Eagle Mountain Pumped Storage Project – Seepage Analyses for Upper and Lower Reservoirs

Prepared by: Nick Miller and Dick Westmore, GEI Consultants, Inc.

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This memorandum summarizes preliminary estimates of seepage from the proposed Upper and Lower Reservoirs for the Eagle Mountain Pumped Storage Project. In addition, this TM provides opinions on the potential effectiveness of using the available fine mine tailings as a seepage control blanket to minimize seepage losses from the Upper and Lower Reservoirs. This treatment measure was proposed in the earlier project concepts developed in the 1990s. We also assessed the potential effectiveness of other seepage control measures at the two reservoirs.

Due to the current access constraints at the site, all geotechnical and geological information used for the seepage estimates was obtained from prior investigations and studies conducted by GeoSyntec Consultants, GSi/Water, and GeoPentech in support of studies for a proposed landfill. The results of those studies represent an initial step in characterizing potential seepage impacts associated with the Eagle Mountain Project. Seepage impacts are of particular concern to the Metropolitan Water District of Southern California (MWD), the State Water Quality Board, and others in the region.

Site Geology

Bedrock geologic units present at the site can be generally classified as either igneous or meta-sedimentary. The igneous units include several varieties of granitic rock including porphyritic quartz monzonite, diorite, monzonite porphyry, and granodiorite. The meta-sedimentary units include quartzites, meta-arkoses, and marbles formed by metamorphosis and/or hydrothermal-alteration or sandstones, conglomerates, arkoses, and carbonate rocks deposited in the Paleozoic or Precambrian age.

Surficial geology of the Eagle Mountain area generally consists of unconsolidated alluvial deposits. The alluvial deposits include sands, silts, gravels, and debris-flow deposits. The most significant alluvial deposits are found on the eastern edge of the site area, where they form a laterally extensive alluvial fan that extends and thickens to the east into the Chuckwalla Valley. Some of these deposits are exposed in the east wall of the east pit and underlie the eastern portion of the Lower Reservoir.

The alluvial deposits within the Chuckwalla Valley extend to significant depths below the ground surface and generally consist of sands, silty sands, sands and gravel, cobbles and boulders. Within the sandy alluvial deposits in the Chuckwalla Valley a predominately clay layer was logged in borings at depths varying from about 600 to 900 feet, and is generally about 100 to 300 feet in thickness.

The entire Central Pit (Upper Reservoir) is incised into bedrock. Alluvial deposits in the area of the Upper Reservoir are smaller in extent and are generally confined to laterally discontinuous, generally thin deposits along the bottoms of the canyons.

Rock containing little to no mineral value (waste rock and tailings) generated by the former Kaiser operations were deposited in numerous areas near the site. These mining by-products include several distinctly different materials, including both bedrock and alluvial overburden, and tailings produced as a result of the mining and separation of iron ore-bearing rock from host rock. The tailings include both fine and coarse varieties.

The hydraulically-placed fine tailings exist in settling ponds to the southeast of the proposed Upper Reservoir. Total volume of these materials is estimated to potentially be over 19 million cubic yards. Laboratory testing indicated that the fine tailings vary in composition, ranging from silty sand and sandy silt to clayey silt to silty clay. In general, soils with higher sand content are located near the slurry discharge point while finer grained soils are present in the distal portions of each pond.

Coarse tailings were placed at several locations around the site, although the largest deposit lies in a stockpile located immediately south of the proposed Lower Reservoir. The total volume of coarse tailings in this stockpile is estimated to be about 50 million cubic yards. The majority of the coarse tailings were classified as clean gravels or sandy gravels containing significant percentages of cobbles and boulders and few fines.

The chemical composition of these materials will be fully investigated during Phase 1 Pre-design investigations. Those studies are described in Section 12.1 of this document.

Upper Reservoir

The Upper Reservoir will occupy the former Central Pit of the Kaiser Mine. The reservoir is elongated generally east-west, with a maximum dimension of about 5,300 feet. North-south dimensions vary between 1,500 and 2,000 feet near the maximum planned reservoir surface (El. 2485). The existing low point in the Upper Reservoir is located in the eastern half of the pit and extends down to El. 2230. Due to topographic conditions, there will be two dams required to create the upper reservoir. The current concept is to construct these dams using roller-compacted concrete (RCC) with aggregate materials being derived from the abundant coarse mine tailings at the site or from other on-site aggregate sources with suitable characteristics for RCC.

Available geologic mapping shows the north side of the pit to be underlain by granitic rock units, while the central and southern portions of the pit are underlain by metasedimentary units and iron ore. Areas of the proposed Upper Reservoir are also covered with coarse tailings. Two borings completed in the bottom of the Upper Reservoir site (MW-10 and CH-10) provide insights on the hydrogeologic character of the rock materials. Rock core was obtained from boring CH-10. The boring was drilled to a total depth of 1,389 feet. Water was first observed at a depth of 1,309 feet. Rock lithology in the upper 350 feet of the boring was found to be moderately fractured, interbedded igneous and metasedimentary rock. Monitoring well MW-10, a 13.5-inch diameter borehole, was drilled to a total depth of 1,480 feet below ground surface. Water was first encountered at a depth of 506 feet; however, the static water level subsequently dropped and later stabilized at a depth of 1,040 feet. Borehole locations and logs are provided in the Appendix of this report.

Lower Reservoir

The Lower Reservoir will be located in the former East Pit of the Kaiser Mine. No dams are required to provide the needed storage at the Lower Reservoir. The pit has a maximum dimension of about 5,400 feet in an east-west direction, and a maximum dimension of about 2,000 feet in a north-south direction when measured at the normal maximum reservoir water surface at El. 1092. The pit narrows to the west to a minimum width of about 300 feet. The pit includes two low points or bowls, one in the east, and one in the western half of the pit. These low points are separated by a bedrock saddle, which is mantled with tailings deposits on the west side. The low point within the east bowl is at El. 776, while the lowest point within the west bowl is at El. 715. The intervening saddle is at about El. 880.

The proposed Lower Reservoir can be divided into two zones on the basis of geology. The eastern one-quarter of the site is excavated in Quaternary alluvial sediments, including fan deposits and debris flow deposits. In the eastern wall of the pit, a vertical section of about 300 feet of alluvial deposits is exposed. The western three-quarters of the site are underlain by granitic rocks and undifferentiated metasedimentary rocks and rocks of the upper quartzite unit. The granitic rocks are located along the northern face of the pit, while the metasedimentary rocks are found along the south pit face and the lower portions of the north face. Quartzite is located in the central portion of the pit and underlies the unconsolidated deposits.

A total of eight borings were used to characterize the geology in the area that would be occupied by the Lower Reservoir and surrounding areas; these include: MW-13, CH-5A, P-1, MW-1, MW-2, P-11, P-12, and C-10. Borings MW-13, CH-5A were completed along the western and northwestern corner of the Lower Reservoir site. These two borings show slightly fractured, interbedded igneous and metasedimentary rock extending to depths below El. 500. The static water level was subsequently measured in boring MW-13 at about 285 feet below the ground surface. The boring for P-1 is located on the bedrock saddle which divides the East Pit into two sections. This boring was drilled to a depth of 270 feet, and also shows interbedded igneous and metasedimentary rock for the entire depth. A static water level was subsequently measured at 177 feet below the ground surface in P-1.

Boreholes MW-1, MW-2, P-11, P-12, and C-10 were located east of the pit, and were projected onto the geologic section prepared for our analysis. The logs of these boreholes were reviewed to estimate the extent of alluvial deposits found on the eastern edge of the site. Generally, the alluvial deposits form a laterally extensive alluvial fan that extends and thickens to the east into the Chuckwalla Valley. These five borings encountered predominately fine to coarse sand, with gravel and cobbles in several locations. The borings also indicate a relatively thin, predominately clay layer interbedded within the primarily sandy alluvial deposits. The clay layer ranges in elevations from about 600 to 900 feet, and is generally about 100 to 300 feet thick. The groundwater in the bedrock and alluvium generally drops from west to east and from north to south. The groundwater was estimated to be approximately 240 feet below the ground surface at the point where boring P-12 is projected onto the geologic section. Borehole locations and logs are provided in the Appendix.

Seepage Analyses

The expected quantity of seepage through the Upper and Lower Reservoirs was evaluated by performing seepage analyses. The seepage analyses were performed using the two-dimensional, finite element program GeoStudio 2007, specifically the SEEP/W module.

The majority of the seepage from the proposed reservoirs is anticipated to travel from west to east towards the Chuckwalla Valley, similar to the existing ground water conditions at the site. Based on these ground water levels and the geologic conditions, the hydraulic gradient produced by the proposed reservoirs will be greater in the west-east direction than the hydraulic gradient in the north-south direction; therefore, all seepage flow rates and annual seepage volumes were estimated using west-east profiles. However, there is potential for seepage from the proposed reservoirs to travel from north to south. For this reason, north-south seepage profiles were also developed for both reservoirs only for estimating the ground water levels at specific down-gradient facilities of concern. We performed the analyses for the reservoirs using cross sections prepared for the locations shown in plan view on Figure 1. The representative cross sections used for the Upper Reservoir and Lower Reservoir seepage analyses are shown on Figures 2 through 5.

Hydraulic Conductivity

The estimates of hydraulic conductivity for the various geologic materials present at the site were developed based on the available results of field permeability tests, laboratory permeability tests, correlations with published values based on material descriptions and gradations, and empirical correlations between grain size and permeability. The hydraulic conductivity values used in the seepage analyses are presented in Table 1.

Table 1. Summary of Material Hydraulic Conductivities

Material	Hydraulic Conductivity (centimeters/sec)	Hydraulic Conductivity (feet/sec)	Conductivity Ratio
Rock – Upper Reservoir (moderately fractured)	1.00E-04	3.28E-06	1.00
Rock – Lower Reservoir (slightly fractured)	1.00E-05	3.28E-07	1.00
Sand	5.00E-03	1.64E-04	0.25
Clay (sandy)	1.00E-05	3.28E-07	1.00
Liner - (fine tailings)	2.16E-06	7.09E-08	1.00

The value for hydraulic conductivity of the rock in the Lower Reservoir was based on packer pressure testing conducted in 5 boreholes (borings 2, 3, 5A, 11 and 12). None of these boreholes were located within the Lower Reservoir, but are considered to be representative of the rock unit surrounding and within the reservoir. The calculated hydraulic conductivities ranged from 1 x 10-6 cm/s (centimeters/second) to 1 x 10-4 cm/s, with a geometric mean of 1 x 10-5 cm/s. The geometric mean was selected to represent the rock at the Lower Reservoir. Based on boreholes CH-10 (located in Upper Reservoir) and CH-5A (located on rim of Lower Reservoir), the rock at higher elevations is considered to be more fractured, which typically increases the hydraulic conductivity. Because the rock at the Upper Reservoir is considered to be more fractured than the rock in the Lower Reservoir, the hydraulic conductivity was increased by an order of magnitude to account for increased fracturing.

The alluvial deposits will have the highest conductivity and are represented by the sand category in Table 1. The hydraulic conductivity used for the sand category was based on the average of 17 empirical correlations between grain size and permeability. The range of hydraulic conductivities for the sand category was between 1 X 10-2 cm/s to 1 X 10-5 cm/sec, with an average of 5.0 X 10-3 cm/s.

The hydraulic conductivity used for the clay layer was based on an average of two laboratory permeability tests, which gave a value of 1.0 X 10-5 cm/s. Estimates of hydraulic conductivities for the fine tailings liner were based on an average of field and laboratory permeability tests. The results of field permeability tests on the fine tailings ranged from 9.2 X 10-9 to 4.3 X 10-7cm/s; laboratory permeability test yielded results between 5.8 X 10-9 to 8.2 X 10-6 cm/s. The average hydraulic conductivity from these field and laboratory tests was 2.16 X 10-6 cm/s. This averaged hydraulic conductivity value was adjusted proportionally to evaluate varying thicknesses of the liner. Calculations for the hydraulic conductivity used for the various materials are presented in the Appendix.

West-East Profile Analysis Results

Seepage flow rates and gradients were estimated for both the Upper and Lower Reservoirs of the Eagle Mountain Pumped Storage Project at both the minimum and maximum water surface elevations. Seepage flow rates were also estimated using liner thicknesses of 3, 5, and 8 feet for both reservoirs, at minimum and maximum water storage elevations. The seepage blankets would only be placed on the reservoir floors and on zones of the reservoir basin slopes where ground slopes are flat enough to support stable fill placement under rapid draw-down reservoir conditions. For the initial analyses, only seepage blankets were considered. Other treatment measures to reduce reservoir seepage are described later in this memorandum.

The seepage flow rates were determined based on a unit width of the geologic section. To estimate the total seepage rate for the entire reservoir, the unit width seepage rate was multiplied by the average top width for that water surface elevation. The minimum and maximum average top widths for the two reservoirs are shown in Table 2.

Table 2. Reservoir Water Surface Elevation Average Top Widths

Reservoir	Minimum Water Surface Elevation Average Top Width (feet)	Maximum Water Surface Elevation Average Top Width (feet)	Average Top Width Used for Average Annual Seepage Calculations (feet)
Central Pit Upper Reservoir	595	1485	1040
East Pit Lower Reservoir	680	1100	890

The estimated unit width seepage quantities and average annual seepage volumes for the Upper Reservoir are presented in Table 3. Seepage quantities and volumes for the Upper Reservoir with various liner options are also shown in Table 3. The resultant groundwater levels from seepage of the Upper Reservoir at maximum water surface elevation are shown on Figure 6.

Table 3. Upper Reservoir Seepage Analysis Results – Seepage Blanket Only

	Parameter	Max.	Min.	Average
NO LINER	Unit Width Seepage Rate (cfs)	0.00195	0.00124	0.00160
	Annual Seepage (ac-ft/yr)	2097	535	**1202**

3' THICK LINER	Unit Width Seepage Rate (cfs)	0.00178	0.00106	0.00142
	Annual Seepage (ac-ft/yr)	1913	456	**1068**
5' THICK LINER	Unit Width Seepage Rate (cfs)	0.00174	0.00091	0.00133
	Annual Seepage (ac-ft/yr)	1874	394	**1000**
8' THICK LINER	Unit Width Seepage Rate (cfs)	0.00170	0.00070	0.00120
	Annual Seepage (ac-ft/yr)	1823	303	**903**

cfs – cubic feet per second ac-ft/yr – acre-feet per year
Max. – Maximum Min. – Minimum

The estimated unit width seepage quantities and average annual seepage volumes for the Lower Reservoir are presented in Table 4. Seepage quantities and volumes for the Lower Reservoir with various liner options are also shown in Table 4. The resultant groundwater levels from seepage of the Lower Reservoir at maximum water surface elevation are shown on Figure 7. The remaining computer outputs of the analyses are included in the Appendix.

Table 4. Lower Reservoir Seepage Analysis Results – Seepage Blanket Only

	Parameter	**Max.**	**Min.**	**Average**
NO LINER	Unit Width Seepage Rate (cfs)	0.00356	0.00181	0.00269
	Annual Seepage (ac-ft/yr)	2836	891	**1731**
3' THICK LINER	Unit Width Seepage Rate (cfs)	0.00348	0.00177	0.00262
	Annual Seepage (ac-ft/yr)	2768	871	**1690**
5' THICK LINER	Unit Width Seepage Rate (cfs)	0.00347	0.00175	0.00261
	Annual Seepage (ac-ft/yr)	2765	863	**1683**
8' THICK LINER	Unit Width Seepage Rate (cfs)	0.00347	0.00175	0.00261
	Annual Seepage (ac-ft/yr)	2764	860	**1681**

cfs – cubic feet per second ac-ft/yr – acre-feet per year
Max. – Maximum Min. – Minimum

Based on the seepage analyses of the Eagle Mountain Pumped Storage Project and assuming no reservoir seepage treatments, the estimated annual average seepage volume from the Upper Reservoir is approximately 1,200 acre-feet, and the estimated annual average seepage volume from the Lower Reservoir is approximately 1,700 acre-feet. The estimated annual seepage volume for the Lower Reservoir is about 500 acre-feet more than the Upper Reservoir because the eastern wall of the Lower Reservoir primarily consists of alluvial sediments and debris flow deposits, which have significantly higher hydraulic conductivities.

