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March 28, 2014

Tim Cazier, PE, Environmental Protection Specialist
Colorado Division of Reclamation, Mining and Safety
1313 Sherman St., Room 215
Denver, Colorado 80203

Re: Animas Glacier Gravel Pit, Permit No. M-2011-028 – Drainage Report, Amendment 1

Dear Mr. Cazier,

Russell Planning and Engineering (RPE) is pleased to provide the following response to comments from your Memorandum dated March 14, 2014 regarding the Animas Glacier Gravel Pit Drainage Report, Amendment 1.

In response to comment 1.A of the abovementioned Memorandum, RPE performed a water balance calculation for the gravel pit (see Table 1, attached). The calculation is based on the following assumptions:

- The 4.8 acre-feet (AF) retention pond remains full at all times.
- Maximum monthly precipitation data (rain and snowfall) for Durango from the *Western Regional Climate Center.*
- Annual evaporation rate at the site (45 inches) from *Colorado Division of Water Resources* evaporation contours and monthly evaporation rates from *Colorado Division of Water Resources General Guidelines on Substitute Water Supply Plans.*
- Water demands at the gravel pit totaling 162,000 gallons per day.
- Infiltration rate outside of retention pond equals approximately 0.60 inches per hour, which is sufficient to draw down any water storage outside of the 4.8acre-ft retention pond within 1 month. Therefore, during non-winter months will return the water storage volume to 4.8 acre-ft each month. (Assumed the lined retention pond has zero infiltration).
- Infiltration and Water Use during the Winter months assumed to be zero (0).

As the results illustrate, the gravel pit will accumulate water during the winter months (80 AF maximum, in the form of snow) due to zero outflows, but this water will dissipate quickly during spring and summer when evaporation, infiltration and water use peak. As such, the gravel pit does not accumulate water year after year.

In my opinion this analysis is very conservative and any water accumulation (frozen or liquid), will simply be nuisance water than will quickly evaporate or infiltrate into the gravel pit floor. It should also be noted that as the operator of the pit, it will be in the best interest of Four Corners to deal with excess water via dust mitigation, construction of swales, pumping and construction of additional excavated storage ponds, or employing other methods to reduce the quantity of nuisance water within the pit.

In response to comment 1.B of the Memorandum, RPE reviewed the *NOAA Hydrometerological Report No. 49 – Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages* (1984). According to the document, the 24-hour Probable Maximum Precipitation (PMP) near the Durango area is approximately 10 inches. Based on a 50-acre maximum drainage area to the pond, the resulting volume of runoff to the pond during a PMP event is 42 AF, or 178AF less than the maximum storage volume in the pond (220 AF).

Please feel free to contact us if you have any questions or concerns.

Sincerely,

Steve Winters, P.E.

