MEMORANDUM

TO: Mike Kain, Land Use Planning and Development Services, RS
FROM: Nadine Romero, Water Resources Program, RS
       Hydrogeologist, LHG, LG
DATE: November 10, 2010
SUBJECT: Hydrogeologic Review of Maytown Sand and Gravel Mine Ground Water Data Submittals

As requested, I have performed a more ‘in-depth’ review of the ground water data provided by the Maytown Sand and Gravel Mine. Specifically, I went through county files in your department to gain an understanding of both the ground water well layout and monitoring data provided.

In my analysis, I prepared a new geologic cross-section with the available boring logs in the files and a table of data provided for each monitoring well. These two products enabled me to see missing information coupled with the spatial location of where the ‘data gap’ exists both vertically and horizontally in the aquifer. This analysis tells me more about how significant the data gap is relative to the known hydrogeology, because I can examine the site altitudes, excavation depths, well coverage and placement in the aquifer.

Specifically, you posed several questions for me to answer:

a) To address the significance of the monitoring ‘data gaps’ in the ground water monitoring program relative to the startup of the gravel mine operations and monitoring schedule

b) To provide an opinion on the potential impacts to the site in terms of ground water disturbance from the construction of the ‘scale-house’

c) Further clarify the ground water monitoring program and monitoring schedules that I outlined in my previous memos and,
d) Provide an opinion on the environmental consequences of delaying background data collection from December 2005 (Hearings Examiner Requirments) to later dates beginning in January of 2008.

e) Provide an analysis of the monitoring stations and whether 17 stations have been delineated in the monitoring program.

UPDATES

This review includes several new updates since the completion of my initial review on August 13, 2010:

- A site visit was conducted at the Maytown Sand and Gravel site on September 8, 2010 and October 7, 2010.

- A meeting with Pacific Ground Water Group hydrogeologists (Pony Ellingson and Inger Jackson) was held to go over the monitoring program.

FINDINGS

Site Visit and Meeting

The two site visits and a meeting with the consultant hydrogeologists was very helpful in understanding the site history, well layout and the monitoring program. In addition, the county was able to share the geologic cross-section work and our understanding of the monitoring program as outlined in the hearings examiner document, the data submittals and the 2005 PGG Monitoring Plan.

- **The most important outcome of this meeting is that we need an updated Ground Water and Surface Water Monitoring Plan/Program outlining the monitoring stations, the data collected and it needs to address the data gaps that I have identified in this document.**

- My recommendation to Thurston County is to provide this hydrogeologic technical review to Maytown Sand and Gravel and their consultants, the Pacific Ground Water Group, and prepare a new monitoring plan that is organized and shows the new background data collection summaries.

- I understand that the facility has been conducting the comprehensive ground water data collection of the Appendices (I, II and III) that I recommended in my earlier memo. I also understand that this data is forthcoming in the next week.

- The consultants have explained that their 17th monitoring station MT-13 (a monitoring well) was installed in March of 2010 and has been sampled.

- I understand that the final monitoring station is to be a stormwater pond that is not yet constructed. This would mean that no monitoring data exists for this station. However, it is not clear whether PP11 or PP12 was to cover this gap.
I have provided the attached Table 1 showing my interpretation of the monitoring program. As discussed in the meeting, I understand that there are ‘perimeter’ ground water monitoring wells and surface water stations that have been designated. The consultant provided a solid effort explaining the new program. It seemed technically sound. Nonetheless, we need to see a comprehensive updated Sampling and Analysis Plan document in writing (the actual monitoring program that is being enacted) and how it meets the Hearings Examiner requirements for 17 monitoring stations, as well as ‘technical’ appropriateness, as I have outlined here, and in my previous memos.

**Data Gaps**

*Table 1* outlines the ‘on-site’ ground water monitoring wells and surface water sampling stations which were previously approved/agreed upon by the Hearings Examiner and the 2005 Ground Water Monitoring Plan. This table contains the dates of submitted ground water data (water levels and temperature) for each well (start date through most current) and historical water level information.

I went through the submitted data and extracted the highest ground water elevations and the historically lowest ones. I then plotted these elevations on the geologic cross-section to gain a sense of the depth to ground water, hydraulic gradients and well screen depths in the aquifer. The table also shows which well had a well log to assess the site hydrostratigraphy.

The reference table shows missing data for each monitoring well as highlighted in “blue”. It appears that three ground water monitoring wells have not been sampled or at least ground water monitoring data has not been submitted to the county, for PP11 and PP12, along with a new ‘proposed’ monitoring well. It is not clear why these ground water wells were not sampled. Both PP11 and PP12 were installed in 1997 and their boreholes were drilled to depths of 155 feet and greater. Because these are deeper wells this aquifer information is vital (refer to geologic cross-section) to the characterization of background and ground water hydrology and per the Hearings Examiner report.