Based on the seepage analysis, the fine tailings blanket liner options for the Upper Reservoir reduce the average annual seepage volume. The estimated reduction in average annual seepage volume for the Upper Reservoir ranged from about 11 to 25 percent, depending on the liner thickness. The maximum reduction for the Upper Reservoir was approximately 300 acre-feet annually, with an eight-foot thick liner in place.

The fine tailings blanket liner in the Lower Reservoir was estimated to be relatively ineffective. This is because the upper half of the walls in the pit, which consist of the alluvium deposit, are too steep to support the fine tailings liner. And, since the majority of seepage from the Lower Reservoir will be through this alluvium deposit, the analyses indicated little change due to the various liner options. The estimated reduction in average annual seepage volume for the Lower Reservoir was about 2.5 percent, regardless of the liner thickness. The maximum reduction for the Lower Reservoir was approximately 50 acre-feet annually, with an eight-foot thick liner constructed where possible. Based on this analysis, additional seepage reduction measures beyond a fine tailings blanket liner will be required for the Lower Reservoir.

North-South Profile Analysis Results

Seepage and ground water elevations along a north-south profile toward the CRA were estimated for both the Upper and Lower Reservoirs of the Eagle Mountain Pumped Storage Project at both the minimum and maximum water surface elevations. The seepage analysis from the proposed Upper Reservoir at maximum water surface elevation is shown on Figure 8. Generally, the maximum water surface elevation in the Upper Reservoir is projected to cause the ground water levels near the location of the CRA to rise approximately 45 feet above the estimated existing ground water levels. Results of the seepage analysis from the proposed Lower Reservoir at maximum water surface elevation are shown on Figure 9. Generally, the maximum water surface elevation in the Lower Reservoir is projected to cause the ground water levels near the location of the CRA to rise approximately 150 feet above the estimated existing ground water levels. The remaining computer outputs of the analyses are included in the Appendix.

Potential Impacts from Reservoir Seepage

Concerns have been raised about the potential impacts of seepage from the reservoirs on the concrete lining of the Colorado River Aqueduct (CRA), which is owned and operated by MWD. The potential impacts to the CRA from reservoir seepage were analyzed using both west-east and north-south profiles for each of the project reservoirs. The impacts of seepage were expected to be the most noticeable in the west-east profiles due to the close proximity of the Lower Reservoir to the CRA; however, the impacts along the north-south profiles were also investigated to fully assess the seepage concerns.

Based on the west-east seepage analysis for the Lower Reservoir, assuming no seepage treatments and continuous seepage at the maximum reservoir water surface elevation, the estimated groundwater elevation near the location of the CRA is estimated to stabilize at approximately El. 915, as shown on Figure 7. The current static groundwater elevation at this location is about at El. 675, which is about 240 feet lower than the modeled ground water surface elevation with fully-developed reservoir seepage. The ground surface elevation near the CRA is approximately El. 1000, which is about 85 feet higher than the groundwater elevation predicted under worse-case conditions for seepage from the Lower Reservoir. Because the estimated ground water elevation is predicted to be well below the ground surface, no uplift forces are predicted on the concrete lining of the CRA.

Based on the north-south seepage analysis of seepage from the Upper and Lower Reservoirs, the Lower Reservoir produced the greatest increases from the estimated ground water elevations; therefore, the Lower Reservoir seepage results were used to analyze the impacts to the CRA facilities. The CRA facilities that could potentially be impacted by reservoir seepage along the north-south profiles include the CRA Pump Station and CRA channel near the pump station, as shown on Figure 1. Based on the north-south seepage analysis from the Lower Reservoir, and assuming no seepage treatments and continuous seepage at the maximum reservoir water surface elevation, the estimated ground water elevation near the location of the CRA is estimated to reach approximately El. 745 feet, as shown on Figure 9. The current static ground water elevation at this location is assumed to be about at El. 580 feet. However, this elevation may be conservatively high, because ground water wells and elevation data are not available at this location, but data was extrapolated to develop a conservative estimate. Therefore, the existing ground water elevation is estimated to be about 165 feet lower than the modeled ground water surface elevation with fully developed reservoir seepage. The ground surface elevation near the CRA is approximately El. 985 feet, which is estimated to be about 240 feet higher than the ground water elevation predicted under worse-case conditions for seepage from the Lower Reservoir. Because the estimated ground water elevation is predicted to be well below the ground surface, no uplift forces are predicted on the concrete lining of the CRA or at the pump station.

In addition, we estimate that the steady-state groundwater profile for the Lower Reservoir shown on Figure 7 will take at least 15 years to fully develop from the estimated seepage volume, assuming a two year filling period and the reservoir remains at the maximum water surface elevation after filling. We also estimate that the steady-state groundwater profiles for the Upper Reservoir shown on Figures 6 and 8 will take at least 50 years to fully develop, assuming a two year filling period and the reservoir remains at the maximum water surface elevation after filling. Furthermore, it is estimated to take at least 30 years for groundwater levels near the Upper Reservoir to reach and daylight at the nearest surface drainage channel. If the groundwater levels do daylight in the adjacent surface drainage channels, any seepage will be collected and conveyed to the Lower Reservoir. However, the reservoirs can never be completely full at the same time, and reservoir levels will cycle up and down in response to energy demands and hydroelectric operations. Realistically, we expect that the estimated steady-state groundwater levels from seepage from the Eagle Mountain Project may not fully develop during the estimated project service life of 50 years.

Hydrocompaction has also been identified as a potential impact that could be associated with seepage from reservoirs of the Eagle Mountain Project. The potential for hydrocompaction in soils is related to the grain size of the sediments and how they were deposited. Fan deposits, such as those present near the project site, when deposited by flash-flood type of events, are highly susceptible to compaction when wetted either from above or below. Under worse-case conditions, our analyses indicate that groundwater levels will be about 80 feet below ground surface and will not reach the near-surface zones where hydrocompaction would be the most problematic.

Studies conducted for MWD in the Chuckwalla Aquifer (Upper Chuckwalla Groundwater Basin StorageGeoPentech 2003) addressed hydrocompaction. The studies suggested that to depths of 100 feet, hydrocompaction could range from 0.56 to 1.8 percent, depending on soil composition. As such, surface subsidence may total from 0.5 to 1.8 feet. Therefore, additional reduction of seepage is needed and seepage recovery wells are needed to reduce hydrocompaction to negligible levels.

Other Seepage Treatment and Monitoring Measures

The Project plans to limit seepage from the project reservoirs to the maximum extent possible. This includes the Upper Reservoir, Lower Reservoir, and the brine disposal ponds[1] that will be part of the water quality management system for the project, which is described in the draft License Application. A more-detailed hydrogeologic analysis will be prepared during final design of the project. We will also undertake detailed geologic mapping of the reservoirs during project design. Upon completion of the hydrogeologic analysis and detailed geologic

[1] The brine ponds will be lined with clay or geomembrane materials, and to the extent that can be realistically achieved, they will be "zero seepage" facilities.

mapping, engineering design solutions will be provided to reduce seepage from the project reservoirs in order to reduce the potential for hydrocompaction and impacts to groundwater levels and water quality.

Seepage control from the project reservoirs will be accomplished using systematic procedures and steps that have been applied successfully at similar projects. These procedures will include the following:

- After access to the site is obtained, a team of geologists and geotechnical engineers will conduct a detailed reconnaissance of the reservoir basins and pond areas to identify zones where leakage and seepage would be expected to occur. These areas will include faults, fissures and cracks in the bedrock, and zones that have direct connection to the alluvial deposits of the Chuckwalla Valley. During the reconnaissance, the team will evaluate the effectiveness of various methods for seepage and leakage control to mitigate the effects of these particular features.

- Seepage and leakage control methods will be further investigated utilizing data from the geologic reconnaissance and hydrogeologic modeling studies. Potential methods for seepage and leakage control will include curtain grouting of the foundation beneath the dam footprint and around the reservoir rim, as needed; backfill concrete placement and/or slush grouting of the faults, fissures and cracks recognized in the field reconnaissance; placement of low permeability materials, as technically feasible, over zones too large to be grouted and over areas of alluvium within the Lower Reservoir; seepage and leakage collection systems positioned based on the results of the hydrogeologic analyses; and clay or membrane lining of the brine ponds associated with the project’s water quality management system. The collection systems would recycle water into the project reservoirs or the RO (reverse osmosis) system.

- Design and construction of the seepage and leakage control measures, which will be aided by the results of the groundwater modeling.

- Design and construction of a comprehensive monitoring program, consisting of observation wells and piezometers that will be used to assess the effectiveness of the seepage and leakage control measures.

- Based on monitoring results, additional actions may be taken to further control leakage and seepage from the reservoirs and ponds. Such measures may include curtain grouting and the expansion of seepage and leakage collection systems.

We modified the seepage model described above to reflect implementation of the above noted measures, in addition to the use of seepage blankets on the bottom and flatter-sloped areas of the two reservoirs. We assumed that the following measures would provide the indicated levels of seepage reduction:

- Grouting measures in fractured bedrock zones are expected to reduce the effective seepage area by 30% in the Upper Reservoir and 20 % in the Lower Reservoir. Grouting in the Lower Reservoir was not assumed to be possible or effective in the exposed alluvium on the eastern end of the reservoir. The percentage reduction due to grouting of fractured bedrock zones was estimated based on rock quality index (RQI) test results from the earlier subsurface exploration programs. The RQI for the top 100 feet of the boreholes was averaged for each reservoir. The percentage reduction was estimated assuming 100-RQI$_{avg}$ divided by two.

- The exposed alluvium in the eastern portion of the Lower Reservoir extends over a total perimeter distance of approximately 5,000 feet with the maximum depth of approximately 315 feet below the normal water surface elevation. The average slope of the pit walls in this zone is about 3 to 1 (horizontal: vertical), although the upper half of the pit has steep slopes near 1.5 to 1 in inclination. A possible treatment option, which will be investigated during final design for feasibility and effectiveness, would be to blanket the entire zone with a stepped RCC or soil cement overlay. This would reduce the effective seepage area by at least 80%. However, this approach could be very expensive. Therefore, other treatment options will be explored during final design.

Results of these analyses are presented below:

Table 5. Upper Reservoir Seepage Analysis Results – Grouting and Seepage Blanket

	Parameter	**Max.**	**Min.**	**Average**
3' THICK LINER	Unit Width Seepage Rate (cfs)	0.00126	0.00078	0.00102
	Annual Seepage (ac-ft/yr)	1351	338	**768**
5' THICK LINER	Unit Width Seepage Rate (cfs)	0.00124	0.00072	0.00098
	Annual Seepage (ac-ft/yr)	1332	310	**738**
8' THICK LINER	Unit Width Seepage Rate (cfs)	0.00122	0.00061	0.00092
	Annual Seepage (ac-ft/yr)	1308	265	**689**

cfs – cubic feet per second ac-ft/yr – acre-feet per year
Max. – Maximum Min. – Minimum

Table 6. Lower Reservoir Seepage Analysis Results – Grouting, Seepage Blanket and RCC or Soil Cement Treatment over the Alluvium

	Parameter	**Max.**	**Min.**	**Average**
3' THICK LINER	Unit Width Seepage Rate (cfs)	0.00206	0.00135	0.00171
	Annual Seepage (ac-ft/yr)	1641	665	**1099**
5' THICK LINER	Unit Width Seepage Rate (cfs)	0.00170	0.00106	0.00138
	Annual Seepage (ac-ft/yr)	1358	521	**890**
8' THICK LINER	Unit Width Seepage Rate (cfs)	0.00131	0.00090	0.00111
	Annual Seepage (ac-ft/yr)	1045	443	**713**

cfs – cubic feet per second ac-ft/yr – acre-feet per year
Max. – Maximum Min. – Minimum

Based on the seepage analysis of the Upper Reservoir, the grouting of rock fractures could potentially reduce seepage from the reservoir an additional 200 to 300 acre-feet depending on the fine tailings blanket liner thickness. The estimated total reduction in average annual seepage volume from the Upper Reservoir, using both grouting and blanket liner, ranged from about 36 to 41 percent, depending on the liner thickness. The maximum reduction for the Upper Reservoir was approximately 500 acre-feet annually, with an eight-foot thick liner plus grouting in place. The estimated groundwater levels resulting from seepage from the Upper Reservoir utilizing the additional seepage control measures are a minimum of approximately 125 feet lower than the estimated ground surface and are shown on Figure 10 at the average reservoir water surface elevation.

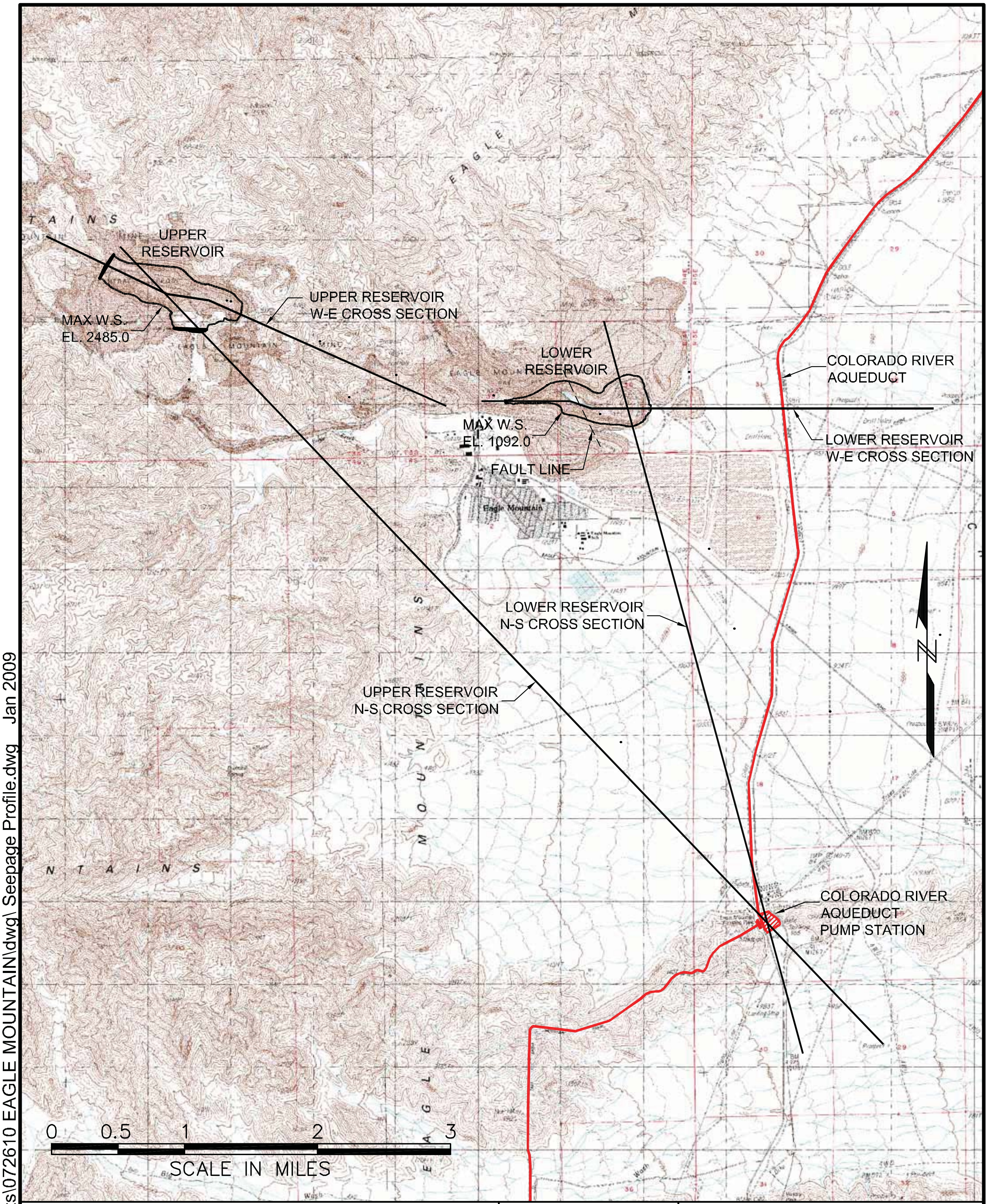
Based on the seepage analysis of the Lower Reservoir, the grouting of rock fractures and RCC or soil cement treatment on the alluvium could potentially reduce seepage from the reservoir an additional 600 to1,000 acre-feet depending on the fine tailings blanket liner thickness. The estimated total reduction in average annual seepage volume from the Lower Reservoir using a blanket liner, grouting rock fractures and treatment of alluvium, ranged from about 37 to 59 percent, depending on the liner thickness. The maximum reduction for the Lower Reservoir was approximately 1,000 acre-feet annually. The estimated groundwater levels resulting from seepage from the Lower Reservoir utilizing the additional seepage control measures are a minimum of approximately 265 feet lower than the estimated ground surface and are shown on Figure 11 at the average reservoir water surface elevation.

