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Technical Memorandum –D R A F T

To: Scott County
From: Ray Wuolo, Barr Engineering Co.
Subject: Approximate Costs for Mitigation Alternatives, Jordan Aggregates LLC
Date: March 13, 2014
Project: 23701010.00

Purpose and Scope

This memorandum presents estimates for approximate costs of construction and implementation of monitoring and alternatives for mitigation of environmental impacts at the proposed Jordan Aggregates LLC sand-and-gravel mine in Sand Creek Township, Scott County, Minnesota. The purpose of developing these approximate costs is to provide further input into selecting possible mitigation strategies, should they become necessary and to provide a basis for establishing financial assurances for future implementation. The monitoring and mitigation proposed for this Site are described in a separate Monitoring and Mitigation Plan. Monitoring during mine operation consists of the following:

1. Routine quarterly monitoring of groundwater quality, mine-pit water quality, water quality of Sand Creek, and groundwater level monitoring.
2. Water quality monitoring immediately following a flood event that inundates the mine pit.

Mitigation actions identified in the plan include the following:

1. Mitigation for groundwater degradation. Two alternatives were identified:
    a. Pumping of the mine pit to remove contaminated water following flooding;
    b. Implementation of a pump-out system to capture contaminated groundwater.
2. Mitigation for nearby wells that may become contaminated as a result of the mine. This mitigation involves replacing existing sand-and-gravel aquifer wells with new wells completed in the deeper Wonowoc Formation (formerly called the Ironton-Galesville Sandstone) and has been proposed to be performed by the mine owner before mining commences. The approximate costs for implementing this alternative are not estimated in this evaluation.
3. Mitigation of stream bank erosion resulting from mine activities.
4. Mitigation of additional contributions to ice jams at the 173rd Street bridge over Sand Creek as a result of additional ice surface from the mine pit. Several mitigation alternatives were identified:
    a. Ice weakening to break up the mine pit ice into small pieces via auguring and/or use of heavy equipment;

b. Placement of ice booms to contain mine pit ice on-site during spring flood events;
c. Placement of tension weirs to contain mine pit ice on-site during spring flood events;
d. Installation of regularly spaced steel or concrete piers in the berm and spillway to contain large ice pieces and beak up ice into sufficiently small chunks.

Method for Approximating Costs

The costs for implementing the monitoring and mitigation activities were approximated by:

1. separating activities into capital (i.e. construction or purchase) expenditures and recurring activities, such as monitoring, operation, and maintenance;
2. defining the major elements of each activity, based on the likely requirements of implementation;
3. approximating costs for each element in 2014 dollars, using quotes from vendors (where available), recent experience in estimating or procuring similar equipment, materials or activities, and/or engineering judgment;
4. For reoccurring activities, estimating the likely frequency of occurrence and converting those occurrences into fractional annual occurrences. For example, if it was estimated that a pump would likely require replacement once every 5 years at a cost of $2,000 (in 2014 dollars), that cost was annualized to be $400 per year.
5. Calculating the Present Worth of capital and reoccurring activities in 2014 dollars, assuming a discount rate and duration. The Present Worth represents the approximate funds in 2014 dollars that would likely be required to be set aside in 2014 in order to pay for the various future activities, allowing for the total time period of implementation and the interest that would accrue.

It is important to recognize that these are estimates of approximate cost for the purposes described above and not estimates that should be relied upon for design, construction, or procurement.

Capital costs were assumed to accrue in 2014 (i.e. the Present Worth is equal to the approximated cost). It is unknown whether groundwater degradation mitigation will ever be needed but it is reasonably certain that there will be flooding events that inundate the mine pit in the near future. Therefore, if groundwater mitigation is necessary, it will likely be implemented within a few years. For mitigation of ice jams, the various alternatives require obtaining, constructing, or otherwise procuring equipment and materials required for implementation before an ice-jam situation occurs.

