APPENDIX H

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MEMORANDUM

TO: William Hutton, Esq.

FROM: Sarah Battelle, Geo-Logic Associates
William Lopez, Geo-Logic Associates

DATE: November 7, 2009

RE: **EVALUATION OF ADDITIONAL PERCOLATING GROUNDWATER RESOURCES ON THE GREGORY CANYON PROPERTY SAN DIEGO COUNTY, CALIFORNIA**

The purpose of this memorandum is to present an evaluation of the available groundwater resources within fractured crystalline rock (percolating bedrock) on the Gregory Canyon property (outside of the pumping wells at the base of the Gregory Canyon watershed) that could be utilized for the landfill project. For this evaluation, three areas were identified including

1. Area 1 - an 82.5 acre basin on the north side of State Highway 76 directly north of the former Lucio Dairy property;
2. Area 2 - a 98.5 acre basin that drains to Couser Canyon that includes portions of the project Stockpile B area; and
3. Area 3 - a smaller, 37.8 acre basin that includes portions of the project Stockpile A area (Figure 1).

Before providing this evaluation of additional groundwater resources, it is important to understand the background for the initial assessment of percolating groundwater within Gregory Canyon as presented below.

BACKGROUND

To estimate the potentially available water within Gregory Canyon, well pumping test data and geophysical test data were used from fractured crystalline bedrock well GLA-3; one of the better water producing bedrock wells within the Gregory Canyon watershed. Downhole geophysical testing (tracer tests) performed in the well borehole indicate that below a depth of 95 feet (approximately 60 feet below the water level), the bedrock fractures in the well bore are less numerous and provide substantially less water production. Therefore, the effective fractured bedrock groundwater resource was interpreted to have a thickness of 60 feet. As described in the 2007 Revised Final Environmental Impact report and Appendix C, Water Supply Report, RockWorks Drawdown Calculator software (RockWare, Inc., 1998), was employed using the pump test data to calculate the drawdown in well GLA-3 after 2000 days (+5.5 years) at discharges of 10, 15, and 20 gallons per minute (gpm). These calculations indicate that pumping rates greater than 15 gpm (21,600 gallons per day [gpd]) will draw the groundwater below approximately 53 feet (near the base of the effective aquifer. Therefore the long-term sustainable yield in GLA-3 was estimated to be approximately 12 gpm (17,280 gpd).

Recognizing that well GLA-3 was one of a series of seven wells screened in the fractured crystalline bedrock proposed to be pumped along the base of the Gregory Canyon watershed, pumping rates were reviewed, using aquifer pumping test data, for the additional pumping wells to estimate the sustainable yield for wells along the base of the Gregory Canyon watershed. Estimated pumping rates ranged from 1 to 2 gpm in proposed pumping wells (GLA-B, GLA-C, GLA-G and GLA-12), approximately 4 gpm from well GLA-13, and up to 10 gpm from well GMW-1, resulting in an estimated "sustainable yield" cumulative pumping rate of 30 gpm (43,200 gpd) or 48.4 AFY.

Factors that affect the amount of percolating groundwater that can be pumped without significant impact (i.e., sustainable yield) also include the underlying storage capacity of the fractured crystalline rock system, in addition to precipitation and percolation. In fractured crystalline rock, the fracture openings and density decrease with depth, and the effective porosity within the fractured crystalline rock will decrease exponentially with depth. In San Diego County, a depth of 400 feet to 500 feet is generally considered to be the depth at which individual fracture widths are thought to become insignificant. Assuming a total depth of 400 feet is used, an estimated maximum volume of 1815 acre-feet of water may be stored within the crystalline rock fractures in the area occupied by the Gregory Canyon watershed, with only about 50 percent of the stored water actually recoverable. This means that in a given year the pumping of 48.4 AFY of percolating groundwater represents only about 5% of the overall storage capacity[1] within the fractured crystalline bedrock.