We anticipate that any water that may escape the engineered seepage and leakage solutions will be captured by groundwater wells that will be operated to mitigate above-normal hydrostatic pressures on the CRA. The groundwater level control wells will be operated to maintain the groundwater levels within ±5 feet of the historic levels in areas where hydrocompaction could potentially occur and adversely impact the CRA or other infrastructure. The combined pumping from the wells will be about 100 gpm from each of the proposed extraction wells for a total of 900 gpm. These wells will return the intercepted water to the Lower Reservoir. The wells, if found to be needed, will be located based on the results of detailed hydrogeologic modeling studies. Groundwater level and quality monitoring will be performed at monitoring wells and the project's extraction and water supply wells. Groundwater level and water quality sampling will be performed at:

- One up-gradient and 3 to 5 down-gradient wells around each reservoir and the brine disposal pond to detect seepage.
- Nine monitoring wells in the valley sediments to assess changes related to seepage or from project pumping.
- Two residential/municipal wells nearest the project to ensure safe drinking water.
- Extraction wells
- Groundwater levels will initially be monitored on a monthly basis, which may later be extended to quarterly or annual monitoring. Water quality sampling and testing will be performed initially on a quarterly basis.

Based on implementation of the above-noted measures, we believe that our engineering design would mitigate any potential impacts to the CRA. The proposed measures to minimize and collect seepage will help insure that seepage emanating from the reservoirs is returned to the reservoirs prior to reaching the CRA.

Source: GeoPentech, 2003. Upper Chuckwalla Groundwater Basin Storage, Draft Report. Produced for Metropolitan Water District.



Eagle Mountain Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy

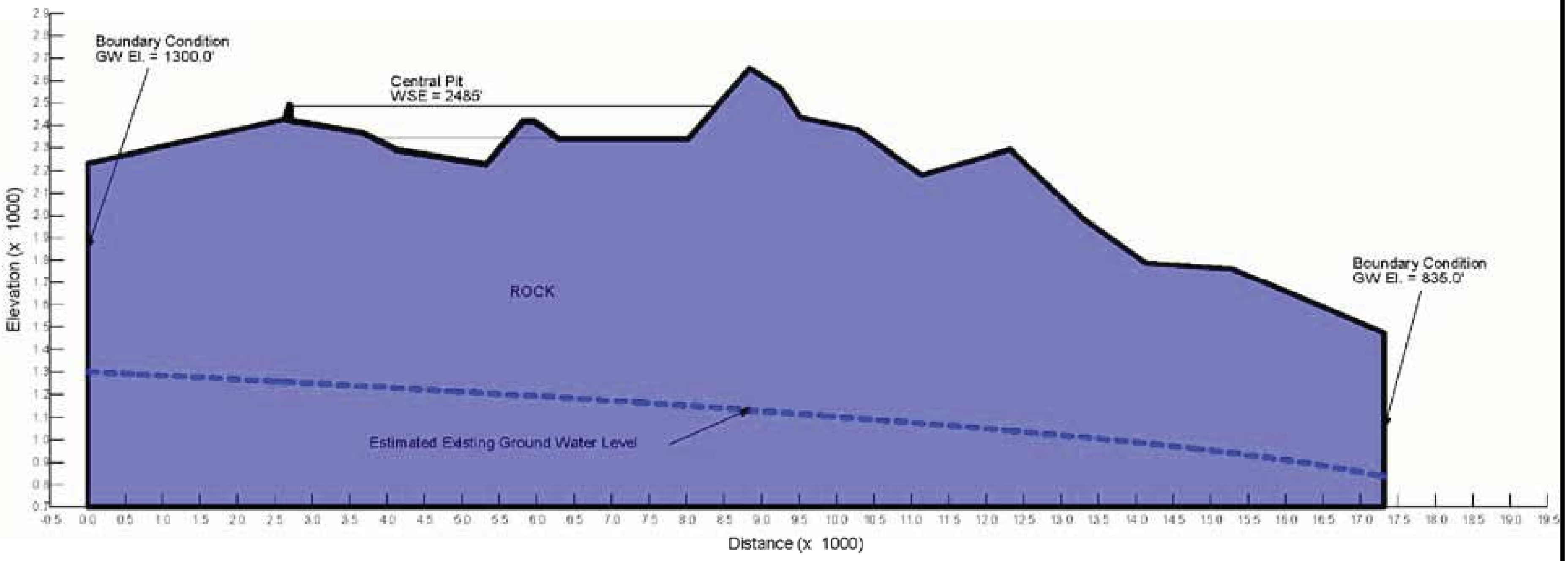
GEI Consultants

Project 080472

PLAN VIEW OF
RESERVOIR GEOLOGIC
CROSS SECTIONS

December 2008 Figure 1

P:\Land Projects\072610 EAGLE MOUNTAIN\dwg\ Seepage Profile.dwg Jan 2009



HYDRAULIC CONDUCTIVITIES:
ROCK = 1.0e-04 cm/s
LINER = 2.2e-06 cm/s

Eagle Mountain Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy

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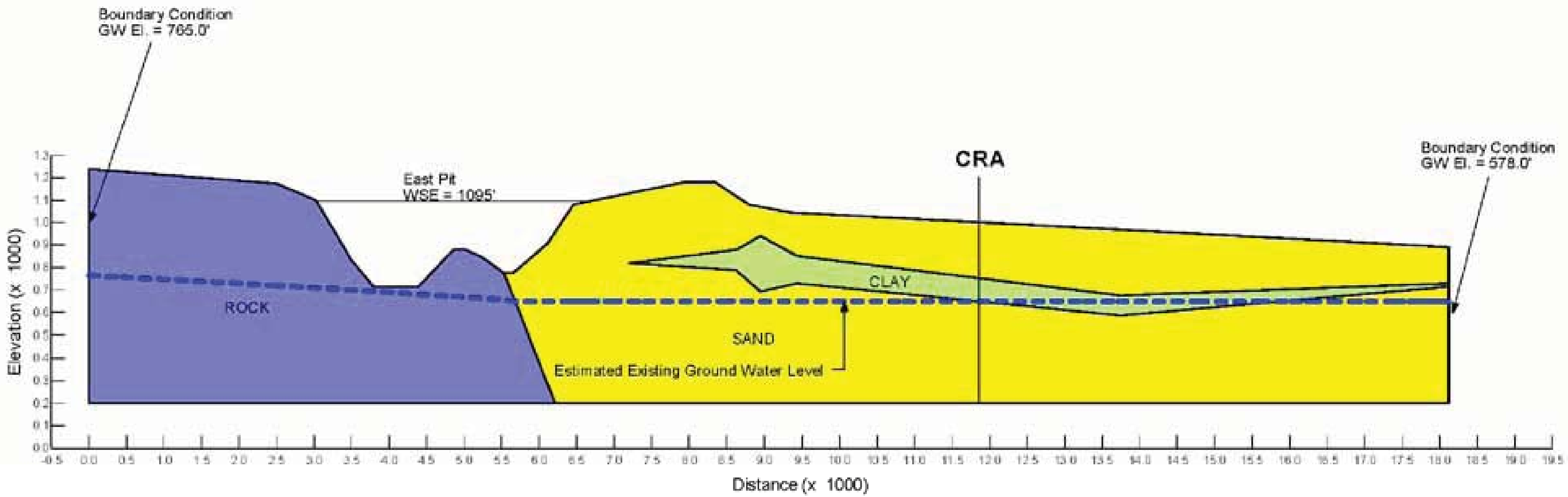
Project 080472

UPPER RESERVOIR
WEST-EAST GEOLOGIC
CROSS SECTION

December 2008

Figure 2



HYDRAULIC CONDUCTIVITIES:
ROCK = 1.0e-05 cm/s
SAND = 5.0e-03 cm/s
CLAY = 1.0e-05 cm/s
LINER = 2.2e-06 cm/s

