January 19, 2007

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Re: Eagle Mine Site - Belden Groundwater Extraction System Performance Report

Dear Wendy and Mike:

In a June 20, 2006 letter, CBS Operations Inc. (CBS) proposed additional testing in the Belden area of the Eagle Mine site to assess the feasibility of meeting proposed performance standards for reduced zinc loading to the Eagle River by extracting and treating groundwater. The Belden area has been identified as the largest remaining source of zinc loading to the river. This System Performance Report is provided to apprise CDPHE and EPA of the data collected thus far and CBS' plans for the near future.

BACKGROUND

Task 3A of the CD/SOW, Waste Rock Monitoring Wells/Monitoring at Belden, was completed in 1997 and zinc loading to the Eagle River via rainfall-runoff, snowmelt, and groundwater seepage from the Belden area was evaluated. In the *Data Evaluation Report Belden Area* (Dames & Moore, 1997), Dames & Moore concluded that zinc loads contributed periodically via rainfall-runoff from the waste rock piles on the canyon slopes constituted a relatively small portion of the zinc load (less than 2 percent of the annual zinc load transported in the river). Snowmelt runoff contributed more zinc to the river than rainfall-runoff, and zinc concentrations in the river were highest during the spring snowmelt period. Based on the evaluation, most of the zinc loading (62-88%), however, could not be accounted for in the flowing tributaries. The source of most of the zinc loading to the river was attributed to mineralized groundwater.

Based on monitoring well sampling, groundwater in the railroad fill in the Belden area is moderately acidic (pH range 2.8-5.8) and contains elevated concentrations of sulfate, zinc, and other metals leached from sulfide minerals within the undifferentiated mineralized source material in the area, and from diffuse seepage from the flooded Eagle Mine through fractured bedrock (see attached Conceptual Groundwater Scenario in Belden). Several years of water level measurements in seven Belden monitoring wells indicate that the water table in the railroad fill rises in the spring in response to recharge from snowmelt. This rise in the local water table in the Belden area is commensurate with a seasonal increase in the zinc concentration in the Belden reach of the river.

WELL INSTALLATION

Belden Area

On June 28 and 29, 2006, wells BW-3R, BW-9R, and BW-10 were installed near the Copper Tipple building. The wells were installed by Layne Environmental Drilling Co. with a percussion drill rig using retrievable steel casing. The small amount of water produced during drilling was contained and allowed to evaporate on site. A plot plan and well logs are attached.

The new pumping wells were constructed with 4-inch diameter blank PVC and 5-foot sections of factory slotted PVC screen (0.010 slot) along with 10-20 Colorado Silica filter pack sand, or generally in the same manner as two existing 4-inch diameter pumping wells BW-8 and BW-9. BW-8 was installed in April 2001 to test ground water conditions near the zinc dryer building or Dryer building 126 on the Belden Plot Plan. Despite drilling the well to 32 feet below ground surface (BGS), the yield was very poor. BW-9, also drilled in 2001, produced water from a zone 15-29 feet BGS, however, broken casing resulted in abandonment of the well in 2004. BW-9R was drilled to replace BW-9. BW-9R was installed to 39 feet BGS, or essentially to the top of the granite (see Plot Plan and drill logs attached). BW-3R replaces BW-3, a shallow 2-inch diameter PVC monitoring well installed in 1995 as a part of Task 3A of the CD/SOW, Waste Rock Monitoring Wells/Monitoring at Belden. BW-10 was drilled near BW-3R but exhibited very poor well yield during development. The BW-10 well will be redeveloped in the spring of 2007 in an attempt to improve its yield when water levels are higher.

Six-foot lengths of Schedule 40 steel 6-inch diameter casing with steel removable locking caps were cemented in and used as protective covers over the PVC wells. BW-3R and BW-10 are located in the right-of-way, near the loading dock, and will need to be surrounded by an earthen embankment this summer to protect the wells from traffic along the abandoned rail siding.

