systems.

A decision tree is presented in Appendix F, which shows suggested actions for upset conditions. In general, potential conditions which may be investigated during operation upsets include:

- High or low pH;
- Impacts of WCP-1 and MSD influent water quality and quantity;
- Lack of lime treatment, because of malfunctioning equipment;
- Lack of influent flow; and
- High or low lagoon water levels.

The above conditions are primarily of concern relative to the treatment lagoons and lime feed system. However, they can be significant in regards to emergency bypassing or recirculating of partially treated water which does not meet the performance standards as described in Section 5.0.

7.1 System Disturbances

7.1.1 Lime Feed System Disturbance

Lime feed system disturbances stop the addition of lime to the influent flow. Disturbances in the additions of lime may be attributed to CAS Building electrical service loss, Accurate Feeder® failure, screw conveyor failure, lime blockage, running out of lime in the silo, slurry tank feed water failure, and loss of flow from the IPS.

7.1.2 Redundant Lime Feed System

In the event of a failure in the primary lime feed system, a back-up lime feed system will be available. The back-up lime feed system is modular and must be moved into position prior to use.

7.1.3 Lime Addition Response

Lime feed system disturbances are separated into three stages to identify and reconfigure the treatment system as necessary for each stage. The three stages and the corresponding operator responses are listed below from minimal to significant.

- **Stage 1** (0 to 6 hours): After the cause of the lime feed disturbance is determined and routine conditions are re-established, a disturbance of 0 to 6 hours will require no changes to the lime feed system. Treatment system and sample results will be monitored.

- **Stage 2** (6 to 12 hours): After the cause of the lime feed disturbance is determined and routine conditions are re-established, a disturbance of 6 to 12 hours will require an increase in the lime feed rate by an amount determined by the volume of water that was untreated during the outage. Procedure 9, *Lime Addition Recovery*, in Appendix C summarizes recovery of inadequate or zero lime addition.

- **Stage 3** (>12 hours): After the cause of the lime feed disturbance is determined and routine conditions are re-established. An electrical service loss greater than 12 hours will require an increase in the lime feed rate similar to a Stage 2 disturbance and the treatment system flows will be changed according to operator parameters. Procedure 6 in Appendix C summarizes recovery of inadequate or zero lime addition.

The decision tree, BTL-DT-5, is provided in Appendix F to aid in making process-based decisions to ensure effluent meets discharge standards during non-routine conditions.

7.1.4 CAS Building Electrical Service Loss

In the event of an electrical service loss to the CAS Building, operation of the lime feeder system will be disrupted. Once an electrical service loss is identified during trouble shooting procedures and it is not within the operator's ability to re-establish the service, the operator will contact NorthWestern Energy to have electrical service restored. Once electrical service is restored, the operator must adjust all affected equipment and ensure the lime feed system is in normal operations. Treatment system settings will be changed according to operator parameters and the duration of the lime system disturbance as discussed above.

7.1.5 Lime Feed Mechanical Failure

Disruptions to the lime feeder system may include malfunctions with the Accurate Feeder®, screw conveyor, massage paddles, or bin discharge. The operator will follow standard procedures detailed in SOP-3 (see Appendix C) to determine and correct the disturbance. A decision tree is available in Appendix F to assist troubleshooting efforts of this system in the event disturbances are encountered.

7.1.6 Slurry Tank Feed Water Interruption

A portion of the influent flow is piped and discharged into the slurry tank were the lime addition occurs. If interruption of the slurry tank feed water occurs, lime addition interruption to the treatment system will also occur and the flow must be re-established. Standard Operating Procedure-7 provided in Appendix C summarizes the slurry tank feed water re-establishment.

7.1.7 No Lime in the Silo

Running out of lime stored in the silo will cause a disruption in the lime feed. This will occur if the operator does not monitor the amount of stored lime and enough lime is used to completely empty the silo. To minimize the potential for this condition, the operator will order lime when approximately 8 tons of lime remains in the silo and schedule the delivery to occur when approximately 4 tons remain. Lime delivery information is contained in Section 6.2.3.2.

Lime may also get blocked/bridged in the lime silo causing a disruption of lime to the Accurate Feeder® hopper. The bin discharge motor was installed to run automatically to prevent this from occurring and installed to run manual to dislodge the lime bridge. Investigate silo vibrator function if the Yo-Yo meter (LT-LAO-1000) indicates lime level is sufficient, but no lime flow.

7.1.8 Troubleshooting Lime Feed

To initiate troubleshooting of the lime feed system, evaluate the lime feed trend line on the OP1 screen. An erratic trend line (jumps up and down sharply) is an indication that the feeder has lost its calibration point and should be re-calibrated. Empty the feeder hopper and recalibrate the feeder. To recalibrate refer to SOP 35 provided in Appendix C. The following instructions will be followed to perform re-calibration:

1. Ensure the 10-inch Salina Vortex pneumatic knife valve (FCV-LAO-1004) is in the closed position. This valve is located inside the silo above the Accurate Feeder®. If in the open position, the valve must be closed using the manual override button on the far south end of the valve. By pressing this button, the valve manually closes, thereby ensuring a "loss-in-weight" position by separating the weight of lime in the silo from the weight of lime inside the Accurate Feeder®.

2. The hopper then must be emptied by placing the lime delivery system into volumetric mode and increasing the helix speed to expedite the empting process.

3. Once the hopper is emptied the Accurate Feeder® must be cleaned of as much lime as possible to ensure an accurate calibration.

4. Press the calibrate button on the Accurate Feeder® display and follow the step-by-step process provided.

   Note: Objects of a known weight for the calibration process are located next to the Accurate Feeder® **in the lime silo.**

5. Once the calibration process is complete the pneumatic knife valve must be opened by depressing the upper button on the air actuating control solenoid located on the end of the knife gate.