Eagle Mountain Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy

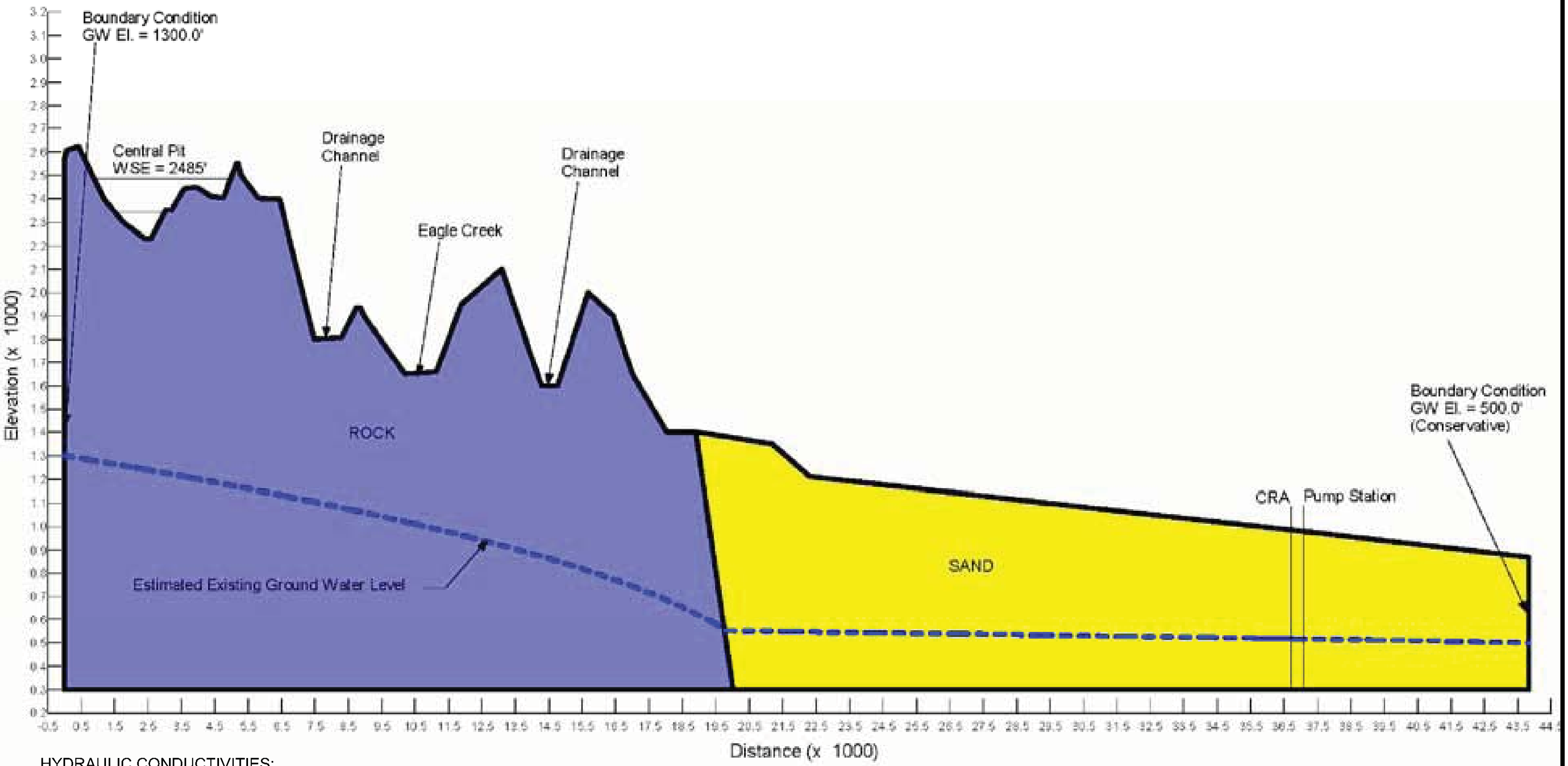
GEI Consultants

Project 080472

LOWER RESERVOIR
WEST-EAST GEOLOGIC
CROSS SECTION

December 2008

Figure 3



HYDRAULIC CONDUCTIVITIES:
ROCK = 1.0e-05 cm/s
SAND = 5.0e-03 cm/s

Eagle Mountain Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy

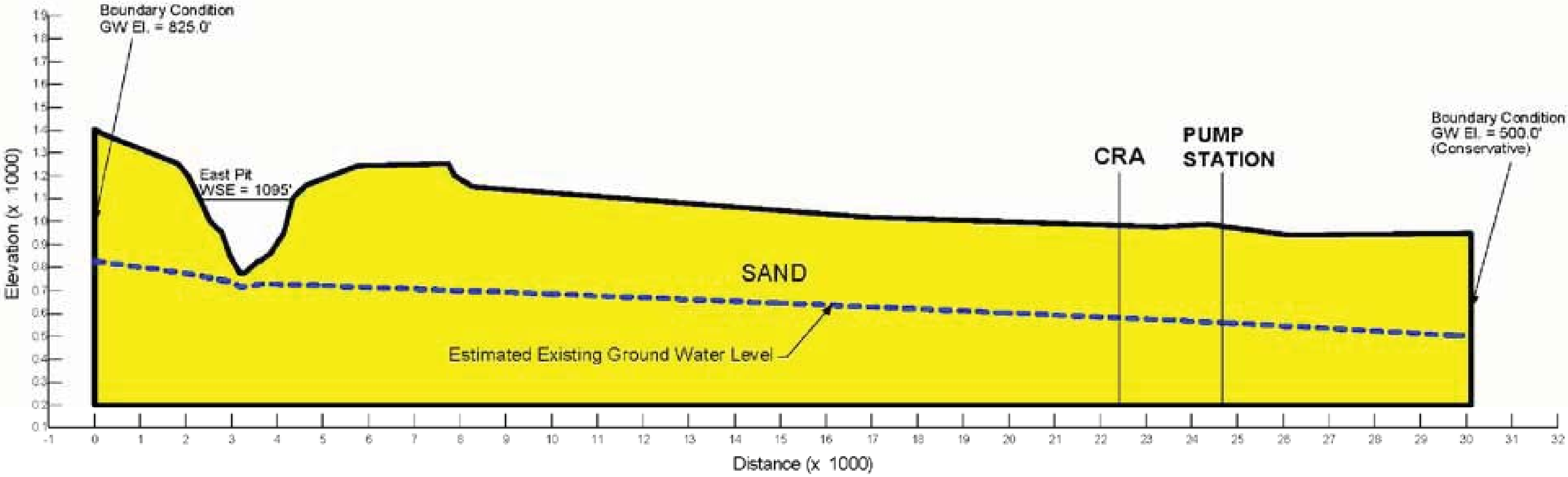
GEI Consultants

Project 080472

UPPER RESERVOIR
NORTH-SOUTH GEOLOGIC
CROSS SECTION

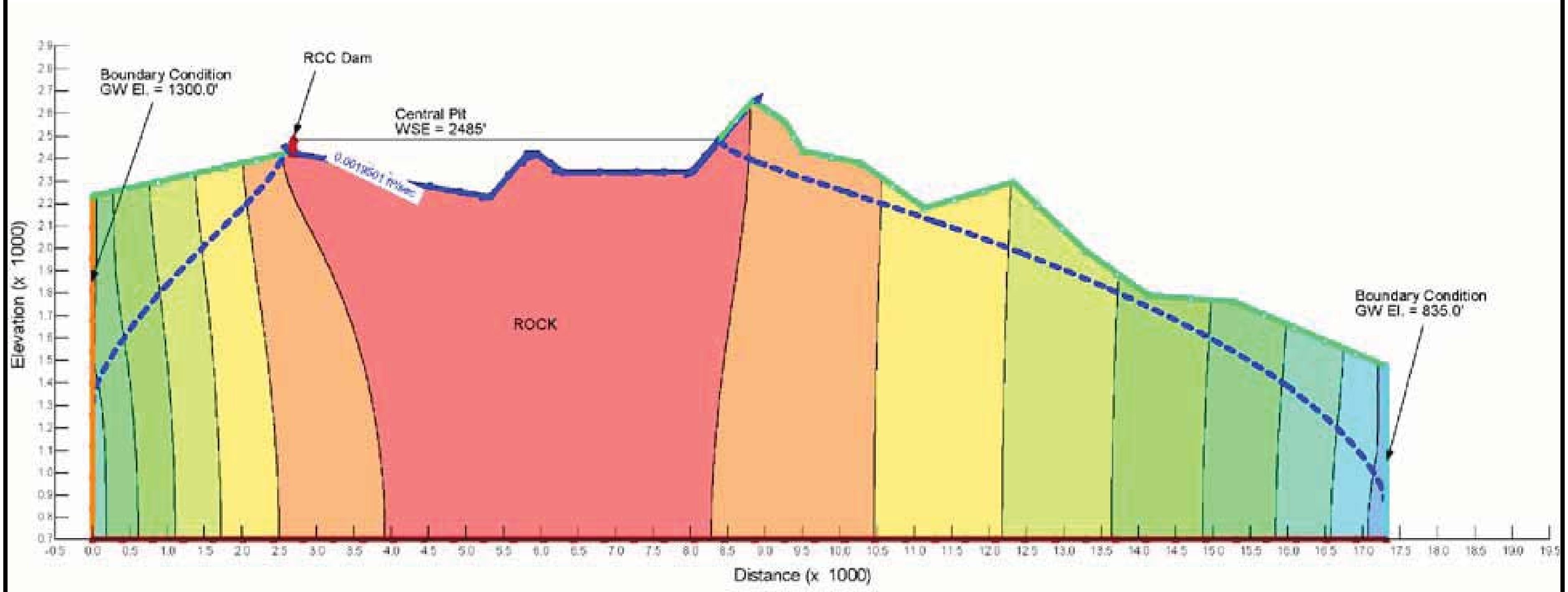
December 2008

Figure 4



HYDRAULIC CONDUCTIVITIES:
SAND = 5.0e-03 cm/s

Eagle Mountain Pumped Storage Project Eagle Mountain, California	GEI Consultants	LOWER RESERVOIR NORTH-SOUTH GEOLOGIC CROSS SECTION
Eagle Crest Energy	Project 080472	December 2008 Figure 5



Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.

Eagle Mountain Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy

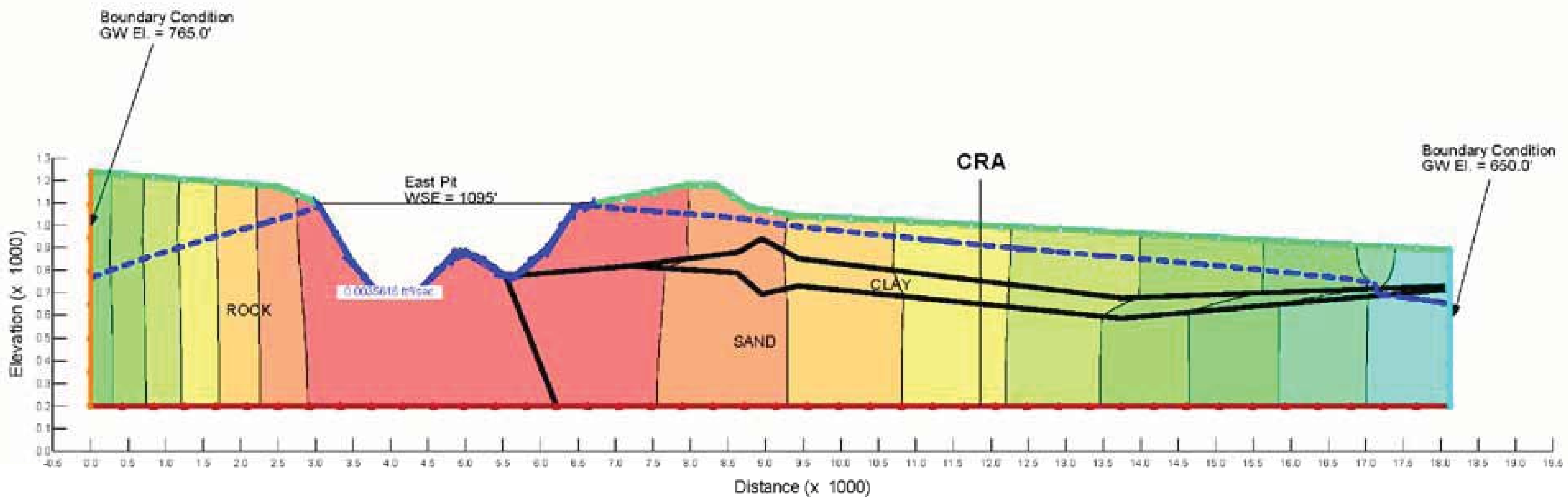
GEI Consultants

Project 080472

UPPER RESERVOIR
MAXIMUM WATER SURFACE
WEST-EAST
SEEPAGE RESULTS

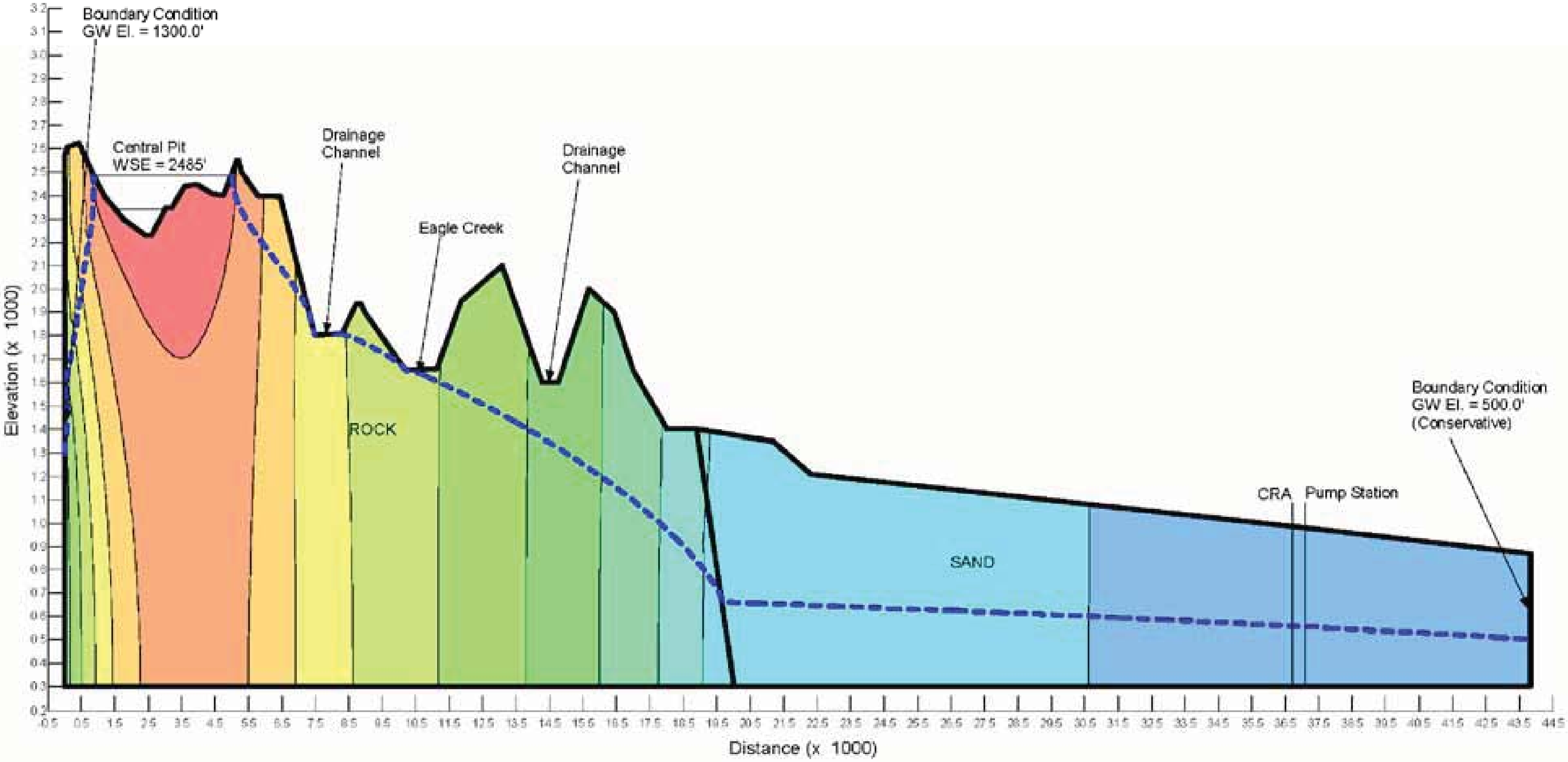
December 2008

Figure 6



Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.

Eagle Mountain Pumped Storage Project Eagle Mountain, California	GEI Consultants	LOWER RESERVOIR MAXIMUM WATER SURFACE WEST-EAST SEEPAGE RESULTS
Eagle Crest Energy	Project 080472	December 2008 Figure 7



<u>Note:</u> The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.

Eagle Mountain Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy

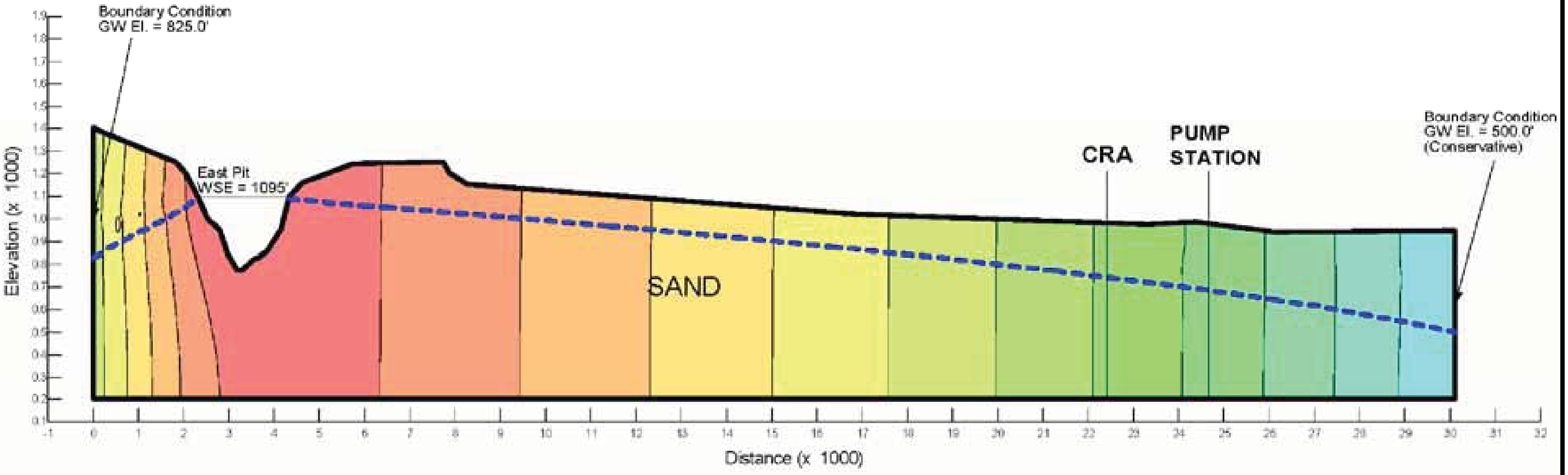
GEI Consultants

Project 080472

UPPER RESERVOIR
MAXIMUM WATER SURFACE
NORTH-SOUTH
SEEPAGE RESULTS

December 2008

Figure 8



Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.

Eagle Mountain Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy

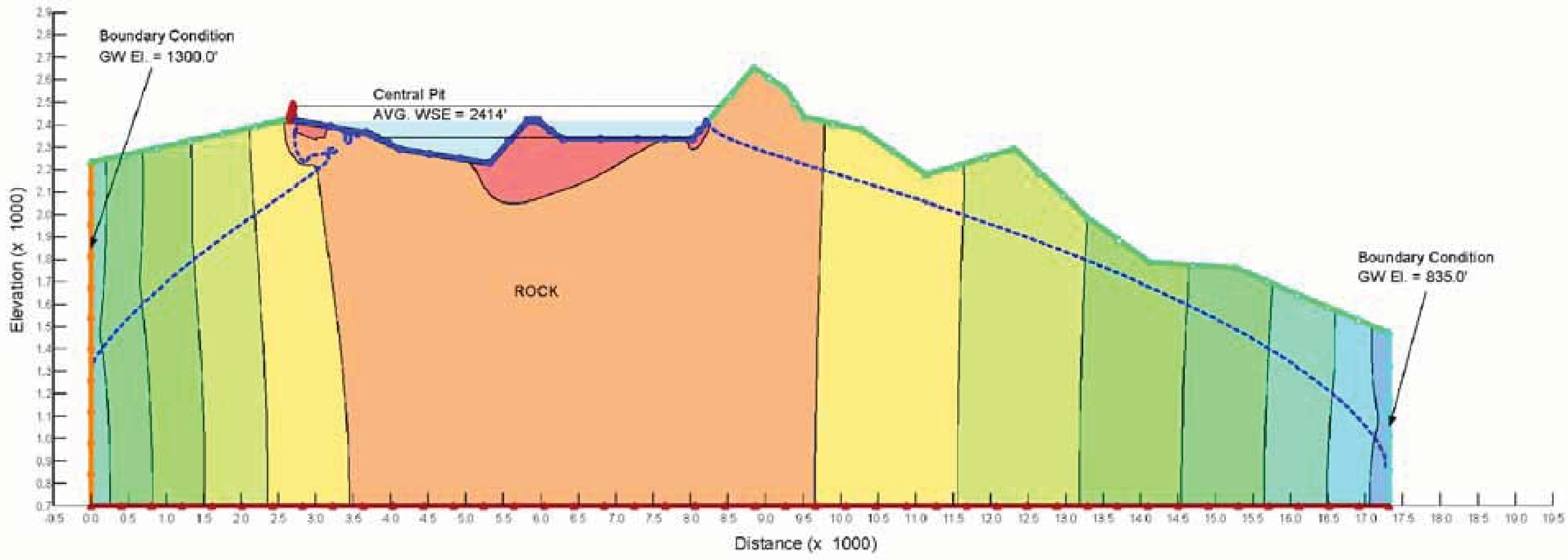
GEI Consultants

Project 080472

LOWER RESERVOIR
MAXIMUM WATER SURFACE
NORTH-SOUTH
SEEPAGE RESULTS

August 2008

Figure 9



Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.