Rock Creek Area

Two existing 4-inch diameter wells, EDS-1 and EDS-2, monitor water quality at the mouth of Rock Creek. On June 29, 2006, a third well, EDS-3, was installed near the confluence of Rock Creek and the Eagle River. The well is screened from 19 to 24 feet BGS in saturated gravels at the mouth of Rock Creek. A plot plan and well log is attached.

PUMPING

Shurflow direct current (DC) submersible pumps were installed in BW-9R and BW-3R. The pumps are powered by 12-volt or 24-volt DC power from four 32-watt photovoltaic (PV) panels on the roof of the zinc dryer building. Single-well flow rates are on the order of 1.2 gpm. The pump rate is limited by the slow permeability of the talus/silt colluvium, the type of pump, and amperage from the DC power source. The pumps are operated during daylight hours when the existing PV panels provide sufficient amperage to run the pumps.

A pump was not dedicated nor was discharge piping installed at well BW-10 because this well exhibited very poor well yield.

A conventional 1/3 hp 4-inch diameter submersible pump was temporarily installed in the EDS-3 well at the base of Rock Creek for sampling. The pump is powered by 110-volt AC power available at the base of Rock Creek.

Pumping was initiated in BW-9R on July 26, 2006. BW-3R began pumping on November 20, 2006. Both wells froze and were shut down on November 29, 2006.

Discharge piping at BW-9R and BW-3R is buried to where it connects to the existing pipeline carrying Tip Top mine water to the treatment plant.

MONITORING RESULTS

Field parameters from several Belden wells and one Rock Creek well, collected on August 29, 2006, are listed in Table 1.

Table 1 August 2006 Field Parameters for Belden and Rock Creek Wells

Well or Piezometer	Specific conductance (µmhos).	Temperature (degrees C)	Notes
BW-3R	2700	12	Yields 1 gpm
BW-9R	2000	17	Pumping at 1.2 gpm
BW-10	2700	8	Yields < 0.5 gpm
EDS-3	490	11	Rock Creek gravels, yields > 2 gpm

Zinc concentrations in groundwater in the vicinity of the Copper Tipple Loading building are elevated as evidenced by samples from wells in the area. Historic and recent water sample results are listed in Table 2.

Table 2 Sample Results for Belden and Rock Creek Wells

Well	Sample date	Total (t) or Dissolved Zinc (mg/L)	Dissolved Cadmium (mg/L)
BW-3	4-02-96	460	1.5
BW-3R	8-29-06	400	3.4
BW-9R	8-29-06 (pumping)	230	0.91
BW-10	8-29-06	680	16
EDS-3	8-29-06	26	0.089
BW-3R	12-11-06 (pumping)	815 (t)	NA

WATER LEVELS IN BELDEN

Water levels in the Belden area are well documented in *Preliminary Data Interpretation Report No. 2, Belden Groundwater Monitoring Program* (Dames & Moore 1996). The water level in BW-3 increased by 1.3 feet to 8367.2 feet MSL in response to the 1996 snowmelt but did not respond to rainfall events. This 2-inch diameter PVC piezometer is too shallow to measure low water levels during the dryer portions of the year so the increase due to spring snowmelt was not measured. See Figure 4-3 from the above-referenced report and Table 3.

Table 3 Water Levels in Piezometers and Wells Near the Copper Tipple

Well or Piezometer	Measurement Date	Water Level (ft MSL)	Water Level (ft below TOC)	Notes
BW-3	August 1995	< 8365.9	Dry	2-inch piezometer
BW-3	March 1996	8367.2	8.38	
BW-3R	8-29-06	8358.2 est.	19.3	4-inch piezometer
BW-4	September 1995	8359	11.05	2-inch piezometer
BW-4	March 1996	8365	5.05	
BW-5	11-17-99	8363.66	14.43	2-inch piezometer
BW-5	8-29-06	8363.84	14.25	
BW-6	11-17-99	8362.02	14.54	2-inch piezometer
BW-6	8-29-06	8362.19	14.37	
BW-7	11-17-99	8359.52	15.64	2-inch piezometer
BW-7	8-29-06	8359.53	15.63	
BW-8	8-29-06		17.7	4-inch piezometer
BW-9R	8-29-06		19.8	Pumping level
BW-10	8-29-06	8359.5 est.	17.5	4-inch piezometer

TOC = top of casing. Piezometers BW-5, BW-6 and BW-7 were installed September 23, 1999 in accordance with the Belden Snowmelt Best Management Plan. Source: 1999 Annual Report (Dames & Moore, March 2000).

