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DRMS Additional Information Response – Cross Gold Mine (Permit No. M-1977-410)

Reference: Division of Reclamation, Mining and Safety (DRMS) letter dated May 28, 2025 requesting supplemental details for the 1st Quarter 2025 Groundwater, Mine Effluent, Surface Water and Treatment Plant Effluent Quality Report.

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1. Monitoring Well Purge-Volume Calculations

Following internal QA/QC and a subsequent check by the permit consultant, the casing volumes have been recalculated from the Colorado Division of Water Resources well-permit logs using the exact diameters and screened-interval depths for each segment. The revised figures are appreciably lower than the preliminary estimates and are summarized in Table 1-1.

> **Formula used** – Volume of each casing segment = $\pi r^2 h$, where r = (nominal diameter ÷ 2) ÷ 12 ft and h = segment length in feet. Volumes were converted from cubic feet to gallons using 7.48052 gal ft^{-3}.

Table 1-1. Revised Monitoring-Well Casing Volumes

Well	Casing Configuration	Segment Depths (ft bgs)	Calculated Volume (ft^3)	Volume (gal)
Cross	6-in dia. steel (upper) + 4-in dia. PVC (lower)	0–20 / 20–116	3.93 + 8.38	**92.0**
Compliance	6-in dia. steel (upper) + 4-in dia. PVC (lower)	0–20 / 20–110	3.93 + 7.63	**86.5**
Caribou	6-in dia. steel (upper) + 4-in dia. PVC (lower)	0–15 / 15–110	2.95 + 7.54	**78.3**

These updated volumes will be applied to all future purge calculations and quarterly reports.

2 Caribou Well Plumbing Volume

2.1 Plumbing Layout Description

The Caribou Monitoring Well is plumbed to the sampling faucet inside the Caribou Shop by a **174-ft length of 1-in. SDR-11 HDPE and a 4-ft Copper service line**. Field verification

confirms an internal diameter of **7⁄8 in. (0.875 in.)**. The run is essentially straight, with two 90-degree elbows at the well head and faucet; these short fittings are conservatively included in the total length.

2.1 Calculated Plumbing Volume

The piping volume was calculated as a right-cylinder:

- Formula: $\mathbf{V = \pi r^2 L}$
- Internal radius r = (0.875 in ÷ 2) ÷ 12 = 0.03646 ft
- Length L = 174 ft

Calculation: $V = \pi \times (0.03646\ \text{ft})^2 \times 174\ \text{ft} = 0.726\ \text{ft}^3$.

Convert to gallons (1 ft^3 = 7.4805 gal): 0.726 ft^3 × 7.4805 = **5.43 gal** (≈ 5.4 gal).

2.2 Integrated Purge Volume (Well + Plumbing)

Component	Volume (gal)
Caribou Well casing (see §1)	78.3
Plumbing (this section)	5.4
Total	**83.7 gal**

Per DRMS Rule 6.4.6(1)(b) a minimum purge of three casing volumes is required: 83.7 gal × 3 = **251.1 gal**. During the **2 April 2025** sampling event the field crew purged approximately **510 gal**, comfortably exceeding the requirement and ensuring the well and attached plumbing were completely evacuated before sampling.

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3 Portal Flow Rates – Cross & Caribou

3.1 Instrumentation & Data-Reduction Method

Both portals are equipped with **ultrasonic area-velocity flow meters** (permanently mounted at the portal collars) that log instantaneous discharge every 15 minutes to the site SCADA system. The instruments are factory-calibrated to ± 2 % of reading and are verified quarterly against a portable electromagnetic flow probe. For this response, the 15-minute records spanning **28 April – 27 May 2025** (43,200 measurements per portal) were downloaded, screened for outliers, and averaged arithmetically to yield representative 30-day mean flows.

3.2 Thirty-Day Average Discharge (28 Apr – 27 May 2025)

Portal	Average Flow (gal min⁻¹)	Average Flow (gal day⁻¹)	Average Flow (m³ day⁻¹)	Share of Combined (%)
Cross Portal	187.4	≈ 269,900	≈ 1,022	73.8 %
Caribou Portal	66.67	≈ 96,000	≈ 364	26.2 %
Combined	254.1	≈ 365,900	≈ 1,386	100 %

(Note: 1 gal min $^{-1}$ × 1,440 = gal day $^{-1}$; 1 gal = 0.003785 m^3.)