Eagle Mountain Pumped Storage Project
Eagle Mountain, California

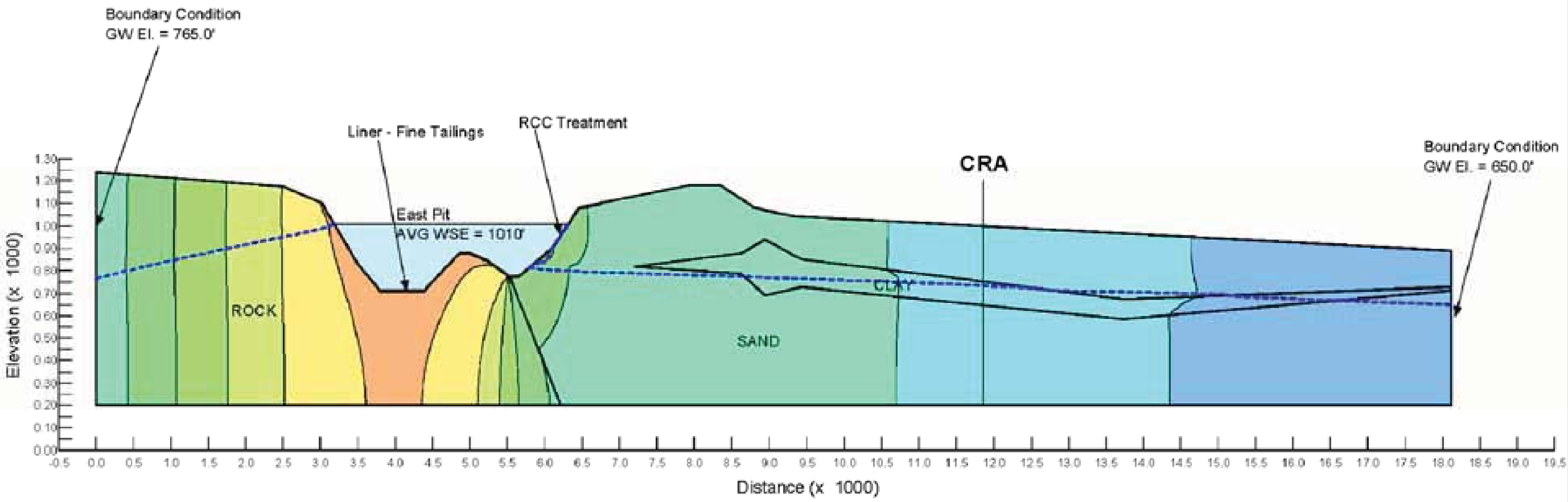
Eagle Crest Energy

GEI Consultants

Project 080472

UPPER RESERVOIR
MAXIMUM SEEPAGE
TREATMENT RESULTS
(AVG. WATER LEVEL)

December 2008 Figure 10



Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.

Eagle Mountain Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy

GEI Consultants

Project 080472

LOWER RESERVOIR
MAXIMUM SEEPAGE
TREATMENT RESULTS
(AVG. WATER LEVEL)

December 2008

Figure 11

APPENDIX

GEI Consultants, Inc.
080470 Eagle Mountain Pumped Storage Project
Reservoir Seepage Analysis (SEEP/W)
9/4/2008
NDM

EAGLE MOUNTAIN - CENTRAL PIT SEEPAGE RESULTS

SEEPAGE BLANKET ONLY

Reservoir Paramters

Max WSE	2485	ft
Min WSE	2343	ft
Max Reservoir WSE Area	48	acres
Min Reservoir WSE Area	191	acres
Max WSE Average Top Width	1485	ft
Min WSE Average Top Width	595	ft
Average Top Width	1040	ft

	Parameter	Max	Min	Average
NO LINER	Unit Width Seepage Rate (cfs)	0.00195	0.00124	0.00160
	Annual Seepage (ac-ft/yr)	2097	535	**1202**
3' THICK LINER	Unit Width Seepage Rate (cfs)	0.00178	0.00106	0.00142
	Annual Seepage (ac-ft/yr)	1913	456	**1068**
5' THICK LINER	Unit Width Seepage Rate (cfs)	0.00174	0.00091	0.00133
	Annual Seepage (ac-ft/yr)	1874	394	**1000**
8' THICK LINER	Unit Width Seepage Rate (cfs)	0.00170	0.00070	0.00120
	Annual Seepage (ac-ft/yr)	1823	303	**903**

GEI Consultants, Inc.
080470 Eagle Mountain Pumped Storage Project
Reservoir Seepage Analysis (SEEP/W)
9/4/2008
NDM

EAGLE MOUNTAIN - CENTRAL PIT SEEPAGE RESULTS

GROUTING AND SEEPAGE BLANKET

Reservoir Paramters

Max WSE	2485	ft
Min WSE	2343	ft
Max Reservoir WSE Area	48	acres
Min Reservoir WSE Area	191	acres
Max WSE Average Top Width	1485	ft
Min WSE Average Top Width	595	ft
Average Top Width	1040	ft

	Parameter	Max	Min	Average
NO LINER	Unit Width Seepage Rate (cfs)	0.00195	0.00124	0.00160
	Annual Seepage (ac-ft/yr)	2097	535	**1202**
3' THICK LINER	Unit Width Seepage Rate (cfs)	0.00126	0.00078	0.00102
	Annual Seepage (ac-ft/yr)	1351	338	**768**
5' THICK LINER	Unit Width Seepage Rate (cfs)	0.00124	0.00072	0.00098
	Annual Seepage (ac-ft/yr)	1332	310	**738**
8' THICK LINER	Unit Width Seepage Rate (cfs)	0.00122	0.00061	0.00092
	Annual Seepage (ac-ft/yr)	1308	265	**689**

GEI Consultants, Inc.
080470 Eagle Mountain Pumped Storage Project
Reservoir Seepage Analysis (SEEP/W)
9/4/2008
NDM

EAGLE MOUNTAIN - EAST PIT SEEPAGE RESULTS

SEEPAGE BLANKET ONLY

Reservoir Paramters

Max WSE	1095	ft
Min WSE	925	ft
Max Reservoir WSE Area	163	acres
Min Reservoir WSE Area	63	acres
Max WSE Average Top Width	1100	ft
Min WSE Average Top Width	680	ft
Average Top Width	890	ft

	Parameter	Max	Min	Average
NO LINER	Unit Width Seepage Rate (cfs)	0.00356	0.00181	0.00269
	Annual Seepage (ac-ft/yr)	2836	891	**1731**
3' THICK LINER	Unit Width Seepage Rate (cfs)	0.00348	0.00177	0.00262
	Annual Seepage (ac-ft/yr)	2768	871	**1690**
5' THICK LINER	Unit Width Seepage Rate (cfs)	0.00347	0.00175	0.00261
	Annual Seepage (ac-ft/yr)	2765	863	**1683**
8' THICK LINER	Unit Width Seepage Rate (cfs)	0.00347	0.00175	0.00261
	Annual Seepage (ac-ft/yr)	2764	860	**1681**

GEI Consultants, Inc.
080470 Eagle Mountain Pumped Storage Project
Reservoir Seepage Analysis (SEEP/W)
9/4/2008
NDM

EAGLE MOUNTAIN - EAST PIT SEEPAGE RESULTS

GROUTING, SEEPAGE BLANKET, AND RCC TREATMENT

Reservoir Paramters

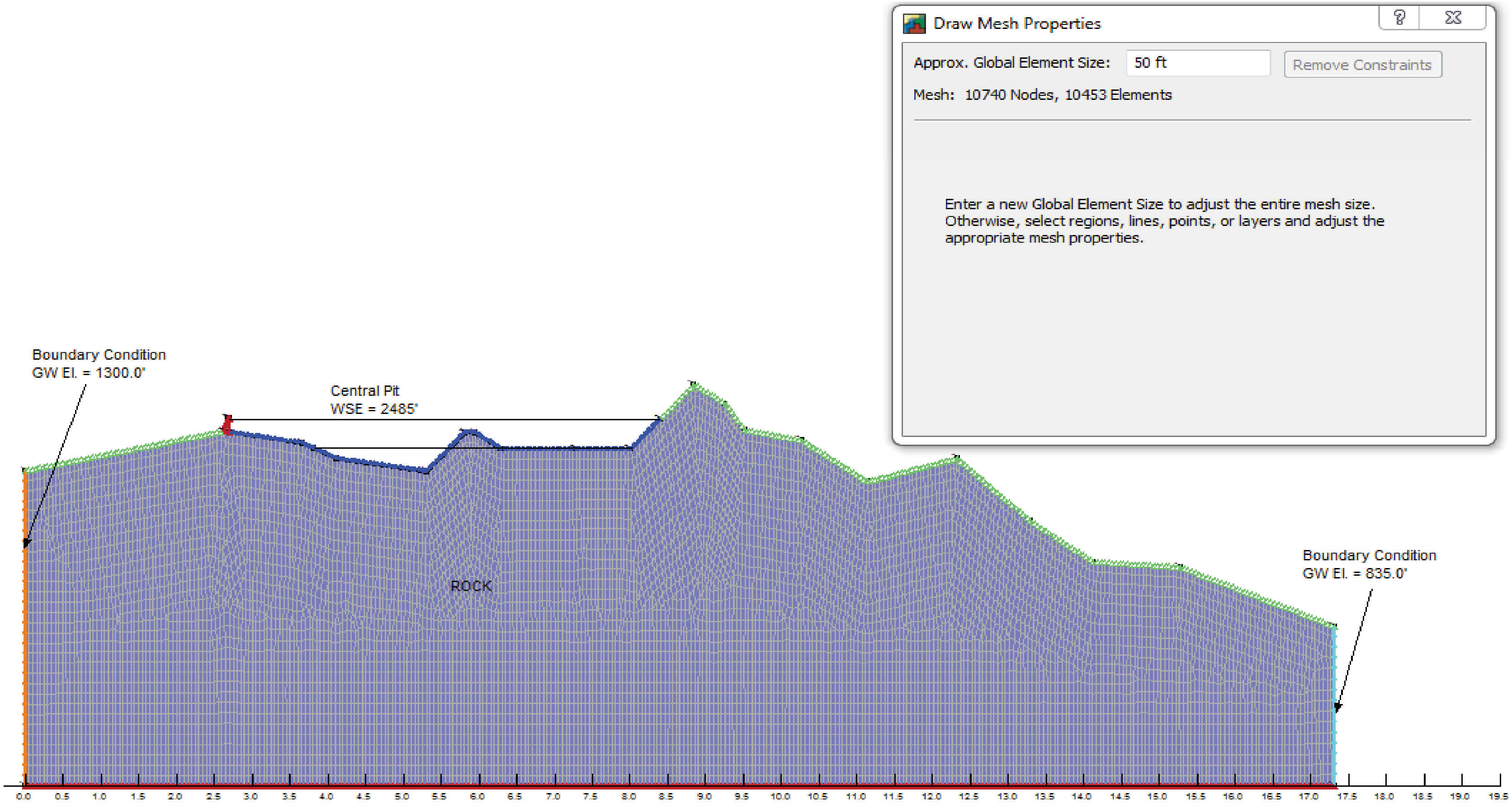
Max WSE	1095	ft
Min WSE	925	ft
Max Reservoir WSE Area	163	acres
Min Reservoir WSE Area	63	acres
Max WSE Average Top Width	1100	ft
Min WSE Average Top Width	680	ft
Average Top Width	890	ft

	Parameter	Max	Min	Average
NO LINER	Unit Width Seepage Rate (cfs)	0.00356	0.00181	0.00269
	Annual Seepage (ac-ft/yr)	2836	891	**1731**
3' THICK LINER	Unit Width Seepage Rate (cfs)	0.00206	0.00135	0.00171
	Annual Seepage (ac-ft/yr)	1641	665	**1099**
5' THICK LINER	Unit Width Seepage Rate (cfs)	0.00170	0.00106	0.00138
	Annual Seepage (ac-ft/yr)	1358	521	**890**
8' THICK LINER	Unit Width Seepage Rate (cfs)	0.00131	0.00090	0.00111
	Annual Seepage (ac-ft/yr)	1045	443	**713**

Eagle Mountain Pumped Storage Project
Upper Reservoir - SEEP/W Output

GEI Consultants, Inc.
080470 Eagle Mountain Pumped Storage Project
Reservoir Seepage Analysis (SEEP/W)
1/4/2011
NDM

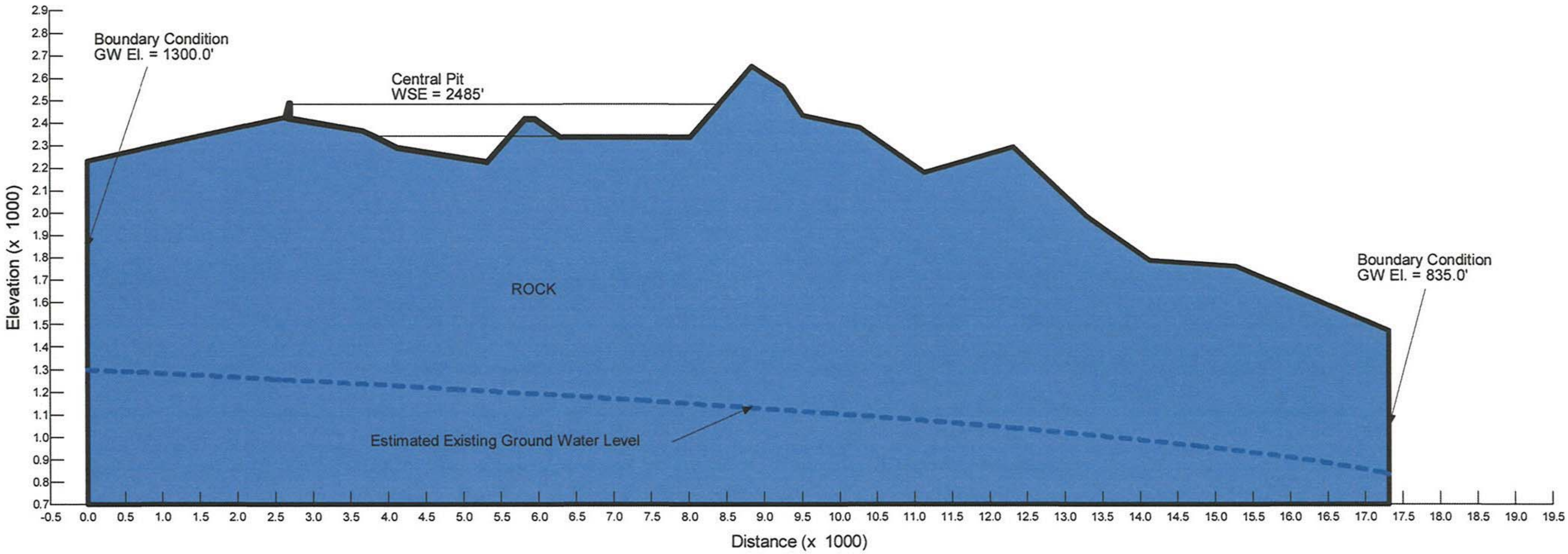
Model Mesh Properties - Upper Reservoir (East-West)


Draw Mesh Properties

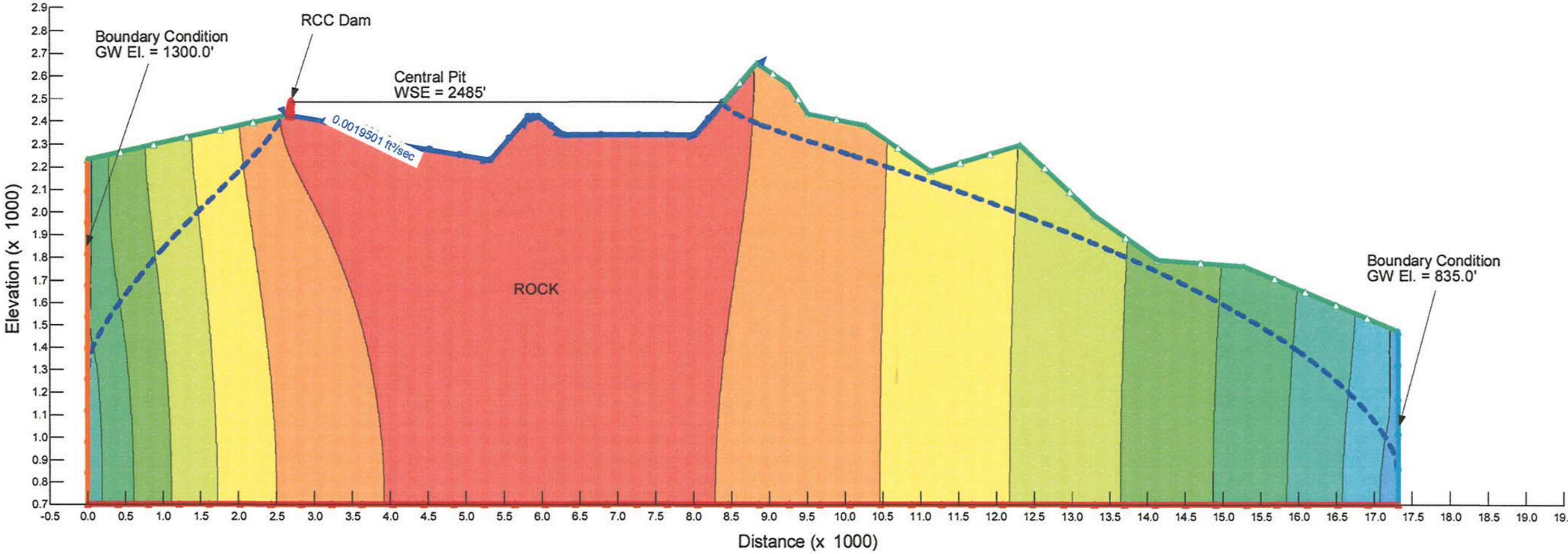
Approx. Global Element Size: 50 ft

Mesh: 10740 Nodes, 10453 Elements

Enter a new Global Element Size to adjust the entire mesh size. Otherwise, select regions, lines, points, or layers and adjust the appropriate mesh properties.

