

March 27, 2020

Email

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Email

Mr. Daryl Reed, State Project Officer
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Re: Butte Mine Flooding Operable Unit Berkeley Pit and Discharge Pilot Project, Discharge System 2019 Annual Operations and Maintenance Report

Dear Mr. Greene and Mr. Reed:

Atlantic Richfield Company (Atlantic Richfield), on behalf of Montana Resources, LLP (MR) and Atlantic Richfield herein referred to as the Settling Defendants for the Butte Mine Flooding Operable Unit (BMFOU), is submitting the *Discharge System 2019 Annual Operations and Maintenance Report* to the U. S. Environmental Protection Agency and Montana Department of Environmental Quality (Agencies). The attached report summarizes the Discharge System annual operations and maintenance for 2019 as part of the Berkeley Pit and Discharge Pilot Project (Pilot Project).

Please contact me with any questions or if you would like to set up a meeting to review.

On behalf of the Settling Defendants,



Tim Hilmo, P.E.
Operations Project Manager
Remediation Management Services Company
An affiliate of Atlantic Richfield Company

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Discharge System 2019 Annual Operations and Maintenance Report



**DISCHARGE SYSTEM 2019
ANNUAL OPERATIONS AND MAINTENANCE REPORT
Berkeley Pit and Discharge Pilot Project**

Silver Bow Creek/Butte Area NPL Site
Butte Mine Flooding Operable Unit
Butte, Montana

Prepared for:

Atlantic Richfield Company

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March 2020

Project No. 32820137

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Acronyms and Abbreviations

Atlantic Richfield	Atlantic Richfield Company
BMFOU	Butte Mine Flooding Operable Unit
CARV	Combined Air Relief-Vacuum Valve
CD	Consent Decree
DEQ	State of Montana Department of Environmental Quality
DMR	Discharge Monitoring Report
HBEL	Horseshoe Bend Effluent Line
HMI	human machine interface
HsB	Horseshoe Bend
HsBWTP	Horseshoe Bend Water Treatment Plant
HVAC	heating, ventilation, and air conditioning
M gal	million gallons
mg/L	milligram per liter
MGD	million gallons per day
MMF	multi-media filtration
MR	Montana Resources, LLP
O&M	operations and maintenance
OAP	Operations Assurance Plan
Pilot Project	Berkeley Pit and Discharge Pilot Project
PLC	programmable logic controller
RCRA	Resource Conservation and Recovery Act
RFC	Request for Change
RO	reverse osmosis
SDs	Settling Defendants
SOP	Standard Operating Procedure
USEPA	United States Environmental Protection Agency
Wood	Wood Environment & Infrastructure Solutions, Inc.
YDTI	Yankee Doodle Tailings Impoundment

DISCHARGE SYSTEM 2019
ANNUAL OPERATIONS AND MAINTENANCE REPORT
Berkeley Pit and Discharge Pilot Project
Silver Bow Creek/Butte Area NPL Site
Butte Mine Flooding Operable Unit
Butte, Montana

1.0 Introduction

This Discharge System 2019 Annual Operations and Maintenance (O&M) Report summarizes the performance, operation, and maintenance activities for the off-site discharge portion of the Berkeley Pit and Discharge Pilot Project (Pilot Project) at the Butte Mine Flooding Operable Unit (BMFOU) site.

Atlantic Richfield Company (Atlantic Richfield) has contracted with Wood Environment & Infrastructure Solutions, Inc. (Wood) for O&M of the Discharge System component of the broader Pilot Project as described in Section 2.0. Construction of the Discharge System began in 2018 and was partially commissioned during 2019. The Settling Defendants (SDs)¹ initiated Off-Site Discharge on 30 September 2019. Operation of the Discharge System continued through the remainder of 2019. All off-site discharge is compliant with the Consent Decree (CD) Interim Discharge Standards (USEPA, 2002) for point-source discharges released from the BMFOU of the Silver Bow Creek/Butte Area Superfund Site.

