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TECHNICAL MEMORANDUM

Date:	February 12, 2010
To:	Bill McDonald, City Administrator City of DuPont
From:	Mike Warfel, Hydrogeologist
Subject:	Review of Preliminary Draft Feasibility Study Pioneer Aggregates Gravel Mine Expansion Sequalitchew Creek Ecosystem and Watershed Restoration
cc:	File, David Sherrard
Project Number:	55330040-01
Project Name:	Pioneer Aggregates Gravel Mine Expansion

Introduction

In response to the request of the City of DuPont, Parametrix has reviewed the following document pertaining to the proposed Pioneer Aggregates Gravel Mine Expansion:

> *Pioneer Aggregates Gravel Mine Expansion – Sequalitchew Creek Ecosystem and Watershed Restoration, Preliminary Draft Feasibility Study. Prepared for CalPortland, Seattle, WA. Prepared by Anchor QEA, Seattle, WA, and Aspect Consulting, Seattle, WA. January 18, 2010.*

The review described in this memorandum focused on the two following groups of Feasibility Study (FS) alternatives associated with hydrogeologic issues:

- Alternatives focused on limiting changes to the DuPont Delta Aquifer (the Aquifer) and/or flows to Sequalitchew Creek (the Creek)
- Alternatives focused on improving flows and habitat conditions to the Creek

Review of the FS Alternatives

The two groups of alternatives are listed in Table 1, which also summarizes four key aspects of each alternative:

- Method of Analysis
- Environmental Effects
- Level of Uncertainty
- Data Gaps

Information to complete the table was extracted from the FS report; however, the table entries reflect the reviewer's opinions of the FS report information. For example, the FS report may have rated the uncertainty of an alternative as low, whereas the reviewer's opinion was low to moderate.

Conclusions

- The project groundwater model, water balance spreadsheets, and other tools developed by the FS report authors continue to be used as appropriate methods to assess project impacts and are well document in the references to the FS report.
- Updating and re-running these models may be sufficient to address most data gaps for the alternatives that rely on the well-documented model predictions, for alternatives with low to moderate uncertainties.
- Alternatives with moderate to high uncertainties require additional quantitative analysis to confirm or refute their feasibility with respect to mitigation of impacts to groundwater quantity and quality.

Table 1. Summary of Comments on Hydrogeologic Factors of Alternatives, Preliminary Draft Feasibility Study, Pioneer Aggregates Gravel Mine Expansion

Alternative	Section Numbers in FS Report	Methods of Analysis	Environmental Effect	Level of Uncertainty	Data Gaps
Limiting Changes to Aquifer and/or Flows to Sequalitchew Creek	***2.1 and 3.1***				
Mine above the Aquifer	2.1.1 and 3.1.1	Data from monitoring wells and surface-water stations	Preserve groundwater flow system, kettle wetland, and ravine springs intact	**Low**; many years of groundwater level data available	None; continue groundwater and surface water level monitoring
Subaqueous (Wet) Mining within the Aquifer	2.1.2 and 3.1.2	Data from monitoring wells and surface-water stations	Preserve groundwater levels and creek flows; lower water level in lake slightly; possible water level change in kettle wetland and turbidity plume flow to creek	**Moderate**; further evaluation of potential negative environmental effects warranted	Estimated magnitude of aquifer and surface water elevations; subsurface conditions west of mining area; slope stability of west berm; borings needed to address
Construct Low-Permeability Wall	2.1.3 and 3.1.3	Project Groundwater Model	Stormwater drainage issues from groundwater mounding; reduction of baseflow to the Creek (limited wall); reduction of groundwater discharge to the Delta Aquifer; potential mounding impacts to Ft. Lewis Landfill 5 from mounding	**High;** changes predicted by model are order-of-magnitude; effects of groundwater rise to unprecedented levels unknown; continuity of low wall permeability questionable at required installation depths	Additional detailed modeling and model calibration is required to address uncertainties in groundwater level responses and associated implications

Alternative	Section Numbers in FS Report	Methods of Analysis	Environmental Effect	Level of Uncertainty	Data Gaps
Install Low-Permeability Wall Post-Mining	2.1.4 and 3.1.4	Project Groundwater Model	Minimal groundwater drawdown effects to Edmond Marsh;	**Moderate**; better knowledge of subsurface conditions after mining	Additional modeling required; better calibration with new data
Infiltrate Dewatering Water within Mine	2.1.5 and 3.1.5	Project Groundwater Model and Water-balance spreadsheet model (2004)	Drawdown of aquifer levels beneath Edmond Marsh; removal of the kettle wetland; dewatering of the seep wetland	**Low to Moderate**; modeling to date based on large dataset	Update water balance spreadsheets; need multi-well aquifer tests during dewatering well installation to verify project groundwater model predictions
Infiltrate a Portion of Dewatering and Post-Mining Groundwater Discharge to Recharge Puget Sound Springs	2.1.6 and 3.1.6	Project Groundwater Model and Water-balance spreadsheet model (2004)	Potential, but not expected, effects of recharge distribution and peak timing on biota in subtidal and intertidal springs;	**Low to moderate**, with respect to groundwater flow patterns in the Delta Aquifer	Additional data regarding flow paths to the springs and groundwater/salt water level interactions