6. The system can then be returned to gravimetric mode.

****Upon completion of lime feed calibration, the operator will monitor a several loading cycles to verify load rates are accurate.****

A troubleshooting decision tree is available in Appendix F to assist in identifying problems with the lime feed system.

7.2 Influent Flow Disturbance

An influent flow disturbance prevents the flow water through the treatment process and into the treatment cells. Disturbances in the influent flow may be attributed to IPS electrical service loss, pump failure, pipe line malfunction, valve malfunction, and pump intake screen failure. Cell D4 is capable of storing water for a flow disturbance until water crests the sheet pile at an elevation of 5,417.0 feet amsl. Influent flow disturbances are separated into three stages to identify and reconfigure the treatment system as necessary for each stage. The three stages and the corresponding operator responses are listed below from minimal to significant.

- **Stage 1** (0 to 6 hours): After the cause of the influent flow disturbance is determined and the system is brought back to normal operations, a disturbance of 0 to 6 hours will require no changes to the lime feed system. After the pump(s) are brought back on line, pumping will be increased to account for the increase in the water level of Cell D4. Treatment system and sample results will be monitored.

- **Stage 2** (6 to 12 hours): After the cause of the influent flow disturbance is determined and the system is brought back to normal operations, a disturbance of 6 to 12 hours will require a decrease in the lime feed rate by an amount determined by the volume of lime added to the slurry tank during the disturbance. After the pump(s) are brought back on line, pumping will be increased to account for the increase in the water level of Cell D4.

- **Stage 3** (>12 hours): After the cause of the influent flow disturbance is determined and the system is brought back to normal operations. An electrical service loss greater than 12 hours will require and decrease in the lime feed rate similar to a Stage 2 disturbance and the treatment system flows will be changed according to operator parameters. After the pump(s) are brought back on line, pumping will be increased to account for the increase in the water level of Cell D4.

Disturbances of longer duration than the stages listed above require implementation of Water Management Contingency Operations to prolong water storage capabilities until the disturbance can be remedied. Refer to the *BLT-LAO Water Management Contingency Operations* (Atlantic Richfield Company, 2010b) for additional instructions and diversion strategies.

7.2.1 Influent Pump Station Electrical Service Loss

In the event of an electrical service loss to the IPS; the influent flow will be disrupted. Once an electrical service loss is determined and it is not within the operator’s ability to re-establish the service, the operator will contact NorthWestern Energy to have electrical service restored. Once electrical service is restored, the operator will adjust all affected equipment and ensure the IPS operation has returned to routine conditions. Treatment system configurations will be changed according to operator parameters and the duration of the lime system disturbance as discussed above. Refer to Appendix C for IPS startup procedure.

7.2.2 Influent Pump Station Pump Failure

Pump failure may include but is not limited to, the electrical wire deterioration on the pumps, impeller failure, and pump control failure. Pump failures and normal wear events may degrade flow rates or cause zero influent flows. In the event of one pump failing during base flow conditions from the influent sources Cell D4 can store water for approximately 120 hours while the other pump continues to operate. If both pumps were shut down, Cell D4 can store water for approximately 24 hours.

The WCP-1 should be shutdown to reduce the influent flow until IPS is restored and functioning normally. The BRW stop logs should be installed to mitigate influent. The MSD has a very short retention capacity, and therefore should remain operating. Refer to the *BLT-LAO Water Management Contingency Operations* (Atlantic Richfield Company, 2010b) for available retention times associated with the BTL-LAO systems.

7.3 Monitoring Equipment Disturbance

7.3.1 Electrical Service Loss to CASB

In the event of an electrical service loss to the monitoring equipment located in the CAS Building a Universal Power Supply (UPS) will provide uninterrupted electrical services for approximately 15 minutes. The alarm call out system will begin notifying the operator of the electrical service loss. An onsite generator is capable of providing long-term electrical supply. The CAS Building back-up generator is equipped with an auto-transfer switch.

7.3.2 Monitoring Control Failure

In the event of an electrical service loss to the remote monitoring equipment, NorthWestern Energy will be contacted to restore electrical service. Once electrical service is restored, the operator will make sure the monitoring equipment returns to routine conditions.

A signal loss from one of the remote stations (A1, A2, or A3) may be caused by a radio failure or an electrical service loss at one or more of the stations. A malfunction with the radios will cause a disruption with the transfer of data from the monitoring equipment to the monitoring system and initiate the alarm callout.

7.4 Off-site Disturbances

7.4.1 West Camp Pump Station and MSD Pump Station Electrical Service Loss

In the event of an electrical service loss to the West Camp or MSD, electrical supply will resume with the automatic transfer of power provided by the on-site emergency back-up generator. The operator will verify WCP-1 or MSD returns to routine operating conditions. A signal loss from one of the remote stations (West Camp or MSD) may be caused by a radio failure or an electrical service loss. A malfunction with the radios would cause a disruption with the transfer of data from the remote monitoring equipment to the primary PLC located in the CAS Building, and initiate the callout. NorthWestern Energy will be contacted to restore electrical service.

7.4.2 West Camp Pump Station and MSD Pump Failure

Pump failure at WCP-1 is confirmed by completing troubleshooting procedures described in Volume III, West Camp Pumping System and Missoula Gulch. Pump failure at WCP-1 or MSD may be caused by normal wear, electrical failure, or other mechanical factors. A pump failure at WCP-1 longer than 2 to 3 days, refer to Volume III, West Camp Pumping System and Missoula Gulch. A pump failure at MSD may be limited to one pump or both pumps within the vault. A temporary pump will be used to bypass the pump vault to allow for access and pump replacement.

7.4.3 West Camp Pump Station and MSD Monitoring Equipment Failure

Monitoring equipment failures at the West Camp (level meter and flow meter) or MSD (float switch in the wet vault and pump status) are detected in the local monitoring system. The operator will be notified by the primary PLC in the CAS Building via automatic callout. Following notification and troubleshooting, the operator will correct the disturbance as needed.