2.0 Discharge System Overview

As part of the broader Pilot Project, flows from the Horseshoe Bend (HsB) area seeps are conveyed to the Yankee Doodle Tailings Impoundment (YDTI) for treatment following lime addition. Flows from the Berkeley Pit, following treatment at the HsB Water Treatment Plant (HsBWTP), are incorporated into the active mining circuit. The Discharge System consists of the following:

- Infrastructure to convey YDTI return water to a new water treatment plant (Polishing Facility),
- The Polishing Facility water treatment system,
- Piping infrastructure for transporting effluent, reverse osmosis (RO) brine, and multi-media filtration system waste (i.e., backwash water), and,
- Infrastructure to combine treated effluent with Silver Lake water (if necessary, for up to one year)² and discharge to Silver Bow Creek through the Horseshoe Bend Effluent Line (HBEL) and Discharge Structure.

¹ Settling Defendants: Atlantic Richfield Company (Atlantic Richfield), Montana Resources, Inc., Montana Resources LLP (MR), and Dennis Washington.

² Per a letter to the SDs from the USEPA dated August 24, 2018 (USEPA, 2018), "Use of flow augmentation is limited to one year from the start of discharge to Silver Bow Creek from the [Pilot Project], unless extended by EPA in consultation with the DEQ." The use of effluent flow augmentation will eventually be replaced with split-stream reverse osmosis treatment.



This section describes the components of the Discharge System. Further details regarding the Discharge System design are provided in the Discharge System Work Plan (Wood, 2020) and associated addenda.

2.1 Polishing Facility

The Polishing Facility consists of the following process systems:

- *Multi-Media Filtration (MMF)*: Six horizontal pressure filters containing gravel, fine sand, and anthracite provide MMF. Two operating modes (single-stage and two-stage filtration) accommodate varying water quality. The addition of chemical reagents and pH adjustment provides removal of total suspended solids (TSS), including metal precipitates.
- *Reverse Osmosis (RO)*: A RO system consisting of two skids, with nanofiltration pore size membranes, operate as needed at a planned recovery of approximately 75% to produce a net permeate flow of 3 million gallons per day (MGD). When operated, a portion of the MMF effluent will flow by gravity to the RO system for removal of total dissolved solids (TDS). Commissioning of the RO systems is expected to occur during the first quarter of 2020 following construction completion.
- *Product Tank*: The Product Tank combines the balance of the filtered effluent routed around the RO system with the RO permeate, when operating in that configuration, prior to being discharged from the Polishing Facility.
- *Chemical Feed Systems*: Four chemical feed systems have been included enhance filtration and RO performance and ensure effluent compliance. These include polymeric coagulant, antiscalant, carbon dioxide, and organosulfide reagent systems.

Additionally, the Polishing Facility includes supporting infrastructure, piping, and service systems, such as electrical power, building services (potable water, sanitation, and heating, ventilation, and air conditioning [HVAC]), instrument air, communications (fiber-optic and ethernet), and process control system (Programmable Logic Controllers [PLCs] and human-machine interface [HMI]).

The Polishing Facility can be operated in numerous operational configurations between the MMF and RO systems, as described in the Discharge System Operations Assurance Plan (OAP, Attachment E of the Discharge System Work Plan) (Wood, 2019a). Single-stage and two-stage filtration with no RO treatment were demonstrated during the Fall of 2019. A Discharge Demonstration incorporating RO treatment is planned for first quarter 2020.

2.2 Conveyance Infrastructure

The conveyance infrastructure consists of the following components, which are further detailed in the Conveyance Infrastructure Work Plan (Pioneer Technical Services, Inc. [Pioneer] and Copper Environmental Consulting [Copper], 2019):

- *Polishing Facility Influent Line*: The takeoff location for conveying YDTI return water to the Polishing Facility is upstream of the HsBWTP tie-in to the YDTI return water line. A new pipeline

was constructed to convey water from the takeoff location to the Polishing Facility and commissioned during 2019.

- *On-Site Effluent Line:* Final treated effluent from the Polishing Facility flows through a newly installed effluent pipeline which connects to the HBEL and eventually discharges through the Discharge Structure at Silver Bow Creek. The HBEL and Discharge Structure were both modified and commissioned in 2019.
- *Off-Spec/Backwash Line:* MMF system filter backwash and water determined to be off-spec (either influent or effluent) is conveyed via a pipeline to the existing Dredge Pond located near MR's mill. The water collected in the Dredge Pond may be incorporated into MR operations in the mill or allowed to overflow to the Berkeley Pit if the volume exceeds MR's intake capacity and demand. Backwash and Off-Spec Water pipelines were constructed and commissioned in 2019.
- *RO Reject Line:* The RO reject is routed to the Berkeley Pit through a newly installed RO Reject pipeline from the Polishing Facility connecting to the existing Belmont stormwater drain. The RO reject line was constructed and commissioned in 2019.