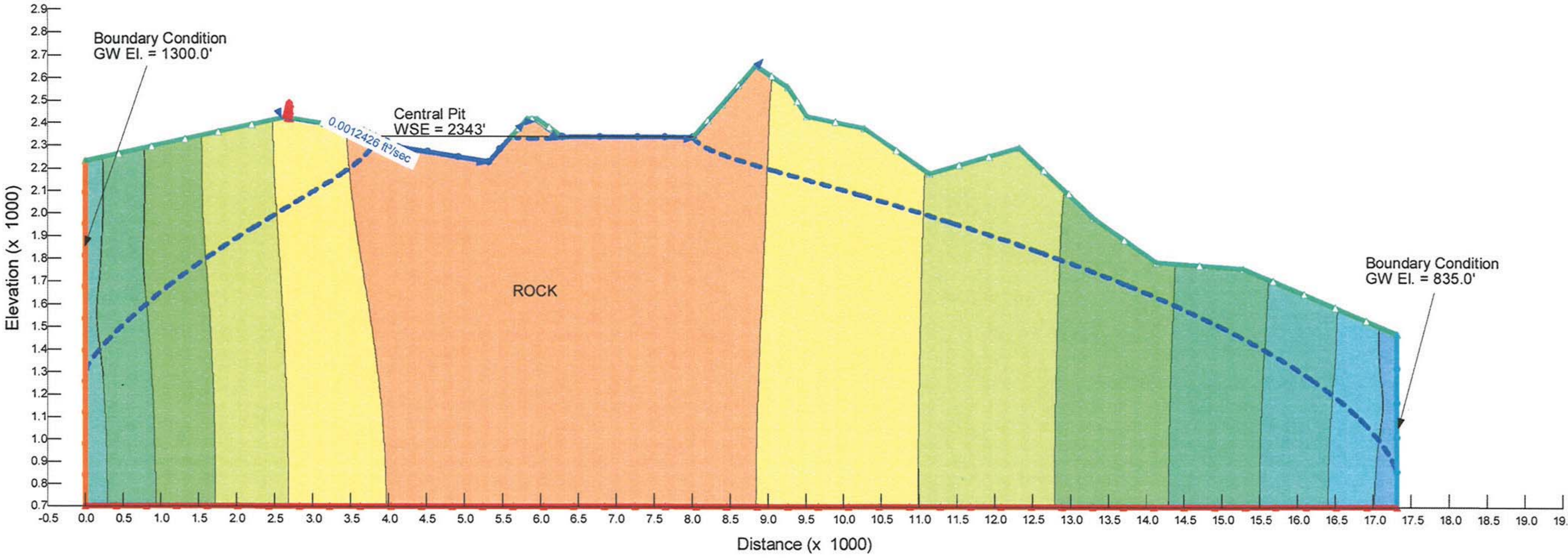


EXISTING CONDITIONS



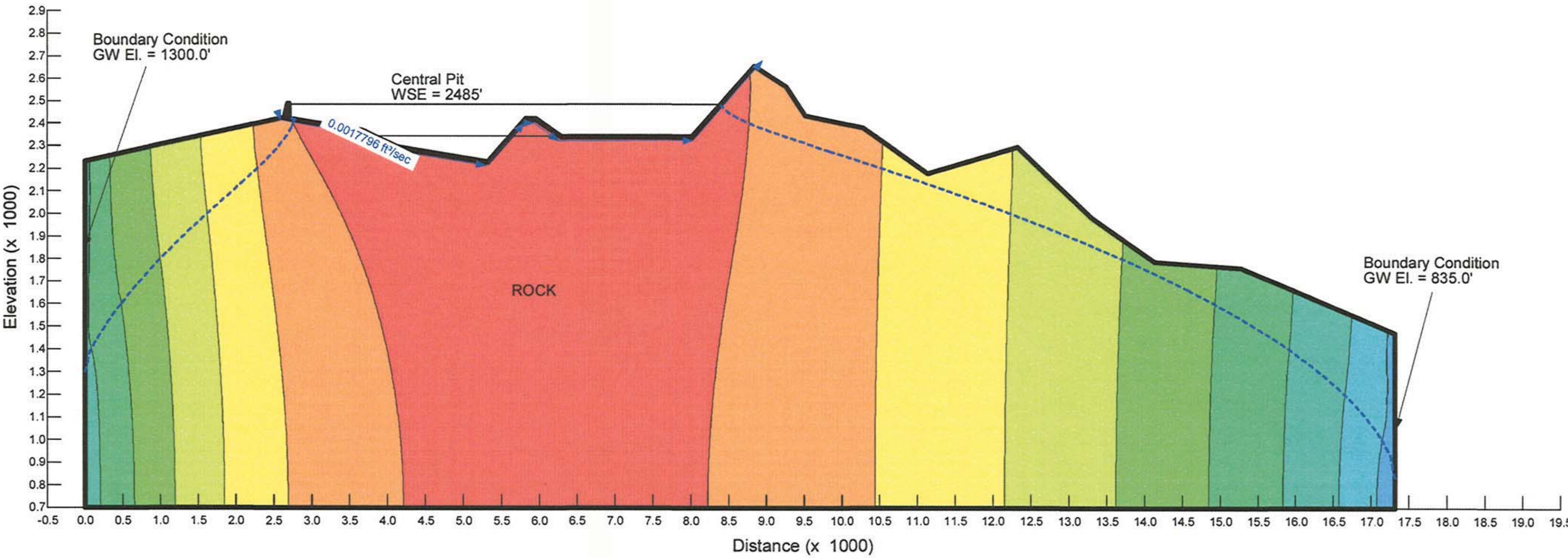
NO LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



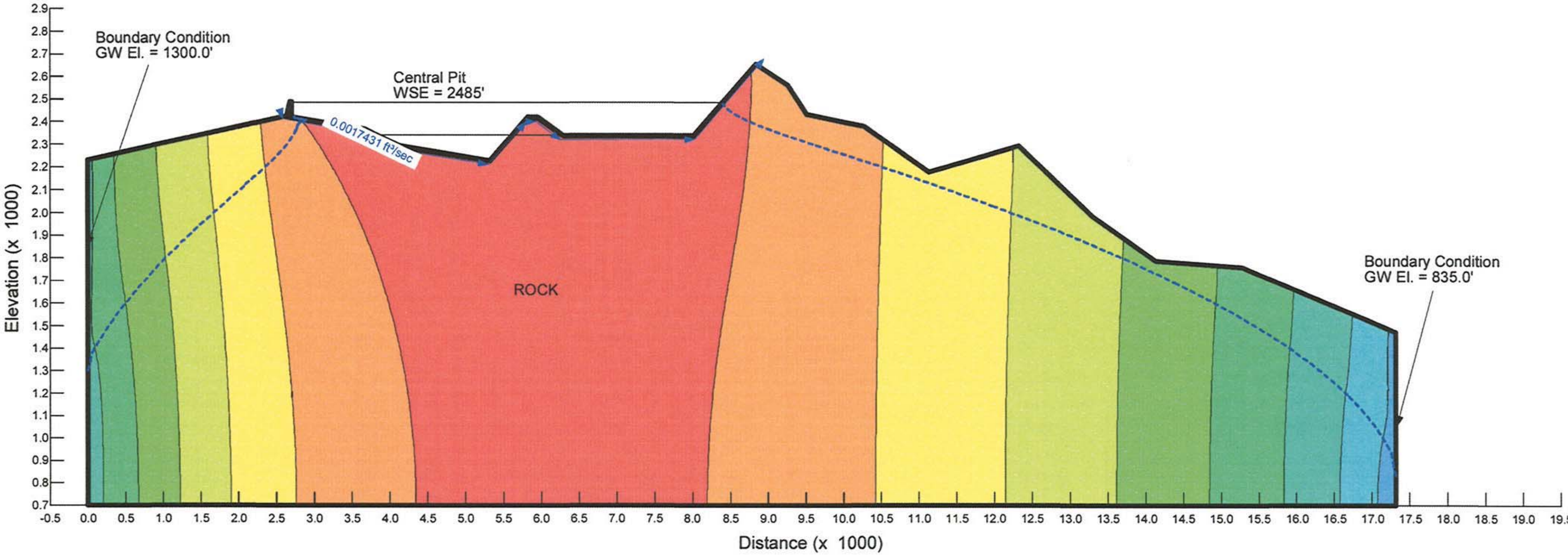
NO LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



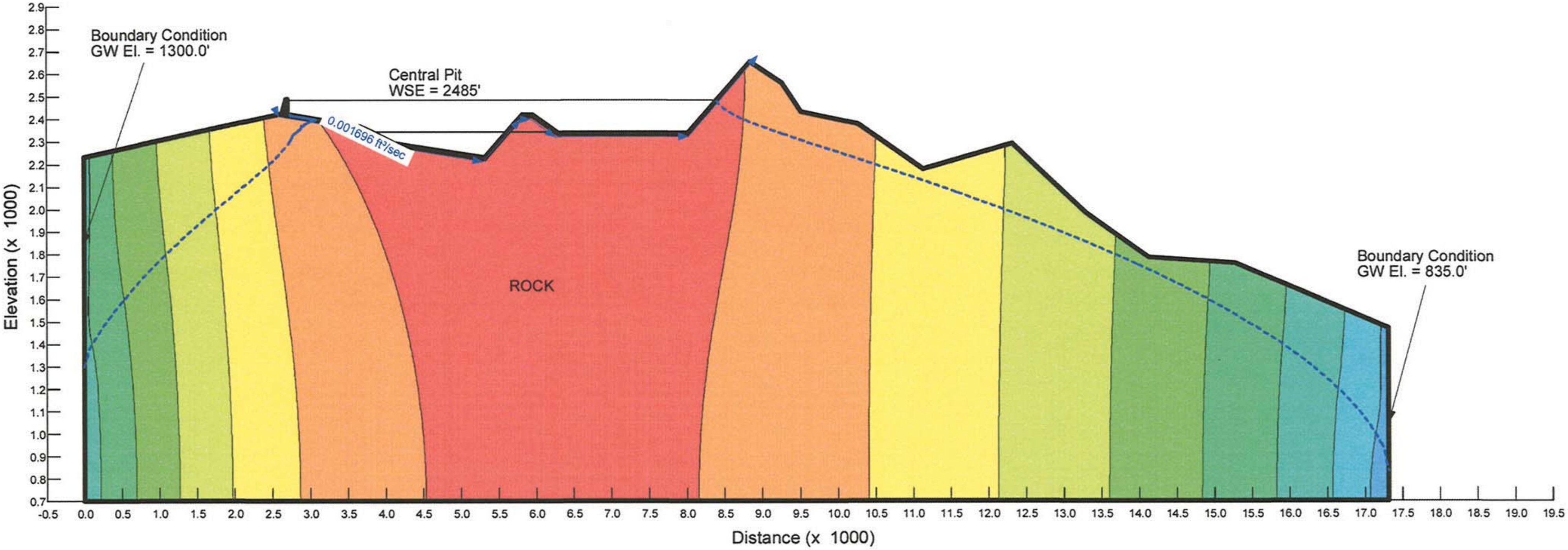
3' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



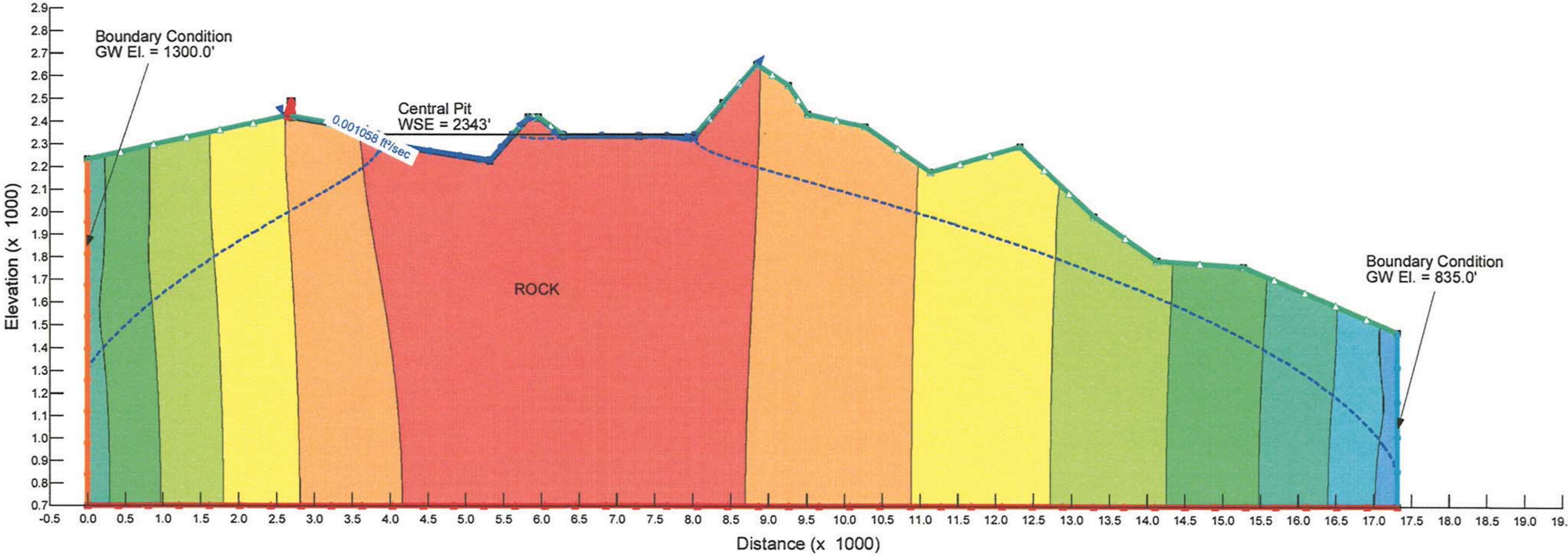
5' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



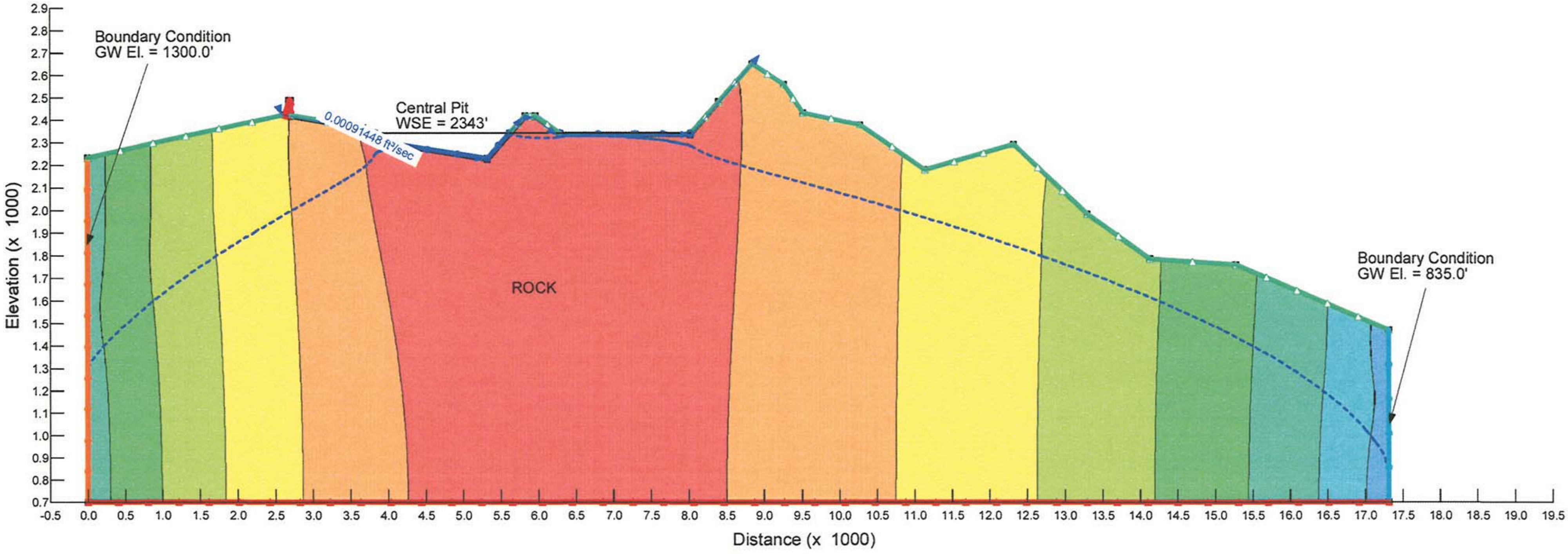
8' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