7.5 Environmental Disturbances

If a large precipitation or snowmelt event occurs while the influent pumps at Cell D4 are running at maximum pump rate and Cell D4 is at full capacity, water may breach the crest of the sheet pile weir located directly below HCC-07. Reducing flow rates from WCP-1 and MSD to accommodate the excessive precipitation or snowmelt events will minimize the potential impacts to Silver Bow Creek. Refer to the *BLT-LAO Water Management Contingency Operations* (Atlantic Richfield Company, 2010b) for available retention times associated with the BTL-LAO systems.

8.0 MONITORING AND LABORATORY TESTING

The purpose of this section is to define the routine monitoring activities required of the site operator with respect to system control and performance reporting. Monitoring sites and facilities are described in Section 2.4. The frequency and location of water quality sampling at the BTL is presented in the Weekly Operations Report provided in Appendix H.

8.1 Operator Observations

To facilitate data generation and minimize data gaps, collected data will be sorted into the following categories:

- Operator observations;
- Control system generated data;
- Automatic electronic monitoring data; and
- Manual water level, flow, and quality data.

Routine operation of the BTL systems involves a number of operator activities, some of which are routine or planned activities and others that are not.

Many of the routine activities involve data forms or checklists completed by the operator as he/she proceeds with routine activities. Many of the routine operator activities and most of the unplanned activities involve other observations that should be documented for future reference. Such observations may include the extent of lagoon ice cover, movement of the ice sheets, algal and aquatic plant density and range and other biological, chemical, or physical activities within and influencing the BTL. The operator is responsible for generating and recording both types of observations on a daily basis. This documentation provides a basis for report preparation and response to potential questions and/or refinement of operations. These operator observations are to be kept in an operator logbook maintained in such a way that another person can understand each entry. Logbook entries are generally made in chronological order as the operator enters a site and begins routine tasks. References to equipment should reference equipment numbers, operating conditions, and detailed description of any operational issues. An example logbook page is shown below.

Date 9/21/2010 Site: WCP
Time 0921 Hrs

General observations:
Site *Normal, no disturbances*

Equipment/ System Status:
Pump running, FE-WC-101*, 225 GPM*

Operator: *John Operator*

8.2 System Generated Data

Data collected includes data from remote sensing devices as described in Section 2.4, alarms logs generated, and operator actions associated with the BTL. For example, when the operator adjusts set points of an input or acknowledges an alarm, the software maintains a record of that occurrence that can be retrieved later. Section 9.2 summarizes the data management system.

8.3 Automatic Electronic Monitoring Data

Facilities described in Section 2.3 generate large amounts of data on flow rates, water levels and various other inputs. These data are recorded on the treatment system computer located within the CAS Building. The data can be accessed as necessary (via telephone/computer connection) for routine operation and troubleshooting. However, the predominant use of the data will be for review and analysis of the BTL's effectiveness and to improve understanding of the factors that affect performance. Procedures for emergency conditions and troubleshooting guidance are included in Section 12.0.

The accuracy of the electronic monitoring systems requires inspections and regular calibration checks to ensure proper operation of the monitoring equipment (see Section 8.5).

8.4 Field Measurements and Sample Collection

Electronic monitoring facilities are available for collecting only a portion of the project's water data. Other data are derived from field measurements of water levels or flow and from composite and grab samples. The samples require both field and/or laboratory analyses. Subsequent receipt, use, and data management/storage are also necessary. Documentation of water levels, flow, and water quality data are particularly important to verify regulatory performance.

Specific monitoring and analytical requirements are detailed in the *Draft Butte Treatment Lagoons (BTL) Systems at Lower Area One Sampling and Analysis Plan (SAP)* (Atlantic Richfield Company, 2005). Refer to Appendix G. Additional field measurements or samples may be collected by the operator as necessary to aid in optimizing water treatment. Figure 5 shows sample locations for the BTL system.

8.5 Routine Inspection and Calibration of On-Site Monitoring Systems

Monitoring instrumentation must be routinely checked to verify their accuracy and to ensure proper calibration and operation. Operator attention to proper functioning of instruments is essential in order to provide accurate information on important BTL operating parameters. The following paragraphs discuss various types of instrumentation, common problems associated with their operation and attention required by the operator to ensure proper function. Monitoring equipment will also require periodic, routine recalibration and maintenance. Appendix C also contains SOPs for instrument recalibration tasks.

8.5.1 On-Site pH Meters

The on-site pH meter used for daily monitoring will be calibrated each day before use. This instrument is a portable meter used for various measurements throughout the site. For required maintenance and probe replacement, refer to the manufacturer's specifications maintained within the BTL CAS Building.

8.5.2 Lagoon Water Level Recorders

Rosemount water level recorders and transmitters are installed within 6 cells of the BTL systems. These level recorders send a 4 to 20 mA signal back to the primary PLC and the Operator Interface then displays a water level for each corresponding cell. The level recorders are installed inside a PVC stilling pipe to prevent inaccurate readings created from rough water or debris that might be in the cell. The stilling pipes are installed on the wing walls of the associated outlet structures located within each cell. For required maintenance and recalibration, refer to the manufacturer's specifications provided in Appendix B. Manufacturer's specifications are also maintained within the BTL CAS Building.

8.5.3 Slurry Tank Level Indicators

One ultrasonic level indicator is located in each of the two slurry tanks located within the CAS Building. Lime has been known to build-up on the sides of the slurry tanks and cause inaccurate level readings. Periodically the tanks will require cleaning and/or the indicators will need to be recalibrated and cleaned.

To clean the tanks, the indicator is removed and a 1-inch PVC pipe is used to break up the lime build-up. Refer to the manufacturer's instructions for proper maintenance and recalibration. These instructions are maintained within the CAS Building.