2.3 Effluent Flow Augmentation

Silver Lake water can be blended in-line with effluent from the Polishing Facility through a newly modified connection to the HBEL. The Silver Lake Water Line tie-in is located just upstream of the Polishing Facility tie-in location to the HBEL. The rate of blending is based on a desired flow rate, as determined by the Discharge System Operations Team. During the first year of operations, effluent flow augmentation with Silver Lake water may be used to meet the chronic Whole Effluent Toxicity (WET) discharge standards.

3.0 Operations Summary

The OAP and CD specify that annual reports will be submitted to the United States Environmental Protection Agency (USEPA) and the State of Montana Department of Environmental Quality (DEQ), collectively referred as the Agencies, summarizing system performance and O&M activities during the prior year. This section describes the Discharge System construction, commissioning, demonstrations, and performance for 2019.

3.1 Discharge System Commissioning

The following Discharge System components were constructed and commissioned during 2019:

- Process Systems of the Polishing Facility including six MMF vessels, a carbon dioxide system for pH adjustment, a coagulant dosing system, and organosulfide (TMT-15) dosing system;
- Service Systems including electrical power, building services (potable water, sanitation, and HVAC), instrument air, communications (fiber-optic and ethernet), and process control system (PLCs and HMI);



- Conveyance Infrastructure, including the Polishing Facility influent line, the on-site effluent line, the backwash and off-spec line, and the RO reject line; and
- Silver Lake water effluent flow augmentation infrastructure.

The Discharge System Commissioning and Startup Report (Wood, 2019b) provides a description of the overall activities executed to successfully commission and start-up the Discharge System. Only the MMF and associated equipment are included in the Report submitted on 30 October 2019. Construction of the RO system and associated equipment commenced in 2019; commissioning is planned for early 2020 and will be documented in a separate submittal. The primary objective of the commissioning and start-up period was to thoroughly test and verify that all components and systems were working as designed, prior to initiating demonstration and operations. Commissioning of the Conveyance Infrastructure flow meters³ and Discharge Structure water quality instrumentation continued into early 2020.

Additional commissioning was performed on all 6 MMF units for single-stage filtration with increased flow rate up to 10 MGD in late September 2019, and was summarized in a notification letter to the Agencies on 11 October 2019. Conditional approval pending further commissioning and demonstration efforts was granted in a letter on 6 November 2019 from the Agencies.

3.2 Discharge Demonstrations

Discharge Demonstrations were performed for the following operational configurations in 2019:

- Single-stage MMF with no RO treatment
- Two-stage MMF with no RO treatment

The single-stage MMF Discharge Demonstration completion notification and discharge approval request was submitted to the Agencies on 9 September 2019 (Atlantic Richfield and Montana Resources, 2019a). The USEPA approved the results of this Discharge Demonstration in a letter to the SDs dated 26 September 2019 (USEPA, 2019). Off-site discharge operations utilizing single-stage MMF with no RO treatment commenced on 30 September 2019 as discussed below. A detailed report summarizing results from the single-stage MMF demonstration period was provided to the Agencies on 7 October 2019 (Atlantic Richfield and Montana Resources, 2019b).

The two-stage MMF Discharge Demonstration results were detailed in a summary report submitted to the Agencies on 12 February 2020 (Atlantic Richfield and Montana Resources, 2020). USEPA approval of the results of this Discharge Demonstration is pending at the time of submittal of this report. Two-stage MMF operation for off-site discharge has not been conducted to date.

Operational configurations that utilize the RO system, and other potential operating modes, will be demonstrated during 2020. As requested by the Agencies, demonstration of all six MMF units in single-stage filtration operational mode up to 10 MGD is also anticipated for 2020.

³ The off-spec and effluent line flow meters are housed in the Meter Building near the Polishing Facility. A final outfall flow meter is located on the HBEL near the Discharge Structure.