In addition, a "safe yield" calculation for Gregory Canyon was also performed to estimate the volume of water that could be pumped from the Gregory Canyon watershed without creating a significant impact to this water resource. The safe yield calculation used available long-term rainfall data from Lake Henshaw of 25 inches, the Gregory Canyon catch basin area of 415 acres, and an assumption that 5 percent of the rain falling within Gregory Canyon would infiltrate the fractured crystalline bedrock. From this calculation, the estimated safe yield associated with the pumping wells at the base of Gregory Canyon was 27 gpm (38,880 gpd); a somewhat lower value than estimated from the "sustainable yield" cumulative pumping data. The greatest potential uncertainty in the safe yield calculation is the annual rainfall estimation. This uncertainty was discussed in the Revised Final Environmental Impact Report (RFEIR)[2].

Comparing these two distinct analytical approaches, the sustainable yield analysis assures no significant impact to this groundwater resource through limiting pumping to a given elevation, to maintain equilibrium and avoid overdrafting. The strategy adopted in the RFEIR to achieve this goal was the use of level controls in each pumping well. The level control would be set to cycle the pump on and off within the limits established by the calculated long-term sustainable yield.[3] Water level controls in each of the proposed pumping wells at the base of Gregory Canyon would be established based on the results of aquifer pumping tests in each well and the resultant long-term (minimum 5-year) sustainable yield, calculated in the same way as for well GLA-3 and generally accepted practices utilized by the County of San Diego[4].

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[1] *48.4 / (1,815 x 50%) = 5.3%*

[2] *RFEIR, Response to Comments 007-6, Appendix II, 2007*

[3] *Id.*

[4] *County of San Diego Guidelines for Determining Significance and Report Format and Content Requirements, Groundwater Resources, Land Use and Environment Group, March 17, 2007.*

In comparison, the safe yield analysis only looked at precipitation and percolation over a given catch basin area, without consideration of storage capacity or other site-specific data (e.g, soil type, soil moisture, evapotranspiration). However, safe yield can be useful in establishing a general estimate of how much water can be pumped to maintain equilibrium. The strategy adopted in the RFEIR was to utilize safe yield as a monitoring tool to compare actual pumping with calculated safe yield values through the use of flow totalizer meters. That data can be compared over time with the calculated estimated safe yield volume, which is based on average rainfall and percolation.[5]

As described in the RFEIR, through use of these measuring tools, the volume of water stored in the fractures could be controlled over the long term and over a range of climatic conditions to assure no significant impact to the available water resources within Gregory Canyon, and in particular that the volume of water stored within the fractured rock system within the Gregory Canyon watershed would not be over-drafted.

The RFEIR included a project design feature specifying the use of level controls and totalizer meters[6]. However, this project design feature did not discuss the analytical process for calibrating the level controls; therefore, it is recommended that this project design feature be updated to describe the process of establishing the long-term sustainable yield in more detail.

OTHER BASIN AREAS

Without having drilled wells and performed pumping tests in the proposed Areas 1 through 3, as a first approximation of the potential available water resource in these areas, the same rainfall and infiltration rate assumptions were used as the estimated safe yield calculation performed for the catch basin occupied by Gregory Canyon (GLA memorandum dated December 5, 2005). It is recommended that pumping tests be performed and a long term sustainable yield estimates established for each pumping well, along with installation of level controls and a totalizer meters. However, for purposes of the analysis of impacts to these groundwater resources, it is recommended that the calculated safe yield be utilized, as this would establish a conservative estimate of the available percolating groundwater.

As described above, the method uses a simple calculation of the estimated volume of rain (25 inches per year) that falls within the catch basin and assumes that 5% will infiltrate the fractured crystalline rock system and be captured (aquifer recharge). The calculated average rate of aquifer recharge is a function of the area within the catch basin. Based on the three catch basin areas, the following estimated safe yield values were calculated in gallons per day (gpd) and acre-feet per year (AFY):

Area	Acreage	Est. Daily Vol. (gpd)	AFY
1	82.5	7673	8.6
2	98.5	9161	10.3
3	37.8	3515	3.9
	TOTAL	**20,349**	**22.8**

[5] *RFEIR, Response to Comment 007-6, Volume II to 2007 EIR.*
[6] *Id.*

Since there are no proposed modifications to these catch basins (i.e., construction or development) that would have an effect on the ability of the underlying fractured crystalline rock to capture rainfall and no wells that would compete for the water in storage within these catch basins, under the above assumptions, no reduction in the average rate of aquifer recharge would be expected.