8.5.4 Lime Feeder System Equipment

It is necessary to calibrate the lime feeder system once per week for accuracy in order to track lime usage rates, monitor current lime inventory, monitor wear, etc. on the operating equipment and ensure proper lime addition is occurring. A 10-minute test will be conducted to verify the amount of lime the feeder is conveying. Refer to SOP-9 located in Appendix C. Corresponding data sheets correlating the feeder rpm with influent flow rate to achieve appropriate lime rates will require adjustment also.

8.6 Review of Monitoring Data for Operations

8.6.1 Lime Feed and Inventory

The operator needs to maintain knowledge of the amount of lime used and the remaining amount on hand.

- Lime inventory must be monitored and controlled so that shortages are avoided;

- Major deviations in lime usage need to be detected so that troubleshooting activity can be initiated either to explain why such usage is appropriate or to correct the problem; and

- Lime rate and total usage must be reviewed daily.

8.6.2 Lagoon Systems Flow/Elevation

The operator needs to maintain a record of the amount of water entering, retained in, and leaving the lagoon systems. The main reasons for this hydraulic overview are as follows:

- Effectiveness of treatment is likely to vary with hydraulic flows, cell retention, and water levels. The operator may be able to increase system in effectiveness by modifying system operation. For example, cell level can be adjusted to change the retention time.

8.7 Routine Sampling Tasks

The operator is primarily responsible for collecting representative water quality samples for specific locations associated with the BTL. Automatic samplers are provided to assist with this task. The operator must perform various QC tasks to verify operation of monitoring instrumentation. The following items are highlighted:

- Automatic composite samplers will be programmed to automatically start and complete a 24-hour composite sample collection on a twice weekly schedule that anticipates an operator visit shortly after completion of the compositing period.

- During each visit to collect composite samples, the operator will use portable field measurement instruments to ensure the current parameter reading on the continuous measurement unit is within a specified deviation from the portable (checking) unit, then the recent continuous measurement data will be reviewed and the instrument will be recalibrated if necessary. If the deviation persists, the continuous measurement unit will be checked and recalibrated or repaired according to manufacturer's instructions. The permanently installed continuous monitoring unit will be used for reporting purposes unless it has to be removed from service for repairs or replacement.

- Composite samplers will be checked on each visit to confirm proper function.

- Operator must collect the composite samples according to a specified routine designed to prevent contamination of the samples and to ensure that the collected sample or subsample is representative. It will be properly preserved and labeled for subsequent transport to the laboratory. Appendix C presents the standard procedures for collecting and preserving these composite samples.

- Water quality parameters that must be field analyzed will be analyzed following the *Clark Fork River Superfund Site Investigations (CFRSSI) SOPs* (ARCO, 1992a).

8.8 Laboratory Analysis

Sample analysis and analytical methods are included in Appendix G, *Butte Treatment System (BTL) Sampling and Analysis Plan* (Atlantic Richfield Company, 2005).

8.9 Quality Assurance/Quality Control

Water quality monitoring activities will be completed in accordance with QA/QC requirements discussed in Appendix G, Butte Treatment System (BTL) Sampling and Analysis Plan. The SAP contains key elements quality control elements identified in the *Clark Fork River Superfund Investigations Quality Assurance Project Plan* (ARCO, 1992b).

9.0 DATA MANAGEMENT

9.1 Data Management Plan

The BPSOU Data Management Plan outlines the methodology and associated contents relevant to efficiently obtaining, documenting, and presenting pertinent operational data. The BPSOU Data Management Plan is currently under consideration at the time of this publication. The BPSOU Data Management Plan will be included as an appendix upon completion.

9.2 Automated Data Management

The HMI includes data logging and historian software to log all desired system-wide values and status points. Data are logged at various time intervals and into separate files for each logging interval. Data are saved in an appropriate format to match the data format now in use at other Atlantic Richfield treatment and process sites. All data are transferred to Pioneer, either daily or weekly, for analysis and reporting purposes.

The Master PLC (Allen-Bradley ControlLogix) located at the Operations Building at LAO polls all data points being monitored at the remote locations associated with the BTL. The remote monitoring equipment records water levels, flow rates, and equipment/process status in real-time. See Section 2.4 for a description of all of the locations monitored, the equipment used, and the data are collected. The computer located in the Operations Building houses the Wonderware software which collects and displays the values on the HMI screen from the remote monitoring devices. The Wonderware software is the master-monitoring device that polls all data points being monitored at the remote locations associated with the BTL. This information is updated on the HMI screen at 3-second intervals. All data logged are stored on the HMI computer. The software averages each of these input values over a 30-second period, then the average values are attached to a file (ARC"year""month""day"_A3S.csv) located on the local hard drive and are sent via a DSL link to Pioneer's Butte office server. This server hosts the BTL website (www.lao-lagoons.com) that displays the 30-second average data from each of the remote monitoring devices.

The 3-second interval data are also averaged over a 1-hour period. These 1-hour average values are attached to a file (ARC"year""month""day"_A1H.csv) on the local hard drive and sent via a DSL link to the Pioneer's Butte office server. The 1-hour average data are distributed to TREC, Inc. for data management and analysis. Data are saved in an appropriate format to match the data format now in use at other Atlantic Richfield treatment and process sites. All data are transferred to Pioneer, either daily or weekly, for analysis and reporting purposes.

9.3 Field Operator Collected Data

Key process parameters are recorded on the BTL-LAO Weekly Operations Report. These data are used to verify remotely logged data. A blank report is provided in Appendix H.

10.0 OPERATIONS REPORTING AND RECORD KEEPING

10.1 Daily Operations Report

The operator will record the parameters shown:

- Lime feed rate, set point, and actual feed rate, and lime usage;
- Flow instantaneous and totalized;
- Cells pH; and
- Time, date, and relevant system notes.