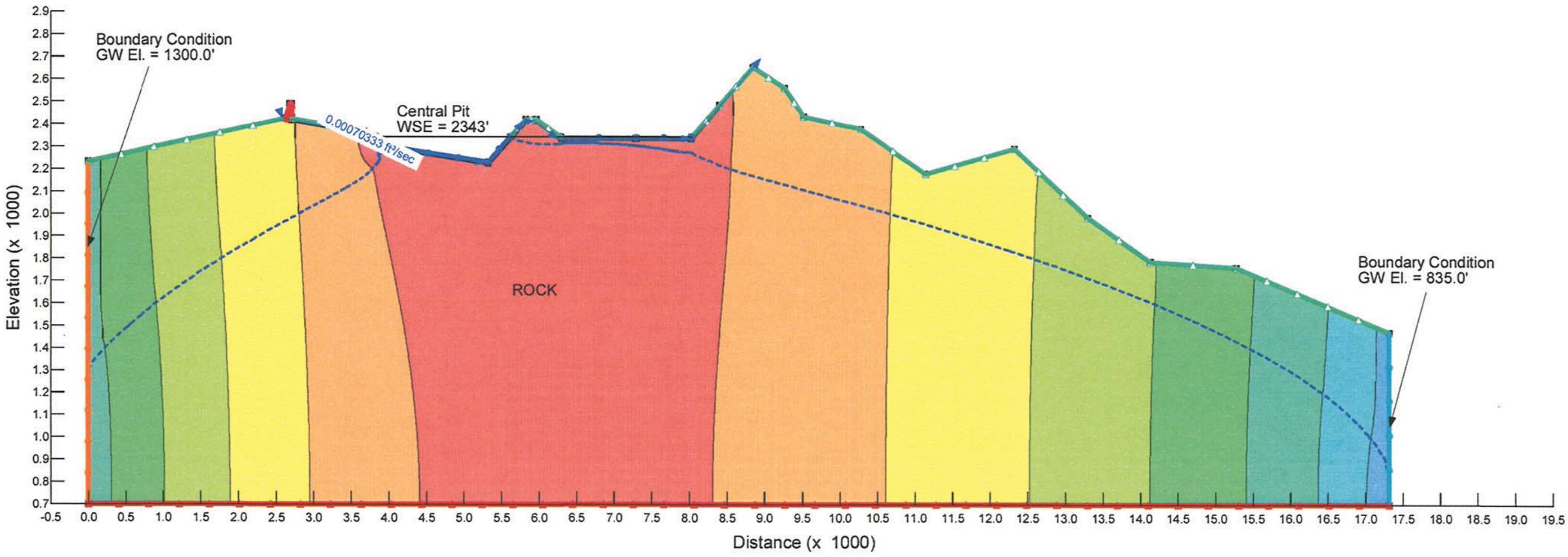
3' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



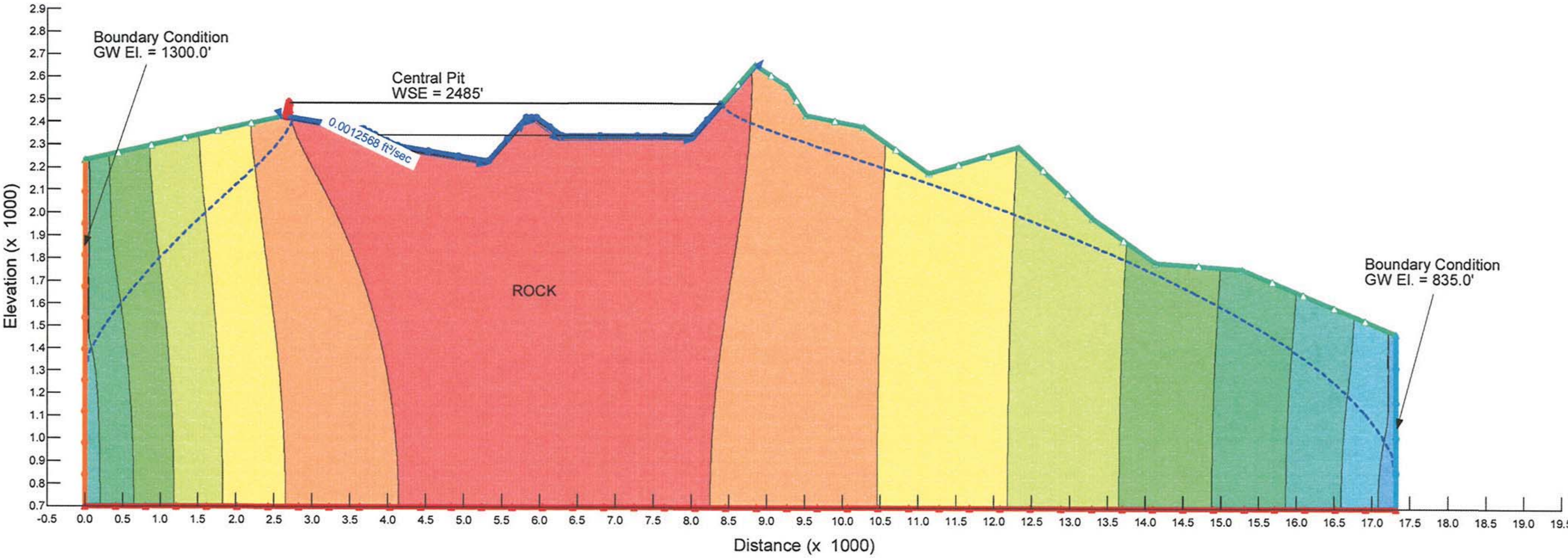
5' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



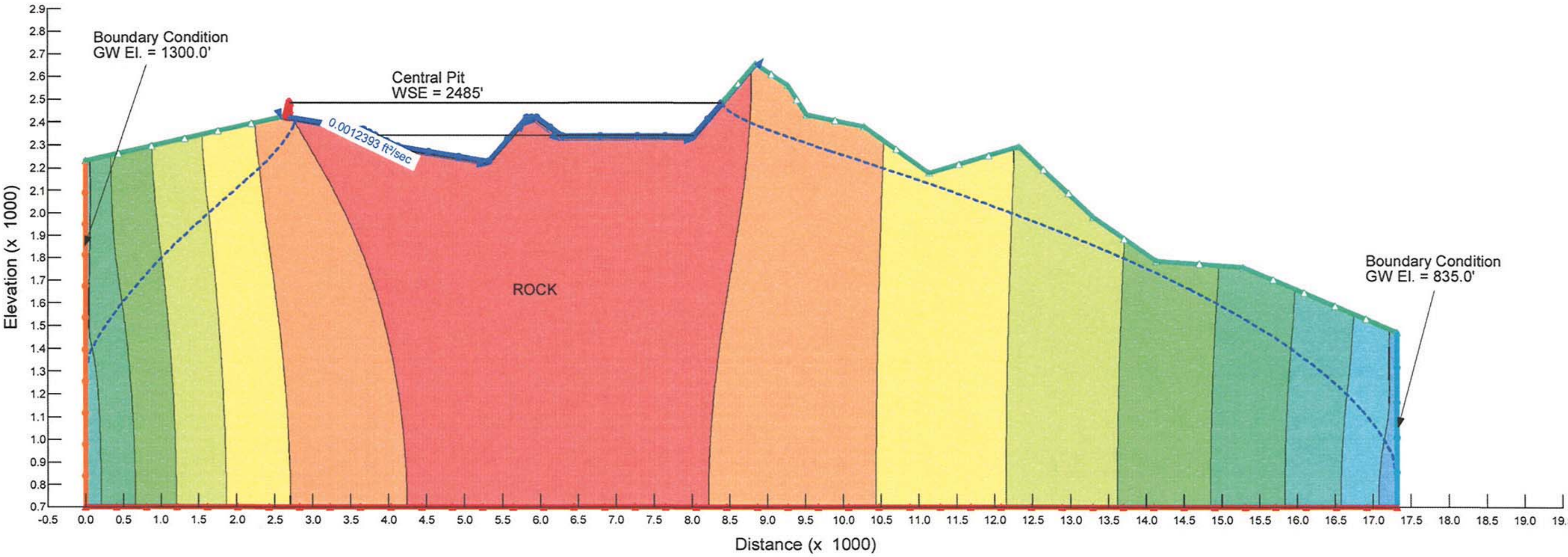
8' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