Approximate costs for reoccurring or future events were converted to annual costs, as described above. In some cases, the reoccurrence interval can be reliably approximated (e.g., continuous operation of a pump-out system or quarterly sampling). But several of the reoccurring future events are triggered by flooding of the mine pit. For purposes of approximating cost for this evaluation, it was assumed that a

flood inundation event would occur once every year (i.e. an annual reoccurrence of 1). The reason for assuming annual flooding is the presence of the spillway, with a crest elevation of 726 feet, msl, which will have the effect causing the mine pit area to flood on a more frequent basis than without the spillway present. Bank-full stage of Sand Creek is assumed to be at flows of 924 cfs, which at the Site is results in an elevation of 728 feet, msl. It was also assumed that ice jam mitigation would require implementation during each flood event. Obviously, it is impossible to know exactly when future flooding of the mine pit will occur but the past history of flooding indicates that inundation will occur with the 10-year flood event and will likely occur with much more frequently with the spillway during less severe flood events.

The duration of future activities is also an unknown variable. It is assumed that the mine pit will be present in some form in perpetuity and will continue to be subject to periodic inundation by flood waters from Sand Creek. If flooding of the mine pit does result in groundwater degradation and/or increased ice jam issues, those conditions would also be present into the future and would require mitigation. As is often the case, the Present Worth of future occurrences becomes less sensitive to duration as the total time increases. In other words, there may be little difference it the total Present Worth for a period of 50 years compared to 70 years. For this reason, several future periods were evaluated.

The Discount Rate (or interest rate) determines what the estimated value of what future money will be in current dollars. Put another way, if money were put into an interest-bearing account today in order to pay for future costs, the amount of money put away would need to be some initial sum, plus the interest accrued on that sum over time. The sum plus interest must be sufficient to keep up with the periodic outlays (which are assumed to occur annually in this evaluation). If the interest rate is higher, less initial funds need to be set aside. For purposes of this evaluation, it was assumed that the discount rate is equal to the current 30-year Treasury bond: 3.95%.

Cost Assumptions and Calculations

Installation of New Monitoring Wells and Dedicated Sampling Equipment

There are currently 4 shallow monitoring wells (MW-1, MW-2, MW-3, MW-4) and 2 piezometers (PZ-1, PZ-2) at the Site. The Monitoring and Mitigation Plan calls for six additional monitoring wells. The six new wells and the four existing wells will have dedicated sampling pumps installed in them.

The approximate cost for installation of new monitoring wells is:

Monitoring Well Installation	Unit Cost	Unit	No. of Units	Capital Cost	Cost per Year
Installation				**$47,820**	**NA**
Mobilization & permitting	$5,000	each	1	$5,000	NA
Drilling	$40	ft	490	$19,600	NA
F&I Riser (PVC)	$20	ft	265	$5,300	NA
F&I Riser (Steel)	$40	ft	165	$6,600	NA
F&I Screens	$100	each	6	$600	NA
F&I filter pack and grout	$3	ft	490	$1,470	NA
F&I protective casing/pipe	$500	each	6	$3,000	NA
F&I dedicated pumps	$500	each	10	$5,000	NA
Flood protected casings	$250	each	5	$1,250	NA

Monitoring wells have maintenance costs, including periodic replacement of dedicated pumps and annual permit fees;

Maintenance	Unit Cost	Unit	No. of Units	Capital Cost	Cost per Year
Monitoring System Maintenance					**$550**
Dedicated sampling pump replacement	$500	1	0.1	**NA**	$50
Annual monitoring well permit fee	50	10	1.0	**NA**	$500

Quarterly Monitoring

Annualized costs for quarterly monitoring are based on the schedule of analytes that is described in the Monitoring and Mitigation Plan. Costs were obtained from Minnesota Department of Health certified labs for the identified analytes and methods (except for stable isotopes).