A 6-foot difference in water level was recorded at piezometer BW-4 located downstream of BW-3 between fall of 1995 and the spring of 1996.

For preliminary design of an extraction system, a 4-foot increase in the groundwater level (8363 to 8367) will be used until water levels are measured this spring.

ZINC LOADING

Belden Area

Surface water samples were collected in September 2006 as a part of the regular Eagle River sampling program. The calculated difference in dissolved zinc results and flow measurements at river monitoring stations E-3 and E-10 (upstream of Rock Creek inputs) indicate that in September 2006 there was a net increase of about 16 pounds per day of zinc in the Belden reach. If, for discussion, it is assumed that the source of the increased zinc to the river is entirely groundwater with an average zinc concentration of 230 mg/L (or equal to BW-9R), the flow to the river can be back-calculated:

(BW-9R) cfs x 5.4 x 230 mg/L = 16 pounds/day; flow = 0.0148 cfs or 5.7 gpm

Daily and weekly sampling has demonstrated snowmelt-related zinc concentration increases in the Belden reach of the river during the spring of each year. From March 1st to early April, the dissolved zinc concentrations at station E-10 can exceed 0.5 mg/L which translates to 30-50 pounds of zinc per day. If the removal of 30 pounds per day of zinc is used as a target for zinc load removal, this would translate into an extraction system flow rate of approximately 10 gpm, assuming the zinc concentration is similar to the measured September 2006 BW-9R concentration.

(BW-9R) cfs x 5.4 x 230 mg/L = 30 pounds/day; flow = 0.0241 cfs or 10.6 gpm

Using 230 mg/L as a predicted spring zinc concentration appears to be reasonable based on past sampling. An April 1996 sample from BW-3 contained 460 mg/L dissolved zinc.

Rock Creek Area

Past sampling during the fall indicates that there is a net increase of 1 to 2 pounds per day of zinc attributable to groundwater base flow from Rock Creek. If it is assumed that the source of the increased zinc to the river is entirely groundwater with an average zinc concentration of 26 mg/L (or equal to EDS-3), by back-calculation the input of Rock Creek groundwater base flow to the river can be estimated:

(EDS-3) cfs x 5.4 x 26 mg/L = 1.5 pounds/day; flow = 0.0185 cfs or 8.1 gpm

While Rock Creek base flow contains low concentrations of zinc compared to Belden area groundwater, extraction with submersible pumps is considered viable because the capture area, both in width and depth, is narrow and well defined, electric power (240 VAC) for the pumps is readily available, and the pipeline to the treatment plant is nearby.

PLANNED ACTIVITIES, 2007

1. Freeze-proof BW-3R and BW-9R by drilling drain-back weep holes above the pump and operate during daylight hours from March 1st until high-flow in April.

2. Survey TOC elevations on new wells drilled in 2006; Continue development of BW-10 to improve well yield.

3. Construct earthen embankments around BW-3R and BW-10, incorporating an earthen ramp to access the Loading Dock with heavy equipment.

4. Collect mid-March water samples from BW-3R and BW9R.

5. Design an interceptor trench based on spring 2007 water levels and excavate a test interceptor trench on the loading dock during the summer. Pump the test trench with a portable pump and estimate steady-state flow rate and average dissolved zinc content.

NewFields will conduct the above-listed tasks and submit a second Belden Groundwater Extraction System Performance Report in August 2007.