The daily report is compiled and distributed to Atlantic Richfield Project Managers, TREC, and internal Pioneer personnel by close of business each working day.

10.2 Weekly Operations Report

The operator will record or log water levels, lagoon parameters, pH, flow rates, and any significant visual observations or systems modifications daily into the BTL-LAO Weekly Operations Report (see Appendix H). Data in the Weekly Operations Report will be filed and stored for future reference and used to help determine trends or eliminate variables during troubleshooting and treatment performance evaluations. These data are also transferred into an electronic version of the form and forwarded to the central database currently and managed by TREC, Inc.

10.3 Quarterly Operations Report

Every 3 months a Quarterly Operations Report will be compiled and distributed. This report will contain pertinent laboratory data from the BTL systems; minimum, maximum, average flow rates and pH for the influent and effluent stations; and minimum, maximum and average lime addition rates for the lime feeder system. These data will be presented in graphs and tables to help visually explain the effectiveness of the BTL systems. Also, notes of maintenance activities on-site, possible upsets in operation and explanations for any elevated laboratory results will be included in the Quarterly Operations Report.

10.4 Supplementary Data

As necessary, supplementary data may be collected for process control and system evaluation to assist the operator to improve the treatment effectiveness or optimize the BTL systems. Record of these data will be included in the Quarterly Operations Report.

11.0 ROUTINE INSPECTION AND MAINTENANCE GUIDELINES

Routine inspection and maintenance is performed as a component of daily system operation and maintenance. Routine inspection involves an operator's use of sight, sound, and touch to identify maintenance items.

11.1 Inspection and Maintenance Guidelines for Process Equipment

The following subsections describe the routine inspection and maintenance tasks necessary for the process and monitoring equipment. For the purposes of inspection and maintenance, the following facilities contain process and monitoring equipment:

- CAS Building;
- ASB; and
- Cell D4 pump station.

11.1.1 Scope and Organization

Manufacturer's literature (Appendix B) provides information that details the routine inspection and maintenance tasks, including a schedule of task performance, identification of required equipment maintenance, and a discussion of records and reporting procedures. Manufacturer's recommendations (see Appendix B) are used to establish the basis of routine maintenance requirements. Maintenance repairs, replacements, and alterations are conducted under the requirements of Volume V, Maintenance Plan.

The Maintenance Plan, Volume V, has been developed as a guide based on recommendations by various manufacturers of the process equipment. Due to the local environmental (dust, extreme temperatures, water, etc.) and operating conditions (frequent and infrequent use, etc.), the maintenance program should remain flexible with maintenance tasks and intervals adjusted as necessary based on the actual operating conditions and experience.

11.1.2 Description of Access to Site Facilities

Routine operator use of the site roads is currently limited to the main entrance route to the CAS Building and along the main FCD road which divides the Silver Bow Creek floodplain from BTL systems. Routine use of the divider dikes between the A-Cells and D-Cells and the cross dikes which separate the A-Cells will be prohibited; however, these routes may be required during repair or improvement work. The FCD road will be used to access the IPS and the ASB. As vegetation becomes established around the BTL cells access to the IPS and ASB will transition to the north dike road adjacent to the HCC. This transition will also coincide with the anticipated construction of the Silver Bow Trail along the main FCD road throughout the LAO site. Following completion of the Silver Bow Trail, routine use of this route by the operator will be prohibited.

11.1.3 Description of Routine Maintenance Tasks

Inspection and maintenance for the process equipment includes preventative maintenance (both scheduled and unscheduled), corrective maintenance, and emergency maintenance and repair tasks. Inspection and maintenance tasks are based on maintenance manuals and related documentation submitted with the installed equipment.

11.1.4 Schedule of Task Performance

Routine visual inspections are conducted weekly to ensure the equipment is operating to meet process requirements. General inspection notes are maintained within the site logbook. A schedule of inspection intervals is provided in Volume V, Maintenance Plan, to inspect key components for evidence of wear. As experience is gained in operation of the facilities and maintenance systems, these schedules will be adjusted as necessary. The inspection and maintenance program will be updated when new inspection and maintenance tasks are defined as the result of on-going operations.

11.1.5 Equipment

Individual equipment manuals and a listing of the equipment documentation provided by the manufacturers' are included in Appendix B, which will be maintained and stored within the CAS Building.

11.1.6 Records and Record Keeping

A maintenance log, located in Volume V, is used to provide written record of all maintenance performed. Additional information and instructions is provided in Volume V, Section 2.0. Routine maintenance activity notes and identification of maintenance are also included in weekly operations reporting described in Section 10.2.

12.0 EMERGENCY PROCEDURES

This section discusses alarm conditions and response actions for each alarm.

In case of injury to personnel at the site, please refer to the *Site Specific Health and Safety Plan for Butte Treatment Lagoons (BTL) and Lower Area One (LAO) Operation and Maintenance (O&M) Activities (SSHASP)* (Pioneer, 2010). **To contact ambulance, fire, rescue or police call 911.** Provide the address "Centennial Avenue, Lower Area One, adjacent to Metro Treatment Plant." Contact personnel and notification information is located in Section 1.4 of this document and also in the SSHASP.

12.1 Alarm Response and Notification

Alarms associated with most of the inputs monitored at the BTL were installed to notify the operator(s) immediately after an upset, malfunction, or maintenance issue occurs. These alarms will assist the operator(s) in maintaining consistent treatment and prevent unsafe conditions to human health or the environment.

The automatic control system is equipped with a dialer that can deliver up to 15 distinct messages, set up according to priority. Alarms deemed primary dial out a notification if the upset, malfunction, or maintenance issue continues after 120 seconds, while the those notifications deemed secondary do not dial out until after 600 seconds of the upset, malfunction, or maintenance issue. Callout priority for each alarm is shown in Table 8. Depending on the severity of the alarm, the operator is expected to respond to an alarm situation as soon as practicable.