	Unit Cost	No. of Units per event	Unit	No. Events per year	Cost per year
Annual Quarterly Sampling					**$46,430**
Ammonia - Nitrogen as N	$30	15	each	4	$1,800
BOD5	$30	15	each	2	$900
Chloride & Nitrate/Nitrate	$70	15	each	3	$3,150
Isotope Ratio: O18/O16 & H2/H1	$50	15	each	2	$1,500
Lab conductivity	$15	15	each	4	$900
Metals	$110	15	each	2	$3,300
Phosphorus, Total	$22	15	each	4	$1,320
Total Dissolved Solids	$15	15	each	4	$900
Total Suspended Solids	$15	15	each	4	$900
SVOCs (inc. PAH)	$160	15	each	2	$4,800
VOCs	$62	15	each	2	$1,860
Pesticides	$110	15	each	2	$3,300
Chlorinated Herbicides	$95	15	each	2	$2,850
DRO	$43	15	each	2	$1,290
Total Coliforms	$30	15	each	2	$900
Sampling (labor)	$110	25	hr	4	$11,000
Sampling (mtrls. & equip.)	$400	1	each	4	$1,600
QA/QC Labor	$110	4	hr	4	$1,760
Reporting (labor)	$120	20	hr	1	$2,400

The "No. of Units per event" refers to the number required for each sampling round. For example, there are 11 monitoring wells and 4 pond samples. Costs are in 2014 dollars. The total approximate cost for quarterly sampling is $46,430, which includes estimates on time and rates for sampling, quality assurance review, and reporting.

Flood-Event Monitoring

Flood-event monitoring takes place immediately after flood waters recede from the inundated mine pit, as described in the Monitoring and Mitigation Plan. Initial sampling events require expedited analyses, which results in an increased cost of approximately two-times the regular turn-around rates.

	Unit Cost	No. of Units per event	Unit	No. Events per year	Cost per year
Flood Sampling					**$5,424**
Ammonia - Nitrogen as N	$60	18	each (expedited)	0.1	$108
BOD5	$60	18	each (expedited)	0.1	$108
Chloride & Nitrate/Nitrate	$140	18	each (expedited)	0.1	$252
Isotope Ratio: O18/O16 & H2/H1	$100	18	each (expedited)	0.1	$180
Lab conductivity	$30	18	each (expedited)	0.1	$54
Metals	$220	18	each (expedited)	0.1	$396
Phosphorus, Total	$44	18	each (expedited)	0.1	$79
Total Dissolved Solids	$30	18	each (expedited)	0.1	$54
Total Suspended Solids	$30	18	each (expedited)	0.1	$54
SVOCs (inc. PAH)	$320	18	each (expedited)	0.1	$576
VOCs	$124	18	each (expedited)	0.1	$223
Pesticides	$220	18	each (expedited)	0.1	$396
Chlorinated Herbicides	$190	18	each (expedited)	0.1	$342
DRO	$86	18	each (expedited)	0.1	$155
Total Coliforms	$60	18	each (expedited)	0.1	$108
Ammonia - Nitrogen as N	$30	18	each	0.1	$54
BOD5	$30	18	each	0.1	$54
Chloride & Nitrate/Nitrate	$70	18	each	0.1	$126
Isotope Ratio: O18/O16 & H2/H1	$50	18	each	0.1	$90
Lab conductivity	$15	18	each	0.1	$27
Metals	$110	18	each	0.1	$198
Phosphorus, Total	$22	18	each	0.1	$40
Total Dissolved Solids	$15	18	each	0.1	$27
Total Suspended Solids	$15	18	each	0.1	$27
SVOCs (inc. PAH)	$160	18	each	0.1	$288
VOCs	$62	18	each	0.1	$112
Pesticides	$110	18	each	0.1	$198
Chlorinated Herbicides	$95	18	each	0.1	$171
DRO	$43	18	each	0.1	$77
Total Coliforms	$30	18	each	0.1	$54
Sampling (labor)	$110	32	hr	0.1	$352
Sampling (mtrls. & equip.)	$400	4	each	0.1	$160
QA/QC Labor	$110	4	hr	0.1	$44
Reporting (labor)	$120	20	hr	0.1	$240

Evacuation and Treatment of Water from Flooded Mine Pit

This mitigation alternative is intended to prevent groundwater degradation from the flooded mine pit and assumes that mitigation must be implemented. A description of the mitigation is in the Monitoring and Mitigation Plan. Approximate capital and annualized costs are listed below. (Note, the example below shows a mitigation reoccurrence of once every 10 years).