Very truly yours,

NEWFIELDS

David R. Hinrichs
Project Manager

Attachments:
Conceptual Groundwater Scenario in Belden
Belden Plot Plan
Rock Creek Plot Plan
Well Logs
Figure 4-3

cc: Hank Ipsen, HRO
Jeff Groy, CBS Operations Inc.

August 21, 2007

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Mike Holmes
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Re: Eagle Mine Site - Belden Groundwater Extraction System Performance Report No. 2, Revision 1

Dear Wendy and Mike:

In a June 20, 2006 letter, CBS Operations Inc. (CBS) proposed additional testing in the Belden area of the Eagle Mine site to assess the feasibility of meeting proposed performance standards for reduced zinc loading to the Eagle River by extracting and treating groundwater. The Belden area has been identified as the largest remaining source of zinc loading to the river. The initial System Performance Report was provided to CDPHE and EPA on January 19, 2007. This Performance Report No. 2 provides additional water level data collected during 2007 and presents a plan for installation of a test section of interceptor trench. Revision 1 incorporates responses to written comments received from W. Naugle on August 6, 2007.

SOLAR PV PUMPING

Shurflow direct current (DC) submersible pumps were installed in BW-9R and BW-10 in 2006. The pumps are powered by 12-volt DC power from four 32-watt photovoltaic (PV) panels on the roof of the boiler house (building 116 in Figure 1). Single-well flow rates are on the order of 1.2 gpm. The pump rate is limited by the slow permeability of the talus/silt colluvium, the type of pump, and amperage from the DC power source. The pumps are operated during daylight hours when the PV panels provide sufficient amperage to run the pumps.

Discharge piping connects the two wells to the existing pipeline carrying Tip Top mine water to the treatment plant. Both wells froze and were shut down on November 29, 2006. The wells resumed operation in March of 2007 when temperatures moderated.

Both wells were freeze-proofed by drilling drain-back weep holes above the pump. Top-of-casing elevations were surveyed on March 2, 2007.

WATER LEVELS IN BELDEN

Belden wells and piezometers are shown in Figure 1. During the mid-1990s, water levels were measured in the Belden area and are recorded in *Preliminary Data Interpretation Report No. 2, Belden Groundwater Monitoring Program* (Dames & Moore 1996). A compilation of historic and recent water levels is presented in Table 1.

Table 1 Water Levels in Piezometers and Wells Near the Copper Tipple

Well or Piezometer	Measurement Date	Water Level (ft MSL)	Water Level (ft below TOC)	Notes
BW-3	August 1995	< 8365.9	Dry	2-inch piezometer
BW-3	March 1996	8367.2	8.38	
BW-3R	8-29-06	8359.3	19.3	4-inch piezometer
BW-3R	3-2-07	8361.25	17.35	Static
BW-3R	7-11-07	8361.75	16.85	Static
BW-4	September 1995	8359	11.05	2-inch piezometer
BW-4	March 1996	8365	NA	
BW-5	11-17-99	8363.66	14.43	2-inch piezometer
BW-5	8-29-06	8363.84	14.25	
BW-5	3-2-07	8363.79	14.3	
BW-5	7-11-07	8364.55	13.54	
BW-6	11-17-99	8362.02	14.54	2-inch piezometer
BW-6	8-29-06	8362.19	14.37	
BW-6	7-11-07	8361.62	14.94	
BW-7	11-17-99	8359.52	15.64	2-inch piezometer
BW-7	8-29-06	8359.53	15.63	
BW-7	7-11-07	8360.27	14.89	
BW-8	8-29-06	8362.44	17.7	4-inch piezometer
BW-8	3-2-07	8362.49	17.65	
BW-9R	8-29-06	8360.69	19.8	Pumping level
BW-9R	3-2-07	8361.84	18.65	Static
BW-9R	7-11-07	8362.04	18.45	Static
BW-10	8-29-06	8359.84	17.5	4-inch piezometer
BW-10	3-2-07	Frozen		
BW-10	7-11-07	NA	NA	Pump at 16.65 ft

TOC = top of casing. Piezometers BW-5, BW-6 and BW-7 were installed September 23, 1999 in accordance with the Belden Snowmelt Best Management Plan. Source: 1999 Annual Report (Dames & Moore, March 2000).