Dialer notification is designed to advise the operator of appropriate needs, while minimizing nuisance alarms that could ultimately nullify the use of the system. When no immediate effect on system performance is probable, dialer notification will not be made and the alarm will be dealt with on the next operator visit.
(*Alarm response procedures are under development at the time of this revision release. Future revisions will contain appropriate instructions to alarm response.)

12.2 Alarm Conditions

Alarm conditions have been established as part of the automatic control system located at the CAS Building. Table 8 provides alarm set points and callout priorities.

12.2.1 CAS Building

This section addresses alarm conditions at the CAS Building and addresses possible cause and appropriate troubleshooting actions. The operator interface panel located on the control and instrument panel displays the status of several system components. The nine monitoring points associated with the CAS Building are as follows:

1. CAS Communications Status – ON/OFF (**Normally ON**); alarm indication at OFF status;

2. CAS Power Status - ON/OFF (**Normally ON**); alarm indication at OFF status;
3. Lime Auger - ON/OFF (**Normally ON**); alarm indication at OFF status;
4. Slurry Tank 1 Discharge - **ON**/OFF; no alarm indication of status only;
5. Slurry Tank 2 Discharge - ON/**OFF**; no alarm indication of status only;
6. Lime Silo - HIGH/LOW Level Alarm; alarm indication at HIGH or LOW level;
7. Slurry Tank 1 - HIGH/LOW Level Alarm; alarm indication at HIGH or LOW level;
8. Slurry Tank 2 - HIGH/LOW Level Alarm; alarm indication at HIGH or LOW level; and
9. Influent Flow Rate - HIGH/LOW Flow Alarm; alarm indication if out of acceptable range.

12.2.1.1 CAS Building Communication Status

Potential Causes for CAS Building Communication Failure:

This status input detects if there is a communications problem between the device and the PLC.

- Potential causes for a communications failure include:

1. PLC malfunction;
2. CAS Building electrical service loss;
3. Poor communication line connection; and
4. Transmitter or receiver malfunction.

Initial Review/Screenings for CAS Building Communication Failure:

Verify CAS Building Communication Status is not alarming on the HMI screen. If status NORMAL is displayed CAS Building communication is operating normal, but if status is alarming proceed to troubleshooting as described below.

Troubleshooting for CAS Building Communication Failure:

1. Ensure the PLC is ON by checking the power lights;
2. Ensure main computer is ON by checking the monitor;
3. Ensure CAS Building has electrical service;
4. Ensure electrical and ethernet cables are connected firmly to the PLC;
5. Ensure cable is in good condition with no exposed wires; and
6. Ensure the operator’s interface and PLC are communicating by checking transmit/receive lights on the PLC located in the Treatment System Control Panel.

Corrective Procedures for CAS Building Communication Failure:

1. Replace PLC electrical power fuse or replace electrical power supply;
2. Replace communication cable and ensure cable is seated into correct port securely; and
4. Reboot PLC to re-establish communication.

12.2.1.2 CAS Building Electrical Service Failure:

The following subsections provide general guidance to troubleshoot electrical service failure at the CAS Building. Appendix F also contains multiple troubleshooting decision trees. Action beyond the steps provide require the assistance of a qualified electrician.

Potential Causes for CAS Building Power Failure:

This status input detects if the 480-Volt 3-phase electrical service is present.

Potential causes for a CAS Building Power Failure include:

1. Power outage; and
2. Tripped breaker due to overload.

Initial Review/Screenings for CAS Building Power Failure:

Verify CAS Building Power Status is not alarming on the Operator interface screen. If status NORMAL is displayed CAS Building communication is operating normal, but if status is alarming proceed to troubleshooting as described below.

Troubleshooting for CAS Building Power Failure:

1. Ensure the power is reaching the CAS Building by checking the lights in the building;
2. Ensure Treatment System Control Panel breaker is not tripped;
3. Ensure the cut-out switch located on the north side of the CAS Building is not in the OFF position; and
4. Ensure the main 480-Volt 3-phase breaker is not tripped.

Corrective Procedures for CAS Building Power Failure:

1. Replace Treatment System Control Panel electrical power supply or blown power fuses;
2. Try to reset tripped breakers, if breakers trips again contact NorthWestern Energy or electrical contractor to perform further repair/troubleshooting as necessary; and
3. Turn ON the cut-out switch located on the north side of the CAS Building.

12.2.1.3 Lime Feeder System Screw Conveyor Failure

Decision trees, BTL-DT-4 and BTL-DT-5 located in Appendix F, provide guidance in troubleshooting and maintaining the lime feed and screw conveyor systems. The following sections provide potential causes and remedies for component operational failures.

Potential Causes for Screw Conveyor Failure:

This status input detects the status of the screw conveyor. The screw conveyor is associated with the Lime Feeder System Control Panel and operates at a constant speed.

Potential causes include:

1. Lime Feeder Control Panel will automatically shut down the screw conveyor when these conditions exist;

    - Screw conveyor motor failure; and
    - Accurate Feeder® motor failure.

2. Power outage; and
3. Tripped breaker due to overload caused by lime clog in the screw conveyor system.

Initial Review/Screenings for Screw Conveyor Failure:

Verify screw conveyor status is not alarming on the HMI screen. If status ON is displayed screw conveyor is operating normal, but if status is alarming proceed to troubleshooting as described below.

Troubleshooting for Screw Conveyor Failure:

1. Ensure the power is reaching the Lime Feeder System Control Panel by checking the lights on the front of the panel;
2. Ensure Lime Feeder System Control Panel breaker is not tripped;
3. Ensure the Accurate Feeder® is operational; and
4. Ensure screw conveyer is not clogged by lime.

Corrective Procedures for Screw Conveyor Failure:

1. Ensure Lime Feeder System Control Panel is properly configured;
2. Procedure 2 in Appendix C summarizes the Screw Conveyor Cleaning; and
3. Try to reset tripped breakers, if breakers trips again contact NorthWestern Energy or electrical contractor to perform further repair/troubleshooting as necessary.