Evacuation & Treatment of Contaminated Mine Pit Water	**Unit Cost**	**Unit**	**No. of Units**	**Capital Cost**	**Cost per Year**
Installation				**$59,000**	**NA**
Pumps (20 hp)	$10,000	each	2	$20,000	NA
Pump structure	$20,000	each	1	$20,000	NA
Piping	$4,000	each	1	$4,000	NA
Settling Basins	$5,000	each	2	$10,000	NA
Discharge Structures	$3,000	each	1	$3,000	NA
Controls and appurtenances	$2,000	each	1	$2,000	NA
Engineering and Design	$130	hr	60	$7,800	NA
County Review	$180	hr	24	$4,320	NA
Yearly Operation & Maintenance				**NA**	**$71,180**
Portable treatment unit (RO)	$20,000	yr	1	NA	$20,000
Electrical Power	$4,000	yr	1	NA	$4,000
Discharge sampling	$6,900	yr	1	NA	$6,900
maintenance	$5,000	each	1	NA	$5,000
Operator labor	$50	hr	400	NA	$20,000
Sampling Labor	$110	hr	40	NA	$4,400
Sampling mtrls. and equip.	$200	each	8	NA	$1,600
QA/QC labor	$110	hr	24	NA	$2,640
Pump replacement	$10,000	each	.2	NA	$2,000
Reporting	$130	hr	8	NA	$1,040
County Review	$180	hr	20	NA	$3,600

The capital costs assume the purchase of two 20 hp pumps, construction of a pump intake structure for the mine pit, two settling basins, and a discharge structure to Sand Creek. When operating, a portable

reverse osmosis (RO) treatment plant is assumed to be rented. Pumps are assumed to need replacing every five years. If multiple flood events occur within the same season, it is assumed that the amount of additional pumping time will be non-significant.

Pump-Out System

This mitigation alternative is intended to become operational if groundwater degradation near the mine pit is detected. A description of the mitigation is in the Monitoring and Mitigation Plan. Once operated, it is assumed that the pump-out system will continue to operate into the future (this assumption is deemed reasonable because most pump-out systems, once in operation, continue for decades). Approximate capital and annualized costs are listed below.

Pump Out System	Unit Cost	Unit	No. of Units	Capital Cost	Cost per Year
Installation				**$130,320**	**NA**
Wells 50 ft (casing, screen, riser), F&I	$15,000	each	4	$60,000	NA
Pumps (3 hp)	$4,000	each	4	$16,000	NA
Pitless units	$2,000	each	4	$8,000	NA
Piping	$5,000	each	1	$5,000	NA
Controls and appurtenances	$1,200	each	4	$4,800	NA
Discharge line to Creek (buried)	$25,000	each	1	$25,000	NA
Discharge Structures	$2,000	each	1	$2,000	NA
Engineering and Design	$130	hr	40	$5,200	NA
County Review	$180	hr	24	$4,320	NA
Yearly Operation & Maintenance				**NA**	**$41,180**
Portable treatment unit (RO)	$20,000	yr	1	NA	$20,000
Power	$3,000	yr	1	NA	$3,000
Well maintenance and redevelopment	$2,500	each	0.2	NA	$500
Appropriations permit fees	$150	yr	1	NA	$150
Discharge sampling	$6,900	yr	1	NA	$6,900
System maintenance	$5,000	each	0.2	NA	$1,000
Sampling Labor	$110	hr	25	NA	$2,750
Sampling mtrls and equip.	$200	each	4	NA	$800
QA/QC labor	$110	hr	16	NA	$1,760
Pump replacement	$4,000	each	0.2	NA	$800

Reporting	$130	hr	16	NA	$2,080
County Review	$180	hr	8	NA	$1,440

It is assumed that the pump-out system is installed as a capital expense. Well maintenance, pump replacement, etc. are also assumed for operation. An RO treatment unit is assumed to be used on a rental basis.

Bank Stabilization

Bank stabilization assumes placement of rip-rap and vegetation. Annual maintenance is minimal.