Furthermore, there appears to be other existing wells (i.e, MT-04, HC-MW4, etc). So, it is not clear why one of these wells has not been proposed for the 17th ground water monitoring station and sampled in accordance with the Hearings Examiner Report. It is also not clear why the on-site domestic wells PP02 and PPO4A have only been sampled since 2008.

I was not able to find construction logs for BC1, BC2, DL1 and WETA1 and I understand these are surface water stations that record stage (please confirm).

In addition, during the March 2010 data submittal (I saw only the data and no cover letter or summary attached) there are two ‘new’ monitoring wells inserted into the data table. These wells
are MT-12 and MT-13. I was not able to locate MT-13 and found MT-12 referenced in the February 4, 2010 PGG letter to well owners. I also do not have any boring logs or water level history for these wells and whether they are being proposed as part of the monitoring network.

**Depth to Ground Water**

Depth to ground water is actually shallow with an average depth of 18 feet below ground surface (bgs) at the end of the summer season and only 9.3 feet bgs at the peak of the winter season. The highest ground water elevation was 224.68 feet above msl at monitoring well MT-11 at the very eastern end of the site (January 18, 2006). The lowest ground water elevation was 200.57 ft at the far northeastern end of the site (October 3, 2002). These ground water levels become important in estimating how long it will take to excavate to ground water in Mine Area 1 and being able to establish background water quality conditions as noted in the next section.

I also examined the March 25, 2010 data table as discussed above. I noted a high temperature reading in well PP02 at 14.2 deg C. Also, PP08 had the highest specific conductance of all wells at 308 umhos/cm.

It was noted in the December 30, 2009 PGG letter to the Port of Tacoma that PP02 was covered during demolition work nearby, so I don’t know if this well is somehow affected by debris (?) or a wood pile (heat up of wood) to raise the ground water temperature. There wasn’t any detail on the type of demolition over this well and whether a well seal was broken when it was buried. The PP08 well appears to be located near WEA-1 in Wetland A. This appears to be a deeper well extending to 155 feet above msl, so it is interesting that specific conductivity is at 308 umhos/cm. Some deeper ground water regimes have higher specific conductivity. I was also not able to compare the specific conductivity to historical values per the ground water monitoring plan for this well. I need confirmation that this water quality information has been submitted to the county.

**Background Water Quality Data Collection**

One key criteria found in the previous reviews of this site was that the 2005 Ground Water Monitoring Plan noted that *background* would be collected prior to excavation into the water table. We used this criterion to establish that mining operations could commence as long as at least two semi-annual samplings were conducted in the *low* and *high* ground water season (this means a minimum of 1-year of background data collection for the water quality parameters as outlined in the June 2010 memorandum—Appendix I, II and III) prior to any mining operation.

I understand that the owner/operator has collected the March 2010 and September 2010 water quality samples and has analyzed for the comprehensive suite of parameters per previous memo. The owner/operator will have to make a case for using these samples and not exceeding hold times or harming sample integrity before such data is approved for background. Note that *background* water levels and other water quality indicator parameters (as noted in the Hearings Examiner Report) must be taken for all ground water monitoring stations (all 17 stations) at least 6 times per year or less as long as there are pressure transducers/data loggers continuously collecting data. It appears many of the site monitoring wells have been sampled since 2002, others more recently, and some not at all.
After two years of background water quality sampling (this means a total of 4 semi-annual ground water sampling events at the low and high ground water season has been conducted – in March and September of each year) the facility can then proceed to full-scale operations (note discussion below) so long as water temperature and water level reporting is deemed acceptable. If there are no water quality concerns in the background datasets then the facility can go down to annual ground water sampling for water quality parameters, as approved by the county Environmental Health Program (EH).

The EH program is currently establishing a compliance inspection program in 2010 for gravel mines in accordance with the County Mineral Extraction Code. On-site inspections of the ground water monitoring networks, files, operations, and even ‘split-samplings’ of water quality samples can occur.