The estimated safe yield within Gregory Canyon of 38,880 gallons per day (43.6 AFY) and the estimated safe yield calculated for the three additional site catch basins of 20,349 gallons per day (22.8 AFY), provide an estimate of 59,229 gallons per day (66.4 AFY) of groundwater from the fractured crystalline rock system that may be captured, stored and used on the project site. It is recognized that the safe yield volume will be reduced as the Gregory Canyon watershed area is reduced (a portion of the recharge area is removed by landfill construction), ultimately reducing the main canyon estimated safe yield (43.6 AFY) by 19.4 AFY to 24.2 AFY or 21,576 gallons per day when the 183-acre landfill footprint is fully constructed. No change in recharge will occur in the three additional catch basins.

It is recommended that the same safe yield and sustainable yield analyses, strategies and tools be incorporated as a project design feature for the three other percolating groundwater catch basins on the landfill property. Once the pumping wells are installed, pump tests will be performed to calculate a long-term sustainable yield pumping rate and maximum allowable drawdown for each pumping well location to avoid over-drafting and prevent significant impacts to the water resource. In addition, given the proximity of the Area 1 and Area 3 bedrock pumping wells to the Pala Basin alluvial aquifer, it is recommended that an alluvial monitoring well be installed in the vicinity of the Area 1 and Area 3 pumping wells to monitor alluvial groundwater elevations during the pumping tests and provide verification that the bedrock wells are not drawing water from the alluvium.

VERIFICATION ANALYSIS

As noted above, without pump test data for each well, there will be uncertainty regarding the exact amount of percolating groundwater that can by pumped and utilized with no significant impact to water resources. The largest source of uncertainty results from climatic factors, and in particular, fluctuations in the amount of rainfall.

In order to provide ongoing verification of a less than significant impact, it is recommended that each pumping well undergo a new pumping test on a bi-annual basis (every other year), the sustainable yield re-calculated using RockWorks Drawdown Calculator software (or an equivalent method approved by the LEA), and the level controls re-set based on the results of the calculation of long term sustainable yield.