3.3 Discharge System Component Performance Summary

Beginning on 30 September 2019, YDTI return water was conveyed to the Polishing Facility for treatment prior to off-site discharge to Silver Bow Creek. Based on the YDTI water chemistry and results from the Field Study Filtration Test, the Polishing Facility was operated in a single-stage filtration configuration with no RO treatment. The Polishing Facility met BMFOU CD Interim Discharge Standards during 2019, as detailed in the Discharge Monitoring Reports (DMRs) submitted for October, November, and December.

The following summarizes the Discharge System component performance in 2019:

- The Discharge System operated from 30 September 2019 through 31 December 2019. Aside from the high flow commissioning activities and the two-stage MMF Discharge Demonstration described in Section 3.2 above, the Polishing Facility was operated in a single-stage MMF configuration, using Filters 1, 2, and 3 to achieve a maximum effluent flow rate of 6.07 MGD.
- There were no significant issues with the Polishing Facility process systems in 2019, with the exception of two overflow events related to the Carbon Dioxide System during the commissioning phase in June and August 2019. No repeats of these events have occurred during operations, and modifications are planned in 2020 to prevent future occurrences.
- There were no significant issues with any Polishing Facility service systems in 2019.
- There were no issues with the conveyance infrastructure in 2019. There were no issues with Silver Lake Water effluent flow augmentation in 2019. Silver Lake water was used for effluent flow augmentation from 9 December 2019 through 20 December 2019 at a maximum rate of 1.98 MGD.



3.4 Discharge System Statistics

The following table summarizes the Discharge System flow rates in 2019.

Table 1: Discharge System 2019 Flow Totals

	<i>Unit</i>	Polishing Facility Effluent ¹	Backwash ²	Off-Spec Discharge ²	RO Reject	Silver Lake Water Flow Augmentation ³	Blacktail Creek ⁴
Monthly Average							
Quarter 4 ⁵	<i>(MGD)</i>	4.81	NA	NA	NA	NA	10.5
2019 Average	<i>(MGD)</i>	4.81	NA	NA	NA	NA	10.5
Daily Maximum							
Quarter 4 ⁵	<i>(MGD)</i>	6.07	0.17	7.51	NA	1.98	15.3
2019 Maximum	<i>(MGD)</i>	6.07	0.17	7.51	NA	1.98	15.3
Total Cumulative Volume							
Quarter 4 ⁵	<i>(M gal)</i>	447	3.08	23.9	NA	16.3 ⁶	NA
2019 Total	<i>(M gal)</i>	447	3.08	23.9	NA	16.3	NA

Notes:

1. Polishing Facility Effluent flow data are estimated from Filters 1, 2, and 3 Flow Meters, FE-2035, FE-2038, and FE-2041, due to erroneous readings at FE-4005.
2. Backwash and off-spec discharge are not a continuous flow rate. For this reason, the monthly average flow rates are not included in the summary.
3. Silver Lake Water Effluent Flow Augmentation was not used continuously. For this reason, the monthly average flow rate is not included in the summary.
4. Backwatering of Blacktail Creek at SS-04 has been observed as a result of Discharge System operations. SS-04 values have been corrected by a factor of 2.5 MGD. The receiving water flow rate was measured at SS-05 starting 1 November 2019 and estimated by subtracting the Polishing Facility effluent flow rate.
5. Includes data beginning on 30 September 2019 at 10:00.
6. 16.3 million gallons is the sum of volumes reported in the monthly DMRs in the fourth quarter and tabulated based on measured flows from the Silver Lake Flow Augmentation meter. Since these flows were reported in the DMR, the SDs have recognized a more accurate method of measuring Silver Lake Flow Augmentation volumes by totalizing the meter readings. Based on totalizer volumes, Silver Lake volume added in the fourth quarter was 17.1 million gallons. Starting in the first quarter, 2020 Silver Lake flow augmentation water volumes will be reported using the more accurate totalizer method.