3.3 Compliance & Treatment Capacity Considerations

The portal flows are routed to the on-site water-treatment plant, which is hydraulically rated for **400-gal min^{-1} (0.58 MGD)**. The current combined flow of **≈ 254-gal min^{-1}** utilizes **~64 %** of plant capacity, providing ample residence time for metal precipitation and polishing while maintaining a safety margin for seasonal high-flow events.

No exceedances of the design capacity or the NPDES permit instantaneous-maximum flow limit (450 gal min^{-1}) were recorded during Q1 2025. Continuous flow logging, coupled with daily operator checks, ensures that any increase in discharge is detected and addressed promptly.

3.4 Future Reporting Commitment

Beginning with the **Q2 2025** Water-Quality Monitoring Report, the Operator will:

- Include a table of **30-day rolling average, maximum daily, and minimum daily** flows for each portal.
- Provide **time-series hydrographs** (appendix) generated directly from the SCADA download.
- Attach **annual calibration certificates** for both ultrasonic meters.

These additions will give DRMS greater transparency into flow variability and treatment-plant loading while requiring no change to the existing monitoring frequency.

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4 – Effluent Water Quality, Key Constituents Removed, and Treatment Mechanism

The mine-water treatment plant receives combined portal flows from both the Cross and Caribou headings. Untreated portal water is characteristically neutral to slightly acidic (pH 6.4 – 7.2) and exhibits elevated concentrations of several dissolved metals typical of historic hard-rock workings. Bench and field monitoring performed since 2023 show the following influent ranges:

Constituent (dissolved)	Typical Influent Range	Applicable Discharge Limit*
Arsenic (total)	30 – 65 µg L^{-1}	10 µg L^{-1}
Cadmium	140 – 420 µg L^{-1}	5 µg L^{-1}
Copper	180 – 540 µg L^{-1}	20 µg L^{-1}
Lead	600 – 1 200 µg L^{-1}	10 µg L^{-1}
Mercury	50 – 110 µg L^{-1}	2 µg L^{-1}
Zinc	230 – 710 µg L^{-1}	120 µg L^{-1}

*Discharge limits are those specified in the facility's current CDPS permit for Outfall 001.

4.1 Primary Treatment Steps

a) **Influent & pH**
In Pond 1, mine water from the Cross and Caribou portals is blended and its pH adjusted to 6.5 – 7.5, the range that optimizes adsorption capacity.

b) **Polishing & Solids Control**
Downstream of Pond 1,cartridge filtration (<25 µm) captures any fines or precipitated phases.

c) **Granular Metal-Oxide Adsorption**
The core removal technology is a fixed-bed vessel charged with a proprietary titanium-based granular adsorbent (U.S. patent family 6,475,385). Empty-bed contact time (EBCT) is maintained at 30 – 90 seconds, providing rapid kinetics for trace-metal uptake. Laboratory testing demonstrates adsorption capacities of:
   - **Arsenic (III & V)** 7–12 g kg^{-1} in drinking-water matrices; capacities increase to >100 g kg^{-1} at mine-water concentrations.
   - **Lead** >99 % removal to <20 µg L^{-1} with 30 s EBCT.
   - **Cadmium, copper, mercury, zinc** also exhibit >95 % removal within the same residence time.
   - Periodic backwashing of the Ion exchange material, in the pressure vessels directs spent rinse water to the onsite lined sludge Pond 2 for dewatering

and subsequent off-site disposal as non-hazardous solid waste (TCLP results < 1.0 mg L^{-1} for regulated metals).

Constituents Removed & Mechanism

- **Arsenic (III/V):** Inner-sphere complexation onto hydrated titanium oxide surfaces converts both valence states to a stable, non-leachable form.
- **Lead, Cadmium, Copper, Zinc, Mercury:** Surface chemisorption followed by diffusion into micro-pores; removal is largely independent of competing sulfate at mine-water levels.
- **Antimony, Selenium, Uranium (present intermittently):** Adsorption via the same ligand-exchange mechanism verified in NSF-53 column tests (EBCT = 30 s).