**Estimated Calculations for Reaching the Water Table (Mine Area 1)**

Preliminary rough calculations for mining Area 1 in the northeast corner of the site (to the water table) shows that a proposed 1.17 million cubic yards per year (maximum gravel extraction rate) will be used. Because depth to water in Area 1 (area estimated at 1.5 million square feet) is estimated at 7 feet (estimated depth using high ground water elevations) this would be 388,888 cubic yards above the water table. Therefore, it would only take less than 5 or 6 months to excavate the entire area of Mine Area 1 to the high water table. Background water quality would need to be completed prior to this depth threshold. Therefore, mining operations would need to slow and/or stop during the first year of operation and resume only after background water quality sampling is completed. Background water quality sampling needs to represent pre-developed conditions.

**Impact to Ground Water on Scale-House Construction**

After examining the site maps and geologic cross-section it does not appear that there would be ground water impacts to an area of 100 feet by 100 feet as long as soil was not removed/disturbed to greater than a 2 or 3 foot depth. I understand soil may have been disturbed to a depth of 8-inches to 1-foot to construct the scale pad/pour concrete. This would not be a major concern to changes in aquifer geochemistry or even physical turbidity. Furthermore, if there is any sort of till or clayey unit beneath the pad this would further minimize disturbance to the ground water monitoring zone of the aquifer.

**Conclusions**

It is not clear why this facility did not conduct ground water monitoring for three key wells as outlined in the Hearings Examiner report and as negotiated in the 2005 Ground Water Sampling Plan. It is not that a few months of data are missing for a well but, that several years of data are lacking for wells PP11, PP12 and another proposed well. Both PP11 and PP12 are deeper aquifer wells and understanding background conditions of the deeper aquifer is extremely important as well.
At least one of these wells spans the complete proposed depth of excavation to 160 feet elevation. Furthermore, these wells have been around since 1997. This absence of information is a ‘large absence of information’. Perhaps, the county did not receive a copy of this data and it does exist. But, it does not appear in the tables and written text of the data submittals. [Update: PGG consultants explained that PP11 and PP12 are water supply wells and were not intended as monitoring wells—again, this will need to be confirmed in writing].

Finally, the gravel mine facility needs to ensure that background water quality is obtained using 4 semi-annual sampling events during the high and low ground water seasons (over 2 years). While the 2005 Ground Water Monitoring Plan specifies prior to reaching the water table we are interpreting that at least 1-year of background water quality data will be collected prior to gravel mining followed by background data collection during the first year of mining. However, mining cannot go into the water table at any part of the mine until background data has been collected.

The rough mining calculations show that it is possible that at the proposed maximum mining rate of 1.17 million cubic yards per year, that all of the mine surface (to the water table) in Area 1 can be excavated in only 4 to 6 months. Therefore, mining would have to slow and or stop prior to completing background water quality sampling.

Finally, on the question you posed about whether there are any ‘environmental consequences’ for conducting background several years later than the Hearings Examiner date of 2005-- I don’t see any environmental impacts as the ‘intent’ of background is to show ambient conditions immediately prior to facility operations. The comprehensive set of analytes in ‘current’ background as I have recommended is more optimum than the “old” background consisting only of water levels, temperature and indicator parameters. We have a more complete view of the ground water quality prior to facility operations.

Bottom line, to be in compliance with the Hearing Examiner decision, the water quality reports and the temperature and water level reports must be submitted for 17 stations at least one year prior to the initiation of substantial land disturbing activity, or the applicant must demonstrate that equivalent or better information has been submitted.

I do not have any other concerns at this point, although please examine this document carefully to ascertain if any other data exists that was submitted by the facility and/or updates.

I hope this hydrogeologic review provides more insight into your questions about the gravel mine impacts and ground water data collection.

ATTACHMENTS

Geologic Cross Section
Table 1 - Monitoring Program Comparison Table — Hydrogeologist Notes
Table 1. Ground Water Monitoring Wells - Maytown Sand and Gravel Site - Hydrogeologist Notes (Prepared by County Hydrogeologist)

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<th>ID*</th>
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<th>MP Depth (ft)</th>
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<th>Well Bottom Elev (ft)</th>
<th>GW Historical Elev (ft)</th>
<th>Date</th>
<th>GW Historical Low (elev)</th>
<th>Date</th>
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Notes: PP02 - 14.3 deg C (3/25/2010); PP08 - 308 umhos/cm (3/25/2010)

N. Romero, 11/05/2010
Maytown Sand & Gravel Mine

- GW Elevation Historical "High" = January 18, 2006
- GW Elevation Historical "Low" = October 3, 2002

Project Mining Area = 587 Acres
Total Site Area = 1625 Acres

*DRAFT*

Thurston County
Environmental Health

Title: Geologic Cross-Section A'-A'
Drawn: Nadine L. Romero, Hydrogeologist, P.G., L.P.H.G.
Project Site: Number:
Date: August 12, 2010
FIGURE A