Abbreviations:

- M gal = million gallons
- MGD = million gallons per day
- MR = Montana Resources
- NA = Not Applicable
- RO = Reverse Osmosis

Beginning 30 September 2019, approximately 447 million gallons of treated effluent were discharged to Silver Bow Creek via the Discharge System. This is approximately 94% of the total influent sent through the Polishing Facility. The remaining 6% of influent resulted in Off-Spec or Backwash volumes and was diverted back to MR's Dredge Pond.



The following tables summarize the chemical and carbon dioxide usage rates in 2019. Due to the configuration of the carbon dioxide dosing system, the cumulative volume consumed by the Polishing Facility can only be estimated by the delivery volume. Modifications to the carbon dioxide system are being considered for 2020.

Table 2: Discharge System 2019 Chemical Usage

	Unit	Coagulant (RoQuest 3000)	Organosulfide ¹ (TMT-15)	Antiscalant ² (Avista 7000)
Dosage Rate	(mg/L)	1.0 / 0.5 ³	0.0	0.0
Quarter 4 ⁴	(gal)	312	0.0	0.0
2019 Average	(gal)	312	0.0	0.0

Notes:

1. Organosulfide was not used during operations in 2019.
2. The antiscalant system was not commissioned in 2019, as this is used for the RO system.
3. The initial coagulant dosage rate was set at 1.0 mg/L and was later reduced to 0.5 mg/L in early November 2019.
4. Includes data beginning on 30 September 2019 at 10:00.

Abbreviations:

gal = gallons
mg/L = milligram per liter

Table 3: Discharge System 2019 Carbon Dioxide Delivery Summary

Delivery Date	Carbon Dioxide (lbs)	Notes
6/26/2019	37,388	Initial Tank Fill
6/27/2019	41,406	Initial Tank Fill
7/13/2019	30,168	Initial Tank Fill
10/17/2019	27,189	--
11/4/2019	41,560	--
12/4/2019	40,620	--
2019 Total ¹	218,331	--

Notes:

1. Total volume includes all deliveries during 2019.

Abbreviations:

lbs = pounds



4.0 Maintenance Activities

The Operations and Maintenance (O&M) Manual for the Polishing Facility is in progress and will be submitted to the Agencies in 2020. The Wood operations team is responsible for following standard operating procedures (SOPs), manufacturer manuals and guidelines, field monitoring, data recording, sample collection, and routine daily preventative and corrective maintenance at the Polishing Facility. This work was routine in 2019. Progressive improvements were made and documented accordingly in SOPs during the year. The Discharge System maintenance activities are described in the following sections.

4.1 Polishing Facility Maintenance

Following are notable 2019 maintenance activities for the Polishing Facility.

4.1.1 Multi-Media Filtration

It was determined during commissioning of the filters that the Combined Air Relief-Vacuum Valves (CARVs) initially installed with the MMF were oversized. The CARVs were downsized from 3-inch to 2-inch and now function as intended. The CARVs were replaced on Filter 3 (FLV-2003) during September 2019, and the CARVs on Filters 4, 5, and 6 (FLV-2004, FLV-2005, and FLV-2006) were replaced during December 2019. The CARVs will be replaced on Filters 1 and 2 (FLV-2001 and FLV-2002) during early 2020.

4.1.2 Backwash

The backwash sequence and timing were tested during commissioning and the Discharge Demonstrations and were refined throughout 2019. Further refinement of the backwash sequence and timing does not appear necessary and is not anticipated for 2020. Several short backwashes were performed throughout the year on all six filtration vessels.

4.1.3 Reverse Osmosis

The RO system will be commissioned and demonstrated in 2020. There were no maintenance activities on the system during 2019.

4.1.4 Product Tank

During the week of 22 November 2019, Polishing Facility flow was diverted to Off-Spec due to discrepancies between Product Tank pH values for in-line instrumentation and handheld instruments. Instrument noise created by turbulent flow within the Product Tank interfered with the accuracy of readings from in-line instrumentation and calibration efforts. A temporary flow-through cell was implemented to more accurately control pH adjustment within the Product Tank. Discharge resumed on 28 November 2019 at 2 MGD, after confirming adequate pH control. The flow rate was gradually increased to 6 MGD over a period of three days. A permanent flow-through cell will be designed and constructed during 2020, and a Request for Change (RFC) will be submitted to the Agencies for approval before implementing any modifications.