INTERCEPTOR TRENCH DESIGN

The goal is to construct a low-maintenance system that will collect groundwater during the spring runoff when groundwater levels are high, zinc concentrations in groundwater are elevated, and loading to the Eagle River by the discharge of groundwater is at a maximum. A preliminary design for the test trench has been developed based on the understanding of local geology and hydrogeology. During 2007, a section of interceptor trench will be installed along the concrete loading dock downstream of the Copper Tipple Loading building and north of existing wells BW-3R and BW-10 to test the flow rate. The proposed location of the test trench is shown in Figure 1.

Hydrogeologic Conditions in Test Trench Area

Geology encountered during installation of the seven existing wells in the Belden Area indicates that surficial materials consist of silty sand and gravel fill to depths of around 10 feet, then cobble-sized talus with gravel, sand, and silt to bedrock. Granite bedrock was encountered at 39 feet during drilling of BW-9R (an elevation of about 8337 feet). The fine-grained material in the surficial material is sufficient to keep borings from caving after drilling.

As described previously, several years of water level measurements from the Belden Area monitoring wells indicate that the groundwater level rises in the spring in response to recharge from snowmelt. Hydrographs of the groundwater levels observed in the wells from September 2006 through July 2007 are shown in Figure 2. Groundwater levels in well BW-7, adjacent to the Eagle River, varied from 8359.5 in September 2006 to 8360.9 in May 2007. Groundwater levels at BW-3R and BW-10 are similar to BW-7 or slightly lower due to pumping at BW-10. The water level of the Eagle River adjacent to well BW-3R generally varies from 8161 to 8163 feet annually (Dames & Moore 1997). A groundwater potentiometric surface map showing the groundwater level in September 2006 is included as Figure 3. The general groundwater flow direction in the unconsolidated materials adjacent to the Eagle River is in the direction of river flow and the gradient is 0.014 foot/foot. The saturated materials in which wells BW-3R and BW-10 are completed have a low hydraulic conductivity based on slug tests conducted in 1996 (Dames & Moore 1997). As a result, the well yields at BW-3R and BW-10 are low and the hydraulic connection to the Eagle River is expected to be poor.

The geologic and hydrogeologic conditions in the area appear to be favorable for the construction of an interceptor trench. Visual examination of boring cuttings indicates that the geotechnical properties of the surficial materials may allow the trench to be excavated with stable vertical walls without the need for support or benching. The hydraulic properties of the subsurface materials are such that intrusion of river water should be minimal, while backfilling the trench with materials of a high hydraulic conductivity will allow interception of groundwater from source areas in the vicinity of the Copper Tipple.

Test Trench Design

The trench will be approximately 160 feet long and will be excavated to about 2 feet below the low groundwater level. The bottom of the trench will be gradually sloped to the west to match the low groundwater level gradient. A cross section view of the trench is shown in Figure 4 (the section location is shown in Figure 1). The surface elevation at the location of the trench is approximately 8377.5 and the bottom elevation of the trench varies from approximately 8358.5 at the east end to 8356.5 at the west end.

Preliminary design details for the test trench are shown in Figure 5. The test trench will be backfilled with approximately 5 to 10 feet of ¾-inch to 1-inch diameter washed gravel. Selected coarse gravel and rock from waste rock pile no. 11 (WRP-11) or other relatively silt-free crushed rock source will be used to bring the level of the drainage gravel to within about 5 feet of the surface and native material excavated from the trench will be used to backfill the remaining 5 feet of the trench. No concentrates or high-metal content backfill will be used. A final grade of approximately 4:1 toward the Loading Dock is planned so that only minimal amounts of runoff and snowmelt infiltrate into the backfill.