12.2.1.4 Slurry Tank Discharge Failure

Decision tree, BTL-DT-7 located in Appendix F, provides guidance in troubleshooting and maintaining the lime slurry feed system.

Potential Causes for Slurry Tank Discharge Failure:

This status input detects the status of the slurry tank discharge. Slurry Tanks 1 and 2 discharge inputs are configured in the Allen-Bradley PLC to only call if both inputs alarms are active. This prevents false alarms at the discharge stage of lime feeder system during tank inactivity.

Potential causes for a slurry tank discharge failure include:

1. Slurry tank feed water interruption;
2. Influent flow interruption; and
3. Lime buildup in the slurry tank discharge pipe.

Initial Review/Screenings for Slurry Tank Discharge Failure:

Verify slurry tank discharge status is not alarming on the HMI screen. If status OPEN is displayed slurry tank discharge is operating normal, but if status is alarming proceed to troubleshooting as described below.

Troubleshooting for Slurry Tank Discharge Failure:

1. Ensure slurry tank feed water flow is present;
2. Ensure the influent flow is present; and
3. Ensure the discharge pipe is not built up with lime.

Corrective Procedures for Slurry Tank Discharge Failure:

1. SOP-7 in Appendix C summarizes slurry tank feed water re-establishment;
2. SOP-6 in Appendix C provides required sequence for IPS startup; and
3. SOP-39 in Appendix C provides required sequence for the slurry tank discharge cleaning.

12.2.1.5 Lime Silo Level

This status input detects the status of the Lime Silo level.

Potential causes for a Lime Silo level failure include:

1. Bindicator® GP-4 Yo-Yo® Failure.

Initial Review/Screenings for Lime Silo Level Failure:

Verify Lime Silo level status is not alarming on the HMI screen. If status is operating within the normal range, the Lime Silo level is operating normal but if status is alarming proceed to troubleshooting as described below.

Troubleshooting for Lime Silo Level Failure:

1. Ensure Bindicator® GP-4 Yo-Yo® meter breaker is not tripped OFF. This breaker is located in the main CAS Building breaker panel.
2. Ensure the meter is measuring.
3. Ensure the sensor weight is correctly attached to the main unit located on top of the lime silo.
4. Ensure the Bindicator® GP-4 Yo-Yo® is configured correctly.

Corrective Procedures for Lime Silo Level Failure:

1. Try to reset tripped breakers; if breakers trips again contact NorthWestern Energy or electrical contractor to perform further repair/troubleshooting as necessary.
2. Manually measure the lime by depressing the manual measure button on the Bindicator® display located in the lime silo.
3. Remove the main measurement device located on the top of the lime silo and observe for any abnormal operations. Refer to the Bindicator® GP-4 Yo-Yo® User's Manual.
4. Refer to the Bindicator® GP-4 Yo-Yo® User's Manual for re-configuration of the parameters for the measuring device.

12.2.1.6 Slurry Tank Level Alarms

This status input detects the status of the slurry tank alarm. A level indicator located on the top of slurry tanks measures the slurry level in the tank and alarms personnel if the level is above or below the set parameters.

Potential causes for a slurry tank level alarm include:

1. A clog in the discharge line, restricting or preventing slurry discharge from the tank. This will raise the level in the tank to the emergency overflow port and cause a high level alarm.
2. The level indicator and measuring pipe may be in need of maintenance. This will cause inaccurate readings and create false alarms.
3. The amount of water entering the slurry tank is greater than that being discharged, eventually creating a high level alarm.

Initial Review/Screenings for Slurry Tank Level Alarms:

Verify the slurry tank levels alarms are not alarming on the HMI screen. If status is operating within the normal range, the slurry tank levels are operating normal, but if status is alarming proceed to troubleshooting as described below.

Troubleshooting for Slurry Tank Level Alarms:

1. Ensure the breaker is not tripped OFF on the main CAS Building breaker panel;
2. Ensure the breaker for the level indicators are not tripped OFF in the Slurry Tank Control Panel;

3. Ensure the level indicators sensors are not covered in lime dust;
4. Ensure the measuring pipe is not clogged with lime slurry; and
5. Ensure the slurry tank discharge pipe is free of lime buildup.

Corrective Procedures for Slurry Tank Level Alarms:

1. Try to reset tripped breakers, if breakers trips again contact NorthWestern Energy or electrical contractor to perform further repair/troubleshooting as necessary.
2. Clean level indictors and measuring pipe for lime buildup. Procedure 12 summarizes the slurry tank discharge pipe cleaning.

12.2.1.7 Influent Flow Rate Alarm

This input measures influent flow with a 10-inch flow meter inside the CAS Building and alarms if the flow is above or below the set parameters.

Potential causes for high or low flow alarm:

1. Influent pump(s) shut down;

    - Power failure; and
    - Pump failure/maintenance issues.

2. Flow meter malfunction; and
3. Low water level in Cell D4 due to base flow conditions.

Initial Review/Screenings for Influent Flow Alarms:

Verify the influent flow rate is not alarming on the HMI screen. If status is operating within the normal range, the influent flow rate is operating normal but if status is alarming proceed to troubleshooting as described below.

Troubleshooting for Influent Flow Alarms:

1. Ensure all breakers associated with the IPS are not tripped OFF;
2. Ensure the Lime Feeder system is in operation – power is on and screen display is visible;
3. Ensure the ASB has electrical service (ASB maintains the PLC for the influent pump control automation) – electrical equipment is functional;
4. Ensure no damage to influent pipeline has occurred – visibly inspect the pipe for damage;
5. Ensure the intake self-cleaning screens are operational – visibly inspect screens for signs of clogging;
6. Visually check flow pumped through CAS Building to verify the alarm is not false. This includes checking the readout mounted on the McCrometer® flow meter; checking whether the communication wire is disconnected, damaged, etc.; and looking for water in the distribution channel;

7. Ensure water level in Cell D4 is operating above the minimum operating (5,414 feet) level; and
8. Ensure all valves located on the influent line are fully open and not restricting flows.