4.1.5 Chemical Dosing Systems

The organosulfide (TMT-15) system was commissioned in 2019 but was not utilized for Off-Site Discharge Operations. The antiscalant dosing system will be commissioned and demonstrated with the RO system in 2020. The coagulant and carbon dioxide dosing systems' maintenance activities are summarized below.

4.1.5.1 Coagulant Dosing System

No notable maintenance occurred on the coagulant dosing system during 2019.

4.1.5.2 Carbon Dioxide System

Notable maintenance on the carbon dioxide system during 2019 included:

- pH adjustment irregularities were noted on 13 November 2019. During troubleshooting, precipitate was removed from in-line diffuser DF-2003. The precipitate removed was analyzed by Pace Laboratories and found to be primarily composed of calcium and sulfate compounds.
- Precipitate was removed again from in-line diffuser DF-2003 on 19 December 2019. Monthly maintenance of the carbon dioxide in-line diffusers was added to the regular maintenance schedule for the Polishing Facility.
- The check valves upstream of the diffusers were cleaned in November and December 2019 to improve delivery performance. The check valve associated with in-line diffuser DF-2003 is scheduled for replacement in the first quarter 2020.

The carbon dioxide system components and controller settings will continue to be monitored, replaced, and refined to ensure system reliability during 2020. A redundant, retractable carbon dioxide diffuser system will be designed and constructed in 2020 to allow for easier routine maintenance, and an RFC will be submitted to the Agencies for approval before implementing any modifications.

4.1.6 Process Control Systems

Several, short HMI data-loss events occurred during the month of December. Data loss events were caused by the HMI computer operating system automatic updates inadvertently disconnecting the database. Events ceased after disabling unnecessary operating system features (automatic updates). Modifications to the HMI have been implemented by the controls subcontractor to prevent this issue from reoccurring. The issue continues to be closely monitored moving forward to ensure no further data loss events occur.

4.2 Silver Lake Water Effluent Flow Augmentation

No notable maintenance was completed on the Silver Lake Water Effluent Flow Augmentation infrastructure during 2019.

4.3 Conveyance Infrastructure

The following notable maintenance items were completed on the Conveyance Infrastructure during 2019.



4.3.1 Polishing Facility Influent Line

No significant maintenance occurred on the Polishing Facility Influent Line during 2019.

4.3.2 Polishing Facility Effluent Line

No significant maintenance occurred on the Polishing Facility Effluent Line during 2019.

4.3.3 HBEL

The HBEL had not been placed into service since its original construction in 2003. In 2019, the HBEL was recommissioned to convey the Discharge System effluent to Silver Bow Creek. The following HBEL modifications were completed:

- Five CARVs were installed at high points identified during the HBEL visual inspection.
- A flow meter was installed prior to the HBEL Discharge Structure.
- A wye was installed to support HBEL diversion, if required for future construction activities.

The modifications were submitted to the Agencies in the *Draft Final Hydrotest Execution Plan Horseshoe Bend Effluent Line Revision 1* (Pioneer, 2018) and RFC #1 to the *Discharge System Work Plan* (Atlantic Richfield, 2019).

4.3.4 Discharge Structure

The HBEL modifications also included modification of the existing discharge structure at the outfall to Silver Bow Creek. The following Discharge Structure modifications were completed in 2019:

- The Discharge Structure was modified to increase its flow capacity.
- Instrumentation including pH, specific conductance, and temperature were installed within the Discharge Structure, along with infrastructure to communicate with the Polishing Facility.
- Fencing was installed to limit access to the Discharge Structure.

These modifications were submitted to the Agencies in RFC #1 to the *Discharge System Work Plan* (Atlantic Richfield, 2019).

5.0 Summary

In 2019, the Discharge System successfully treated 447 million gallons of water from the YDTI prior to Off-Site Discharge. Additional components of the Discharge System will continue to be commissioned and demonstrated during 2020.



6.0 References

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- Atlantic Richfield and Montana Resources. 2019b. Letter to USEPA Region VII and Montana Department of Environmental Quality. Re: Berkeley Pit and Discharge Pilot Project Single-Stage Filtration Demonstration Report. From: Tim Hilmo, Atlantic Richfield Company and Mark Thompson, Montana Resources Inc. October 7.
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