Alternative	Section Numbers in FS Report	Methods of Analysis	Environmental Effect	Level of Uncertainty	Data Gaps
Improving Flows and Habitat Conditions to Sequalitchew Creek	***2.2***				
Pump Dewatering Water to Edmond Marsh	2.2.1 and 3.2.1	Project groundwater model and analysis from Dewatering Plan	Potentially significant increases in water levels in West Edmond Marsh and changes in marsh hydrology	**Moderate to High;** quantities of dewatering discharges predicted by the project model are order-of-magnitude; variations in discharge flow rates over time	Update water balance spreadsheets; conduct additional detailed modeling and model calibration to support prediction of changes in West Edmond Marsh hydrology
Restore Channel within Edmond Marsh Complex to Allow Water to Flow Freely through the Marsh to the Sequalitchew Creek Ravine	2.2.2 and 3.2.2	Qualitative, based on existing topographic information	Potential reduction in surface-water levels in East and West Edmond Marshes, due to improved channel drainage	**High;** questionable if current extremely small slope of channel could be modified and maintained to allow free flow; prediction of potential impacts to Edmond Marshes	Detailed topographic survey using manual field methods required to assess feasibility; prediction of channel flows and marsh impacts needed

Alternative	Section Numbers in FS Report	Methods of Analysis	Environmental Effect	Level of Uncertainty	Data Gaps
Create North Sequalitchew Creek with and Open Channel Connection to Sequalitchew Creek	2.2.3 and 3.2.3	Project groundwater model and stream flow modeling	Improve habitat conditions for fish and native wildlife in the Creek watershed; reduce surface-water levels in West Edmond Marsh, although likely not significant with respect to natural variability; predicted flow decreases in upper reaches of Creek	**Low to Moderate;** modeling to date based on large dataset; uncertainties likely able to be addressed by adaptive management of constructed systems	Update project groundwater model with most current data to re-check predicted water-level and flow changes; confirm that design and O&M plan support successful adaptive management of constructed system
Create North Sequalitchew Creek with a Micro-Tunnel Connection with Sequalitchew Creek	2.2.4 and 3.2.4	Project groundwater model	As above	As above	As above
Divert Post-Mining Groundwater Discharge to Upper Sequalitchew Creek Ravine	2.2.5 and 3.2.5	Qualitative	Potential to offset predicted flow decreases in the upper Creek Ravine (see 2.2.3 and 2.2.4 above)	**High;** alternative is conceptual	Quantitative analyses (including modeling) required to assess optimal collector trench location and predict groundwater level fluctuations
Divert Water in Pipe Running along Wharf Road	2.2.6 and 3.2.6	Preliminary hydraulic analysis	Increase baseflow in upper Creek Ravine and improve fish habitat; reduce flows in Diversion Canal; unknown water quality impacts to Creek or Diversion Canal	**High;** engineering feasibility is uncertain, as well as flow and water quality impacts	Additional flow data and water quality data for the Diversion Canal; prediction of flow reductions and water quality impacts

Alternative	Section Numbers in FS Report	Methods of Analysis	Environmental Effect	Level of Uncertainty	Data Gaps
Divert Water in Surface-Laid Pipe through the Marsh System	2.2.7 and 3.2.7	Preliminary hydraulic analysis	Increase baseflow in upper Creek Ravine and improve fish habitat; marsh system disturbance during construction; reduce flows in Diversion Canal; unknown water quality impacts to Creek or Diversion Canal	**High;** engineering feasibility is uncertain, especially with respect to pipeline construction in wetland environments; flow and water quality impacts are also uncertain	Availability of flow at the proposed pipe inlet in the Diversion Canal; additional flow data and water quality data for the Diversion Canal; prediction of flow reductions and water quality impacts
Divert Water in Pipe Running along Center Drive	2.2.8 and 3.2.8	Preliminary hydraulic analysis	Increase baseflow in upper Creek Ravine and potentially improve fish habitat; reduce flows in Diversion Canal; unknown water quality impacts to Creek or Diversion Canal	**High;** engineering feasibility is uncertain; flow and water quality impacts are also uncertain	Availability of flow at the proposed pipe inlet in the Diversion Canal; additional flow data and water quality data for the Diversion Canal; prediction of flow reductions and water quality impacts
Line Sequalitchew Creek between Edmond Marsh and the Sequalitchew Creek Ravine	2.2.9 and 3.2.9	Qualitative	If combined with a Creek flow enhancement option, this alternative would increase baseflow in upper Creek Ravine and potentially improve fish habitat; potentially increase connectivity between the Brackish Marsh and the Creek	**Moderate to High;** effectiveness of lining this reach of the Creek is not known	Configuration and permeabilities of liner system alternatives need to be evaluated, subsurface conditions beneath this reach of the creek need to be defined, and flow modeling is needed to predict reduction in leakage from the Creek bed

Alternative	Section Numbers in FS Report	Methods of Analysis	Environmental Effect	Level of Uncertainty	Data Gaps
Improve Connections of Bell and Hamer Marshes to Edmond Marsh	2.2.10 and 3.2.10	Water balance analysis;	Provide additional flow to Edmond Marsh from November to June;	**Moderate;** ultimate fate of additional water to be added to Edmond marsh; water quality in Hamer and Bell Marshes	Update the water balance for theses marshes; characterize water quality in these marshes; delineate the wetland boundaries and functions associated with these marshes