Corrective Procedures for Influent Flow Alarms:

1. Try to reset tripped breakers, if breakers trip again contact NorthWestern Energy or electrical contractor to perform further repair/troubleshooting as necessary;
2. Procedure 10 in Appendix C summarizes the steps to startup flow at the IPS;
3. Startup the lime feeder system equipment and primary PLC equipment located in the CAS Building; and
4. Open all valves located on the influent line to ensure they are not restricting flows.

12.2.2 Lagoon Systems Water Level Failure Alarm

This section addresses alarm conditions at the lagoon systems and addresses likely causes and appropriate troubleshooting actions. The operator interface panel located on the control and instrument panel displays the status of several system components. Monitoring points associated with the lagoon systems are as follows:

Instrument Tag Number	Description	Callout Point	Callout Priority
LT-LAO-2000	Pond A1 Level (amsl)	HI/LO	2
LT-LAO-2003	Pond A2 Level (amsl)	HI/LO	2
LT-LAO-2006	Pond A3 Level (amsl)	HI/LO	2
LT-LAO-2009	Pond D2 Level (amsl)	HI/LO	2
LT-LAO-2011	Pond D3 Level (amsl)	HI/LO	2
LT-LAO-2013	Pond D4 Level (amsl)	HI/LO	2
LT-LAO-2015	Pond B1 Level (amsl)	HI/LO	2
LT-LAO-2016	Pond B2 Level (amsl)	HI/LO	2
LT-LAO-2017	Pond B3 Level (amsl)	HI/LO	2
LT-LAO-2021	Pond C1 Level (amsl)	HI/LO	2
LT-LAO-2022	Pond C2 Level (amsl)	HI/LO	2
LT-LAO-2025	Pond C3 Level (amsl)	HI/LO	2

Cells B3, C3, A2, and A3 Levels. All the inputs for the listed lagoon cells were installed with identical level loggers; therefore, causes for alarms and troubleshooting will be the same for each installation throughout the system.

Potential causes for a slurry tank level alarm include:

1. Water level in slurry tank is above or below set parameters;
2. Ice or debris blockage of discharge system;

3. Malfunction with level logger;
4. Debris interfering with level logger reading; and
5. Communication with the PLC failure.

Initial Review/Screenings for Water Level Alarms:

Verify the individual cells' level status for alarming conditions on the HMI monitor. If individual cell status is operating within the normal range, the cells are operating normal but if status is alarming proceed to troubleshooting as described below.

Troubleshooting for Water Level Alarms:

1. Visually ensure water levels are within operation range to verify the alarm is not false; and
2. Ensure communication to remote monitoring stations.

Corrective Procedures for Water Level Alarms:

1. Remove pressure transducer to ensure debris/algae is not prohibiting the correct level;
2. Replace pressure transducer with spare transducer to isolate the problem; and
3. Reset remote radio to ensure communication to the remote monitoring stations.

12.2.3 Effluent Flow Rate Alarm

This input measures influent flow with a 14-inch McCrometer UltraMag flow meter (FIT-LAO-4000) located near station 0+02.

Potential causes for high or low level alarm:

1. Flow rate is above or below set parameters;
2. Malfunction of flow meter;
3. Debris covering flow meter sensor;
4. Outlet structure(s) clogged with debris or ice;
5. ASB Communication status failure; and
6. Malfunction of outlet structure(s).

Initial Review/Screenings for Effluent Flow Alarms:

Verify the effluent flow rate status is not alarming on the HMI monitor. If status is operating within the normal range, the cells are operating normal but if status is alarming proceed to troubleshooting as described below.

Troubleshooting for Effluent Flow Alarms:

1. Visually check to verify that water is discharging into the effluent system (Cells A3, B3, and C3);
2. Visually check flow through the outlet structure weirs to verify the alarm is not false;

3. Ensure all valves located on the effluent line are fully open and not restricting flows;
4. Check for debris or ice in outlet structures and the effluent line to be sure they are not restricting flow;
5. Visually check for flows out of the effluent discharge (CT-EFS7) located south of the ASB; and
6. Ensure flow meter is operating.

Corrective Procedures for Effluent Flow Alarms:

1. Remove flow meter sensor to ensure debris/algae is not prohibiting correct flow rates;
2. Configure valves to divert water into effluent pipeline; and
3. Remove debris that is preventing flow into the effluent pipeline.

13.0 REVISIONS AND UPDATES

Procedures and protocol which address revisions and updates to this manual are discussed in detail in Volume I, Water Collection and Treatment Systems, Section 7.0.

The O&M will be revised as necessary when there are changes to any of the following:

- Program operation or system components;
- Updates of manufacturers' recommended practices for the system or equipment;
- Change in regulatory or compliance requirements;
- Deviations from operating boundaries, physical damage or loss of containment;
- Changes in operating conditions;
- Physical alterations to equipment;
- New knowledge and experience of deterioration mechanisms, or other parameters that could affect the equipment integrity or reliability; or
- Alterations or modification of the system or system equipment.

Each update package will contain the necessary update information, a summary sheet listing the changes and any instructions that may be necessary, and a revised listing of all previous updates. Each page in the update will include the date on which the update was made, as well as the update number.

The procedures for revising or updating this manual are outlined below.

- An update/revision package will be sent to all individuals on the distribution list;
- Recipients will add/replace the necessary pages;
- Recipients will replace the Listing of Previous Updates in the front of the Volume; and
- Recipients will place the Update Summary Sheet for future reference purposes.

14.0 REFERENCES

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