Bank Erosion Stabilization	**Unit Cost**	**Unit**	**No. of Units**	**Capital Cost**	**Cost per Year**
Installation				**$11,000**	**NA**
Rip-Rap placement and grading	$8,000	each	1	$8,000	NA
vegetation	$3,000	each	1	$3,000	NA
Yearly Maintenance	**$500**	**each**	**1**	**NA**	**$500**

Ice Jam Mitigation

Four alternatives for ice-jam mitigation were evaluated in the Monitoring and Mitigation Plan. The amount of annual maintenance is dependent on the type of mitigation. A reoccurrence interval of once every 5 years is assumed.

Ice Jam Mitigation (Ice Weakening)	**Unit Cost**	**Unit**	**No. of Units**	**Capital Cost**	**Cost per Year**
Yearly Expenses				**NA**	**$6,400**
Augering and Pond Ice Break Up	$150	hr	40	NA	$6,000
Equipment rental	$2,000	each	0.2	NA	$400

Ice Boom Deployment	**Unit Cost**	**Unit**	**No. of Units**	**Capital Cost**	**Cost per Year**

Capital				**$81,000**	**NA**
Ice Boom	$2,000	each	40	$80,000	NA
Tethering /winch system	$5,000	each	0.2	$1,000	NA
Yearly Expenses				NA	**$1,760**
Deployment and removal	$110	hr	16	NA	$1,760

Tension Weir Deployment	**Unit Cost**	**Unit**	**No. of Units**	**Capital Cost**	**Cost per Year**
Capital				**$120,000**	**NA**
Tension Weirs	$5,000	each	20	$100,000	NA
Attachement Piers	$500	each	40	$20,000	NA
Deployment and removal	**$110**	**hr**	**80**	**NA**	**$8,800**

Steel or Concrete Piers	**Unit Cost**	**Unit**	**No. of Units**	**Capital Cost**	**Cost per Year**
Capital				**$52,500**	**NA**
F&Y Piers	$1,500	each	35	$52,500	NA
Yearly Expenses				**NA**	**$2,150**
Periodic replacement of Piers	$1,500	yr	0.1	NA	$150
Debris removal following flood	$2,000	yr	1	NA	$2,000

Present Worth Valuation

A Present Worth valuation calculation was made for each mitigation alternative. For each alternative, durations of 30, 50, 75, and 100 years are presented.

Activity	**Capital Expenses**	**Annual Expense**	**Interest Rate**	**Total Present Worth (30 Year duration)**	**Total Present Worth (50 Year duration)**	**Total Present Worth (75 Year duration)**	**Total Present Worth (100 Year duration)**

Quarterly Sampling	$0	$46,430	3.95%	$839,673	$1,045,756	$1,155,010	$1,196,488
Monitoring Well Installation	$47,820	$0	3.95%	$47,820	$47,820	$47,820	$47,820
Flood Sampling	$0	$54,238	3.95%	$980,878	$1,221,618	$1,349,244	$1,397,698
Monitoring System Maintenance	$0	$550	3.95%	$9,947	$12,388	$13,682	$14,173
Groundwater Contamination Mitigation							
Alternative 1: Pit Pumping	$59,000	$71,180	3.95%	$1,346,269	$1,662,207	$1,829,700	$1,893,289
Alternative 2: Pump-Out System	$71,180	$41,180	3.95%	$815,908	$998,689	$1,095,589	$1,132,377
Bank Erosion Mitigation	$11,000	$500	3.95%	$20,042	$22,262	$23,438	$23,885
Ice Jam Mitigation							
Alternative 1: Ice Weakening	$0	$6,400	3.95%	$115,742	$144,149	$159,209	$164,926
Alterntive 2: Ice Booms	$81,000	$1,760	3.95%	$112,829	$120,641	$124,782	$126,355
Alternative 3: Tension Weirs	$120,000	$8,800	3.95%	$279,145	$318,205	$338,912	$346,774
Alternative 4: Piers	$52,500	$150	3.95%	$55,213	$55,878	$56,231	$56,365

The following assumptions are incorporated into the Present Worth calculations:

- a constant interest rate
- periodic or reoccurring activities take place on an annualized basis
- cost of labor is constant
- cost of materials and services is constant
- new or different methods or technologies are not incorporated
- analyte lists do not change
- flood reoccurrence is once every 1 years
- ice jams requiring mitigation every 5 years
- other assumptions, as described elsewhere, are included