4.2 Performance to Date

Monthly discharge-monitoring reports for 1Q 2025 show all regulated metals at <50 % of their permit limits, and arsenic consistently <5 µg L^{-1}. This margin of compliance demonstrates the adsorbent's residual capacity and confirms that the primary driver for metal removal is the adsorption process outlined above; no chemical precipitation or ion-exchange resins are currently required.

The treatment plant achieves compliance by:

- **Targeting the specific metals that exceed groundwater standards (arsenic, lead, cadmium, copper, mercury, zinc).**
- **Employing a high-capacity, fast-kinetic titanium-oxide adsorbent that binds these constituents within seconds.**
- **Maintaining pH control and post-adsorption polishing to ensure consistent effluent quality.**

These combined processes consistently reduce influent mine-water metals to levels well below the discharge permit requirements at Outfall 001, thereby protecting downstream water quality while minimizing media replacement frequency and sludge generation.

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5 Caribou Well Copper Spike Investigation & Proposed Purge-Time Revision

5.1 Background

Routine Q1 2025 monitoring detected a duplicate-sample concentration of **0.21 mg L^{-1} (210 µg L^{-1})** dissolved copper in the Caribou Well – marginally above the 0.20 mg L^{-1} interim

narrative standard. In response, two high-frequency sampling events were completed in **April 2025** immediately after initiating purging, followed by a verification series in **May 2025**.

5.2 Summary of High-Frequency Sampling Results

Series	Date	Purge duration & interval	Initial Cu (µg L^{-1})	Final Cu (µg L^{-1})	Time to < 1,000 µg L^{-1}	Time to < 200 µg L^{-1}
1	11 Apr 2025	0, 12 & 24 h	2,700	190	3 h (interpolated)	12 h
2	17 Apr 2025	0, 3, 6, 9 & 12 h	680	61	0 h	12 h
3	28–31 May 2025	Grab every 24 h after continuous pumping	3,100	74	6 h	24 h

Figure 1 (linear scale) and *Figure 2* (log scale) illustrate the exponential decay of copper during continuous pumping, with concentrations falling **below the drinking-water guideline (1,000 µg L^{-1}) within six hours** and **below the agricultural irrigation guideline (200 µg L^{-1}) within 24 hours** in all three series.