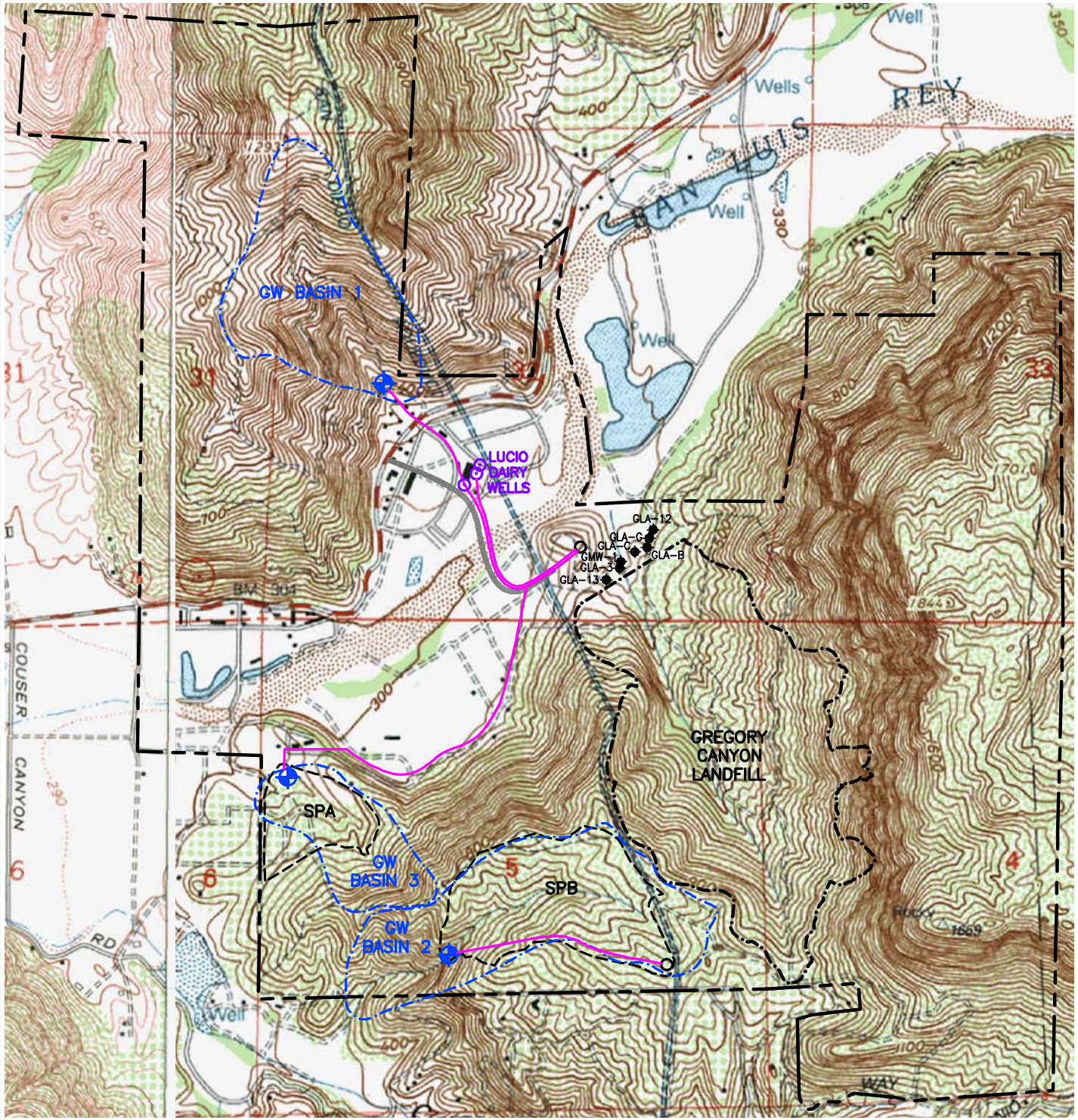
Alluvial groundwater capture will also be evaluated to ensure that groundwater extracted from crystalline bedrock wells does not draw groundwater from the alluvial aquifer. It is recommended that alluvial wells MW-3 and proposed alluvial well GMW-2A be used as observation wells during the pumping tests performed for crystalline bedrock wells GLA-3, GLA-12, GLA-13, GLA-B, GLA-C, GLA-G, and GMW-1. If drawdown is measured in the adjacent alluvial observation wells during the pumping test, the pumping rate will be adjusted so that no measurable drawdown is indicated in these alluvial observation wells.

Finally, a safe yield evaluation will be undertaken on a bi-annual basis, comparing the calculated safe yield with actual pumping rates obtained from the totalizer meters. Based on this comparison, coupled with the bi-annual sustainable yield analysis, a recommendation regarding additional modifications to pumping rates will be submitted to the LEA for review and concurrence.

To the extent there is a shortfall in the available supply of percolating groundwater from the four catch basins in aggregate, as determined by a drop in the groundwater level below the long term sustainable yield determined depths, the landfill would utilize trucked recycled water, as was presented in the RFEIR and analyzed in the 2009 Addendum.[7]

I hope that this memorandum assists you in the assessment of available on site groundwater resources for the Gregory Canyon Landfill project.

[7] *RFEIR, Response to Comments 007-6, Appendix_ to 2009 EIR Addendum.*



EXPLANATION:

- PERCOLATING GROUNDWATER WELL
- RIPARIAN GROUNDWATER WELL
- PROPOSED PERCOLATING GROUNDWATER WELL
- WATER TANK(S) LOCATION
- PROPOSED PIPELINE ROUTE
- ACCESS ROAD
- STOCKPILE AREA BOUNDARY
- APPROXIMATE LIMIT OF GROUNDWATER BASIN
- LANDFILL LIMIT
- PROPERTY BOUNDARY

REFERENCE: USGS 7.5 MINUTE SERIES (TOPOGRAPHIC) PALA (1997) AND BONSALL (1975) CALIFORNIA QUADRANGLES

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GRAPHIC SCALE
600 0 300 600 1200
(in feet)

FIGURE 1

PROPOSED ON-SITE PUMPING WELLS

GREGORY CANYON LANDFILL
SAN DIEGO COUNTY
CALIFORNIA

GeoLogic Associates
Geologists, Hydrogeologists, and Engineers

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