Attachments: Table 1 – Water Balance – No Winter Water Use

Table 1
Animas Glacier Gravel Pit
Water Balance - No Winter Water Use

Year	Month	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				Inflow	Outflows						
		Water Storage Volume	Exposed Water Surface Area	Precipitation (Rain and Snowmelt)	Monthly Evaporation Rate Percentage	Monthly Evaporation		Total Evaporation	Water Demands	Infiltration	Total Outflow
		(acre-feet)	(acres)	(acre-feet)	(%)	(inches)	(feet)	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)
1	January	4.80	0.92	18.13	1.00%	0.45	0.04	0.00	0.00	0.00	0.00
	February	22.93	2.46	14.38	3.00%	1.35	0.11	0.00	0.00	0.00	0.00
	March	37.30	3.68	14.42	6.00%	2.70	0.23	0.00	0.00	0.00	0.00
	April	51.72	4.90	17.50	9.00%	4.05	0.34	1.65	14.91	46.92	63.48
	May	5.73	1.00	14.21	12.50%	5.63	0.47	0.47	15.41	0.93	16.81
	June	4.80	0.92	9.88	15.50%	6.98	0.58	0.54	14.91	0.00	15.45
	July	4.80	0.92	3.58	16.00%	7.20	0.60	0.55	15.41	0.00	15.97
	August	4.80	0.92	7.08	13.00%	5.85	0.49	0.45	15.41	0.00	15.86
	September	4.80	0.92	20.54	11.00%	4.95	0.41	0.38	14.91	0.00	15.30
	October	10.05	1.37	29.75	7.50%	3.38	0.28	0.38	15.41	5.25	21.04
	November	18.75	2.10	1.42	4.00%	1.80	0.15	0.00	0.00	0.00	0.00
	December	20.17	2.22	12.92	1.50%	0.68	0.06	0.00	0.00	0.00	0.00
2	January	33.09	3.32	18.13	1.00%	0.45	0.04	0.00	0.00	0.00	0.00
	February	51.21	4.85	14.38	3.00%	1.35	0.11	0.00	0.00	0.00	0.00
	March	65.59	6.07	14.42	6.00%	2.70	0.23	0.00	0.00	0.00	0.00
	April	80.00	7.29	17.50	9.00%	4.05	0.34	2.46	14.91	75.20	92.58
	May	4.92	0.93	14.21	12.50%	5.63	0.47	0.44	15.41	0.12	15.97
	June	4.80	0.92	9.88	15.50%	6.98	0.58	0.54	14.91	0.00	15.45
	July	4.80	0.92	3.58	16.00%	7.20	0.60	0.55	15.41	0.00	15.97
	August	4.80	0.92	7.08	13.00%	5.85	0.49	0.45	15.41	0.00	15.86
	September	4.80	0.92	20.54	11.00%	4.95	0.41	0.38	14.91	0.00	15.30
	October	10.05	1.37	29.75	7.50%	3.38	0.28	0.38	15.41	5.25	21.04
	November	18.75	2.10	1.42	4.00%	1.80	0.15	0.00	0.00	0.00	0.00
	December	20.17	2.22	12.92	1.50%	0.68	0.06	0.00	0.00	0.00	0.00
3	January	33.09	3.32	18.13	1.00%	0.45	0.04	0.00	0.00	0.00	0.00
	February	51.21	4.85	14.38	3.00%	1.35	0.11	0.00	0.00	0.00	0.00
	March	65.59	6.07	14.42	6.00%	2.70	0.23	0.00	0.00	0.00	0.00
	April	80.00	7.29	17.50	9.00%	4.05	0.34	2.46	14.91	75.20	92.58
	May	4.92	0.93	14.21	12.50%	5.63	0.47	0.44	15.41	0.12	15.97
	June	4.80	0.92	9.88	15.50%	6.98	0.58	0.54	14.91	0.00	15.45
	July	4.80	0.92	3.58	16.00%	7.20	0.60	0.55	15.41	0.00	15.97
	August	4.80	0.92	7.08	13.00%	5.85	0.49	0.45	15.41	0.00	15.86
	September	4.80	0.92	20.54	11.00%	4.95	0.41	0.38	14.91	0.00	15.30
	October	10.05	1.37	29.75	7.50%	3.38	0.28	0.38	15.41	5.25	21.04
	November	18.75	2.10	1.42	4.00%	1.80	0.15	0.00	0.00	0.00	0.00
	December	20.17	2.22	12.92	1.50%	0.68	0.06	0.00	0.00	0.00	0.00

Notes:

1) Assumes Retention Pond is full at start of first month. Each month after is caclulated as previous month's storage plus precipitation minus total outflow. Any calculated storage volume less than 4.8 AF is rounded up to 4.8 AF (simulation assumes retention pond is full at all times).

2) Based on surface area-storage relationship for retention pond.

3) Monthly precipitation values based on maximum annual precipitation data from *Western Regional Climate Center* over a period of record from 1894 to 1991 (max year precipitation is 1941 with 33.64 inches of rain). Precipitation volume is increased to account for max year snowfall. As worst case scenario, simulation assumes full snowmelt within the month it accumulates (at 10% snow density). Precipitation volume calculation assumes 50-acre basin.

4) Monthly evaporation rates from *Colorado Division of Water Resources General Guidelines on Substitute Water Supply Plans*. Total annual evaporation at site (45 inches) deteremined based on Colorado Division of Water Resources Evaporation Contours.

5) Column (4) x annual evaporation rate (45 inches). Assumed zero in winter months.

6) Column (5) / 12.

7) Column (2) x Column (6).

8) Water demands of 162,000 gallons per day from Drainage Report for Site. Assumes zero water use during winter.

9) Assumes Infiltration Rate is enough to draw down to 4.8 AF retention pond. (If Column (2) is greater than 0.92 acres, then equals Column (1) - 4.8 AF, otherwise no infiltration).

10) Sum of Columns 7 through 9.