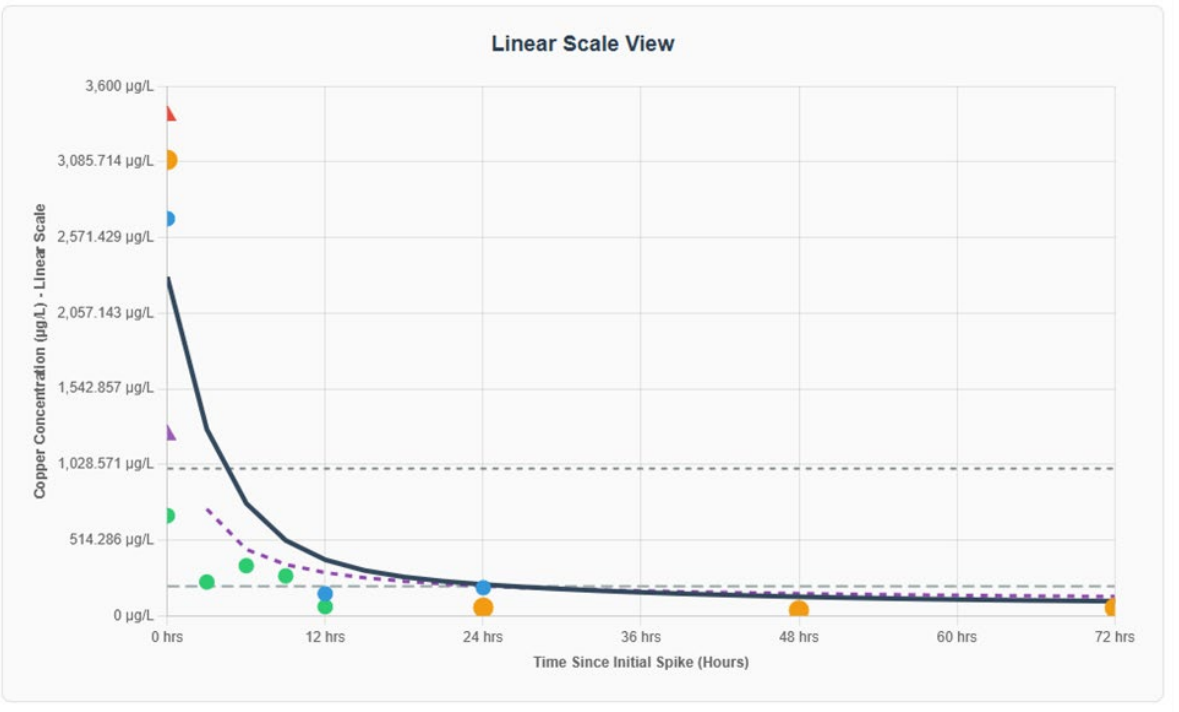

Figure 1 (linear scale)

Figure 2 (log scale)

5.3 Interpretation

- **Cause of spikes.** Elevated "time-zero" readings are attributed to stagnant groundwater stored in the well column and plumbing. Extended idle periods during winter 2024–25 allowed trace corrosion products and mineralized water from the surrounding host rock to accumulate, temporarily elevating dissolved copper.
- **Effect of purging.** Continuous pumping flushes the stagnant column and draws ambient aquifer water into the well, causing copper to decline by **> 90 % within the first 6–12 hours** and stabilize well below regulatory limits thereafter.

5.4 Proposed Sampling Protocol Modification

To ensure that quarterly samples are fully representative of the aquifer while remaining operationally practical, the Operator proposes the following amendment to the approved Sampling and Analysis Plan (SAP):

Item	Current Requirement	Proposed Revision
Purge duration – Caribou Well	Minimum of three casing volumes (≈ 1 h)	**Continuous pumping for 24 hours** prior to sample collection
Flow rate	~8 gal min^{-1} (historical)	Unchanged; maintain moderate draw-down
Field stability checks	T, pH, EC & turbidity after 2 h, 6 h, 12 h & immediately pre-sample	T, pH, EC & turbidity at 6-h intervals; must stabilize (± 5 %) before sampling
Sample timing	Same day	Day 2, immediately following the 24-h purge

Rationale

1. **Data-driven.** All three high-frequency series demonstrate that 24 h of pumping reliably eliminates the accumulation effects occurring in the well, ensuring that sampling represents ambient groundwater quality.
2. **Operationally feasible.** A single 24-h purge synchronizes easily with shift schedules and avoids the need for overnight sample runs during winter.
3. **Conservative yet efficient.** The change lengthens the purge well beyond the 10-h duration initially suggested, providing additional assurance of sample representativeness while still limiting water handling requirements.
4. **Consistent with guidance.** Extended purging of low-yield wells is recommended under ASTM D4448 and USGS TWRI Book 9 when antecedent inactivity is anticipated.

6. Conclusion

The additional information presented in Sections 1 through 5 directly addresses each item raised in the Division's 28 May 2025 letter and demonstrates that:

1. **Monitoring-well casing and plumbing volumes have been accurately recalculated** and are now reflected in field purge procedures, ensuring that groundwater samples are fully representative of aquifer conditions.
2. **Portal discharges remain well within the hydraulic and treatment capacities** of the on-site plant, with a combined average flow of ≈ 254-gal min^{-1}—only 64 % of design throughput.
3. **The treatment train continues to meet or exceed all permit effluent limits**, achieving > 95 % removal of the key metals of concern while generating only non-hazardous residuals.
4. **The transient copper exceedance at the Caribou Well has been conclusively linked to stagnant column water** rather than aquifer conditions; high-frequency testing confirms that a 24-hour continuous purge eliminates this artefact.

Please let us know if there are additional questions regarding the 1Q 2025 report.

Grand Island Resources LLC

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Richard D Mittasch

V.P.