Slotted 4-inch diameter HDPE piping will be installed at the bottom of the trench and connected to one 8-inch diameter riser pipe located at the downstream end near the entrance to the reagent storage area (Figure 1). The riser will serve as a cleanout and will house the temporary sump pumps. The perforated 4-inch diameter HDPE pipe will be extended to the surface on the downstream end to allow for future extension, if necessary. Three 1-inch diameter piezometers will be installed in the trench for water level monitoring.

Best Management Practices (BMPs)

BMPs will be utilized to prevent mud, water and excavated materials from entering the river. A 100-foot long berm will be constructed of local materials along the edge of the Loading Dock to contain excavated materials and mud. Secondary containment will be established by constructing a berm along the river bank in the vicinity of the pipe racks, pump house and reagent tanks. The river bank berm will function to divert water or mud leaving the Loading Dock down the road to the northwest. Straw bale dikes and/or silt fence will be installed per standard procedures at intervals along channels in the road to collect silt and minimize erosion.

Slightly silty decanted water may be pumped to the pipeline for treatment. Under no circumstances will mud be pumped to the pipeline.

Test Trench Construction

The test trench will be excavated with a track hoe and will be approximately 2 to 3 feet wide and up to 21 feet deep. Modifications to the location and/or depth of the trench may be made based on conditions encountered. It is anticipated that the surface of the trench cut may contain elevated metal concentrations. If this material is encountered it will be excavated and hauled to the Temp Cell at the CTP. The depth of the trench will be gauged using the backhoe. The final depth will be surveyed to ensure that the design bottom elevation has been reached. If muddy water accumulates in the trench during excavation it will be pumped out to the access road and allowed to evaporate prior to placing any backfill. HDPE piping, manholes, and 1-inch diameter piezometers will be assembled at the ground surface then lowered to the bottom of the trench using the track hoe. Piezometers will be held to one side of the trench in as vertical of a position as possible.

Approximately 240 cubic yards (if 2 feet wide) to 360 cubic yards (if 3 feet wide) of material will be required to backfill the test trench. Approximately 120 to 180 cubic yards of this material will be drainage gravel, 60 to 90 cubic yards will be WRP-11 waste rock (or equivalent) and the remainder is native material excavated from the trench. About 180 to 270 cubic yards of material will be disposed at the Temp Cell or Sludge Cell at the CTP.

Once completed, a submersible pump will be temporarily installed in the sump and the trench pumped to remove fine grained solids. Flow rates and water levels in the trench piezometers will be monitored during pumping.

Test Trench Operation and Performance Monitoring

The test trench operations will begin during March 2008 after groundwater levels have increased. A 4-inch diameter submersible pump will be installed in the riser pipe and operated using a portable generator. Discharge will be routed to the existing pipeline for treatment at the WTP. A totalizing flow meter will be placed in the discharge line to allow measurement of instantaneous flow rate as well as total flow. The pump will be operated at various pumping rates over a 48-hour period and the associated effects on water levels in the trench piezometers will be measured. Samples of the groundwater produced will be collected every 12 hours and submitted for analysis of total zinc concentration (unfiltered). Split samples will be provided to CDPHE and/or EPA upon request.

After evaluation of the test data, NewFields will prepare a *Belden Groundwater Extraction System Report No. 3* report presenting the test results, the predicted flow rate and zinc load captured by the built-out system.

If you have questions, please feel free to call.

Very truly yours,

NEWFIELDS

David R. Hinrichs
Project Manager

Attachments:
- Figure 1 Location of Groundwater Interceptor Trench
- Figure 2 Groundwater Elevation in Belden Area Wells
- Figure 3 Groundwater Potentiometric Surface, September 2006
- Figure 4 Cross Section at Location of Groundwater Interceptor Trench
- Figure 5 Design Detail Groundwater Interceptor Trench

cc: Hank Ipsen, HRO
Jeff Groy, CBS Operations Inc.