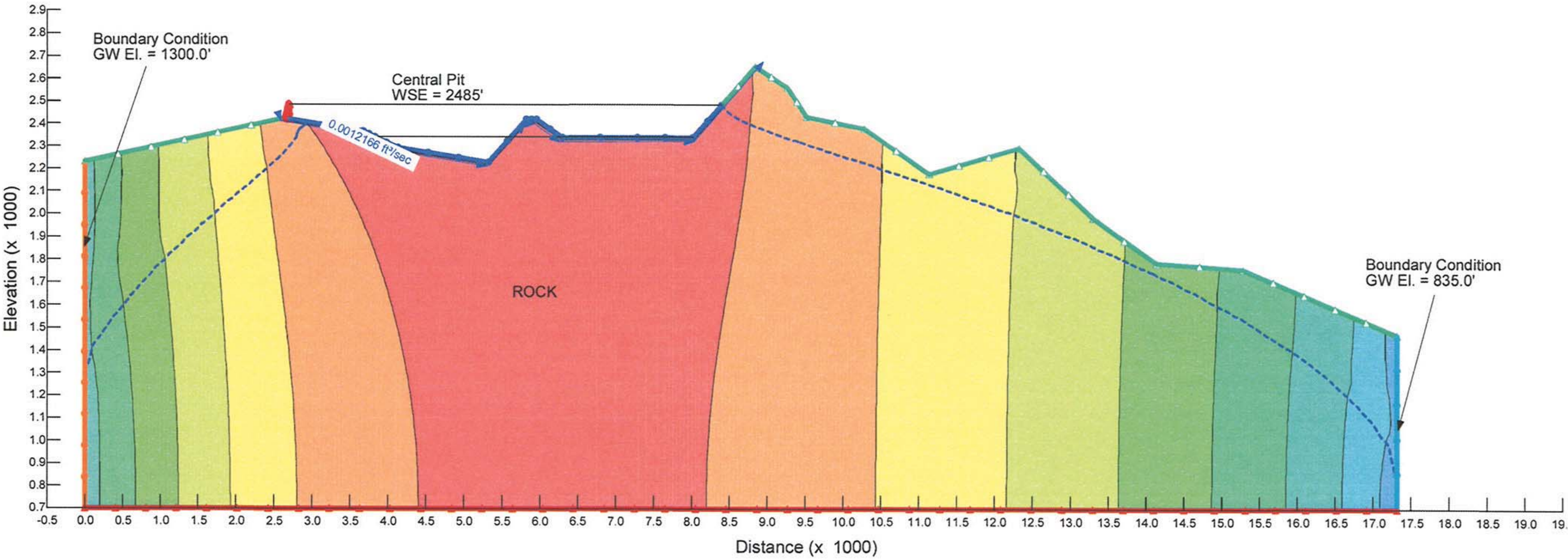
3' LINER W/ GROUTING

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



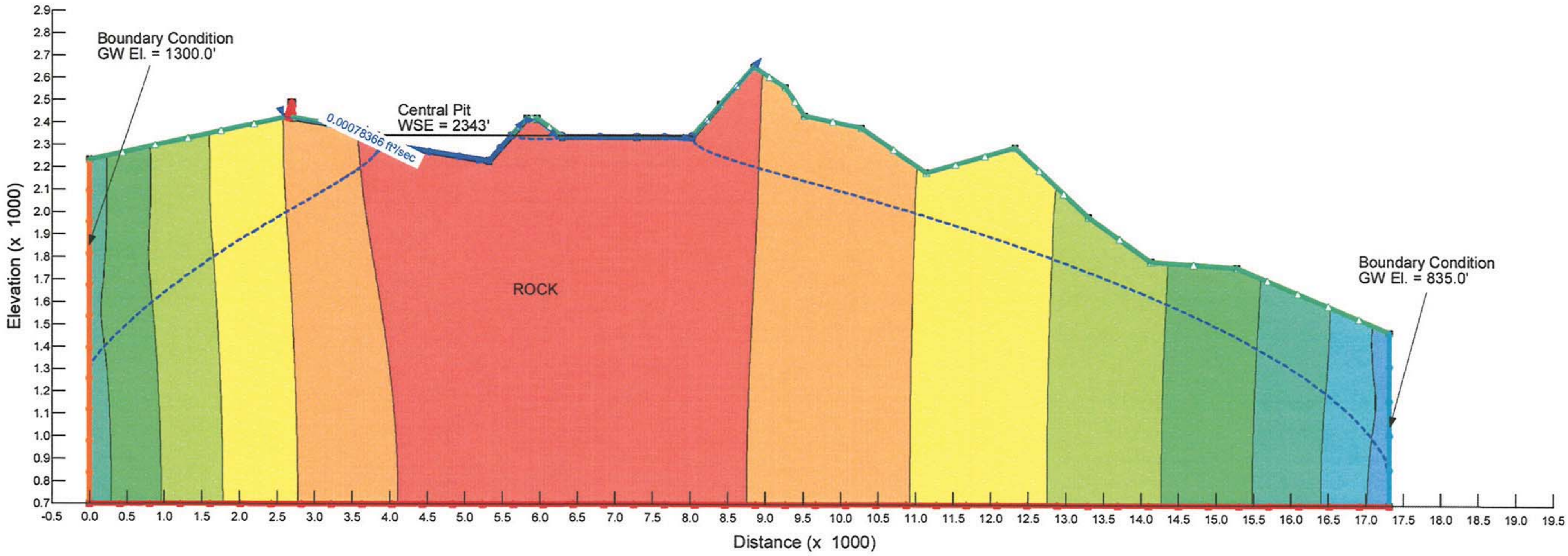
5' LINER W/ GROUTING

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



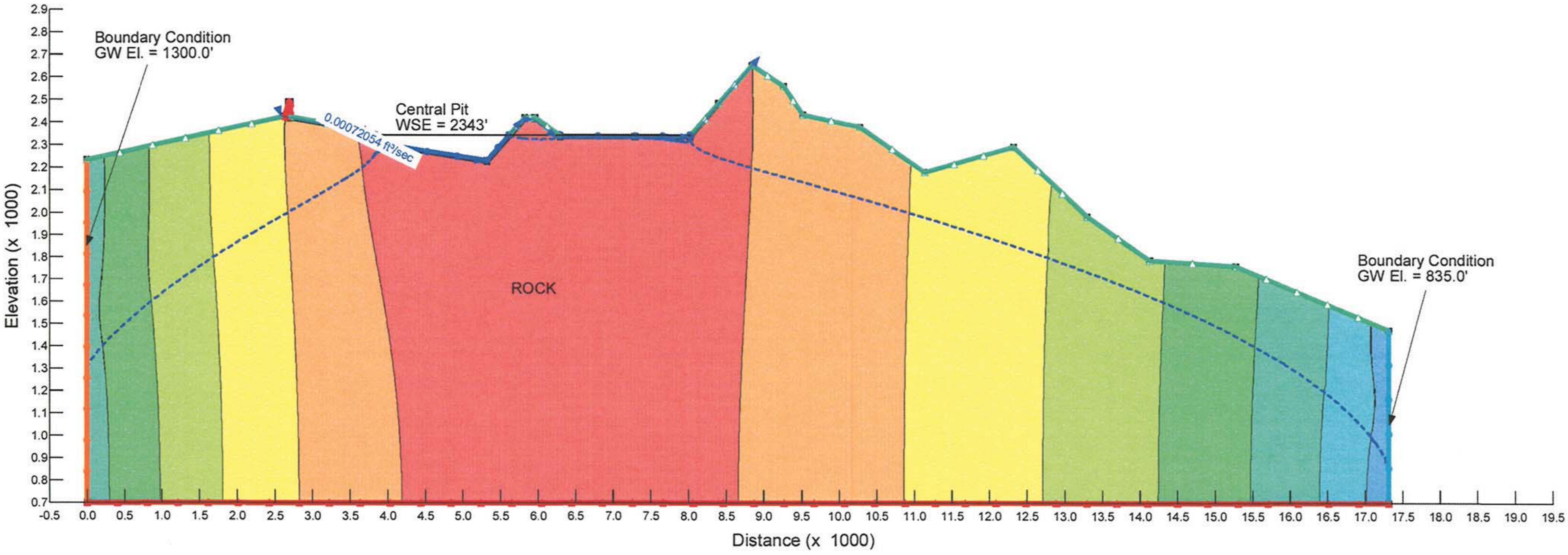
8' LINER W/ GROUTING

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



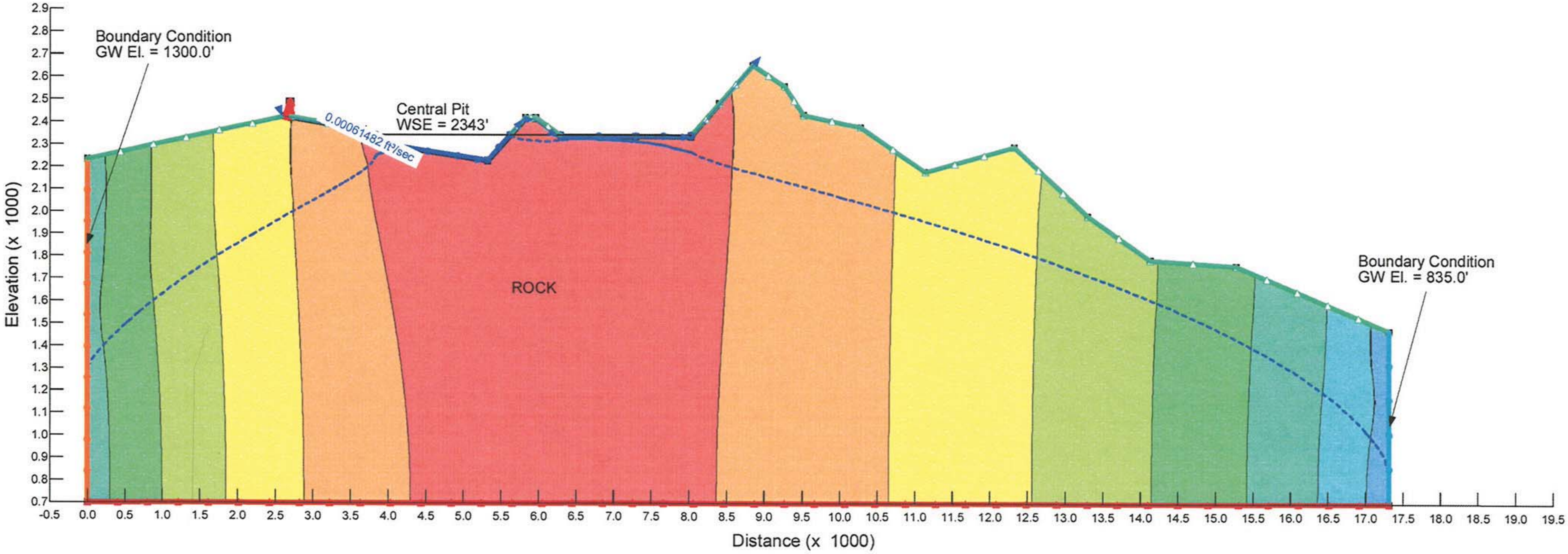
3' LINER W/ GROUTING

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



5' LINER W/ GROUTING

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.

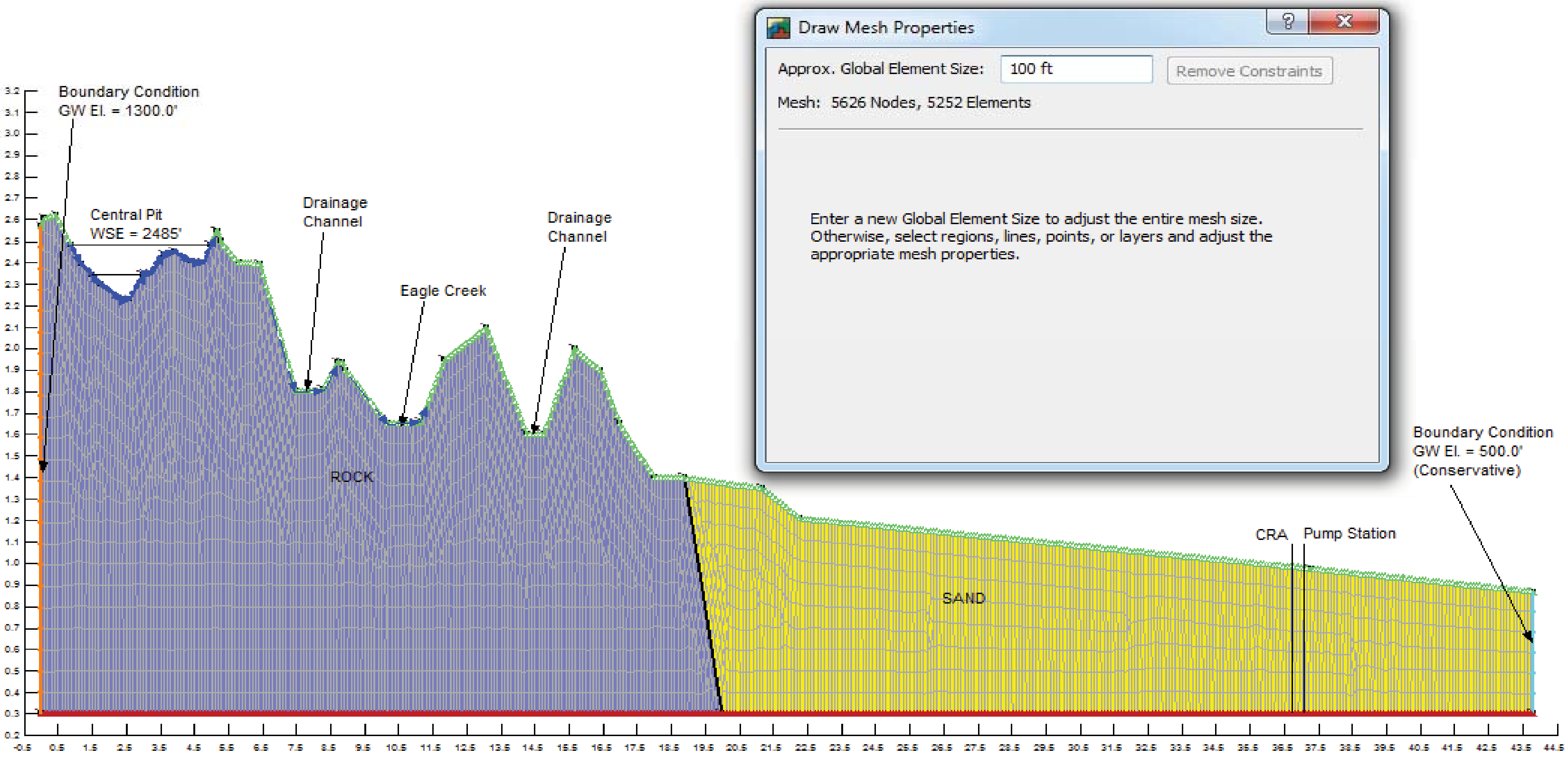


8' LINER W/ GROUTING

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.

GEI Consultants, Inc.
080470 Eagle Mountain Pumped Storage Project
Reservoir Seepage Analysis (SEEP/W)
1/4/2011
NDM

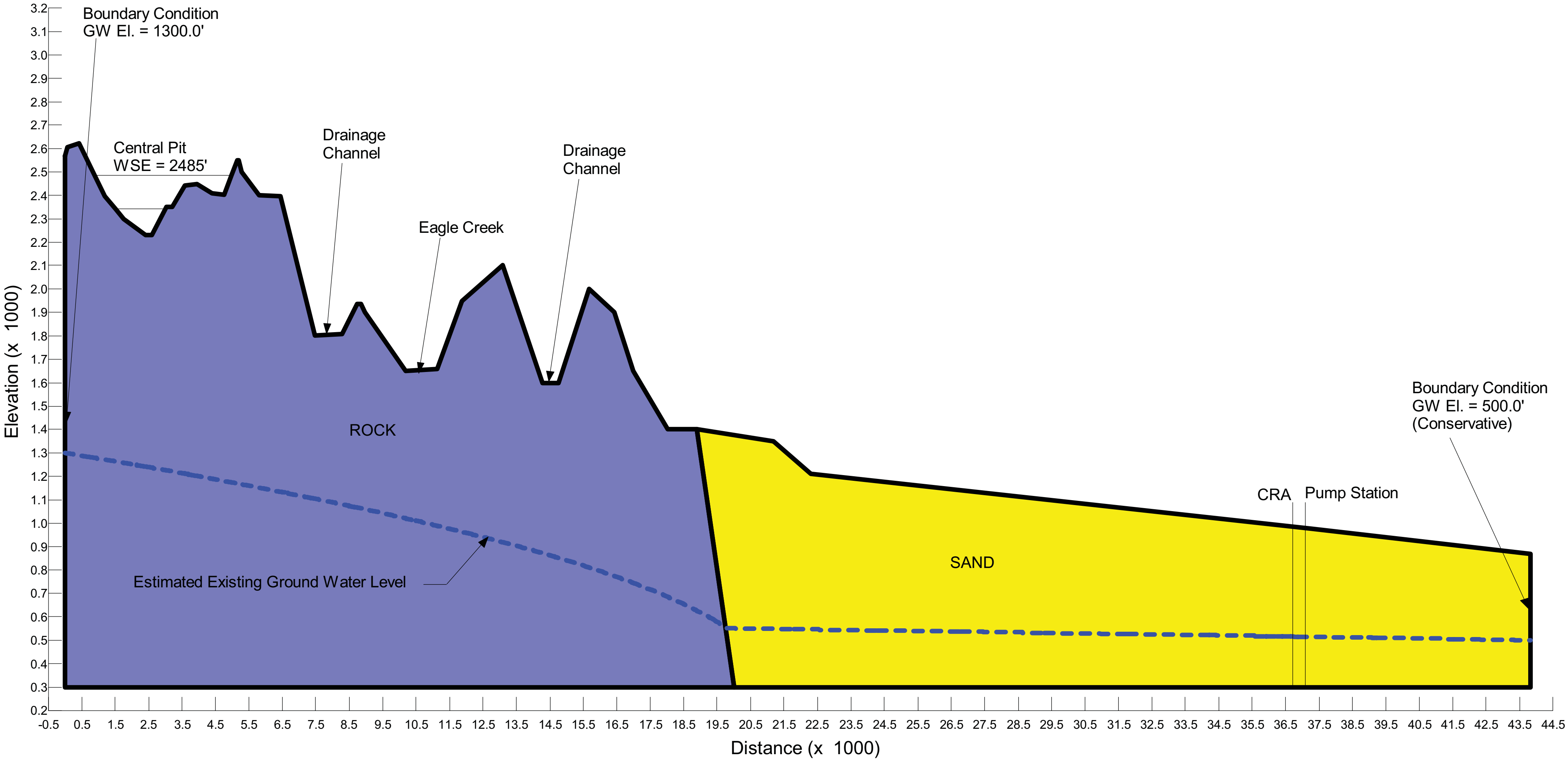
Model Mesh Properties - Upper Reservoir (North-South)

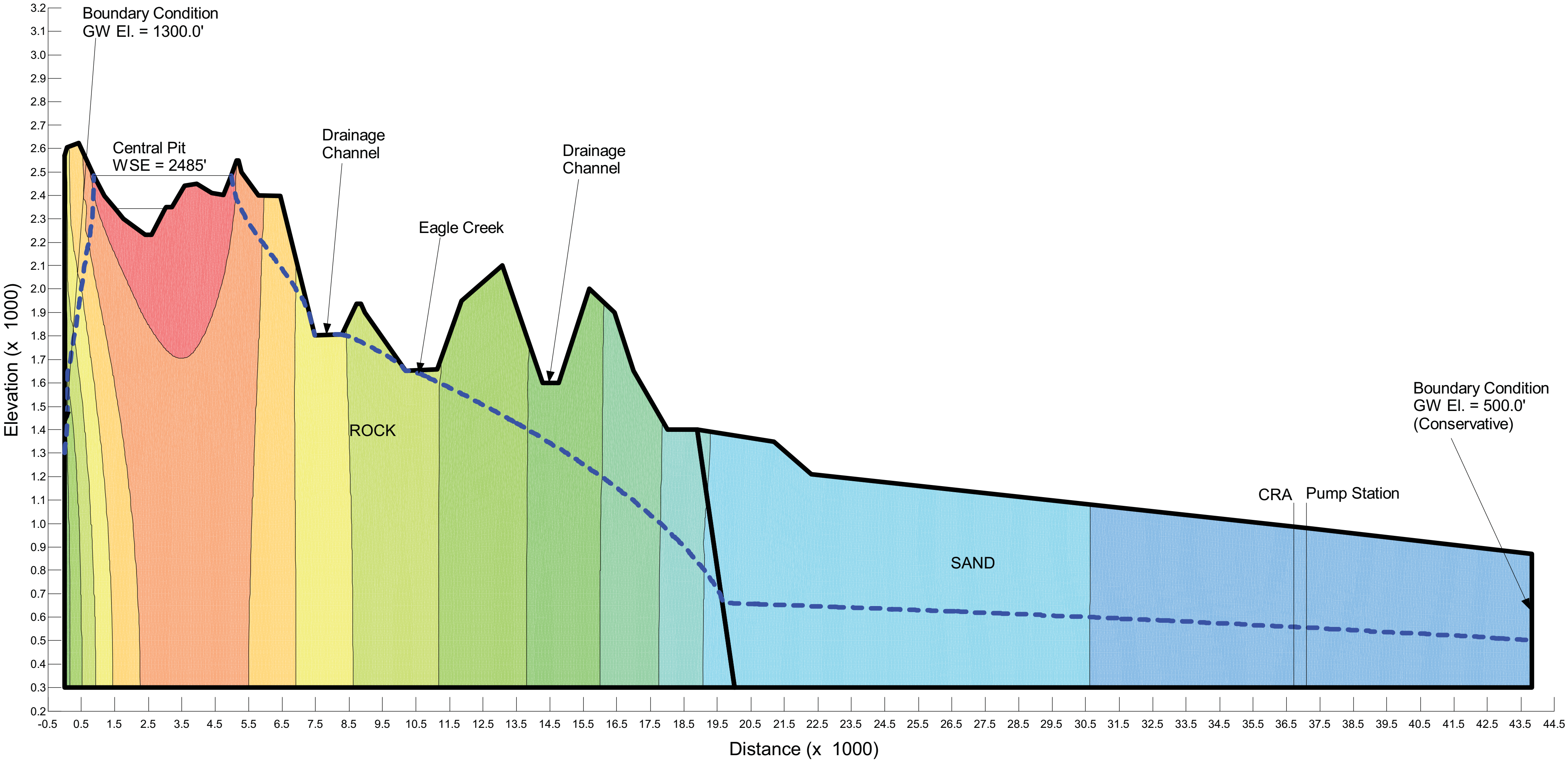


Approx. Global Element Size: 100 ft

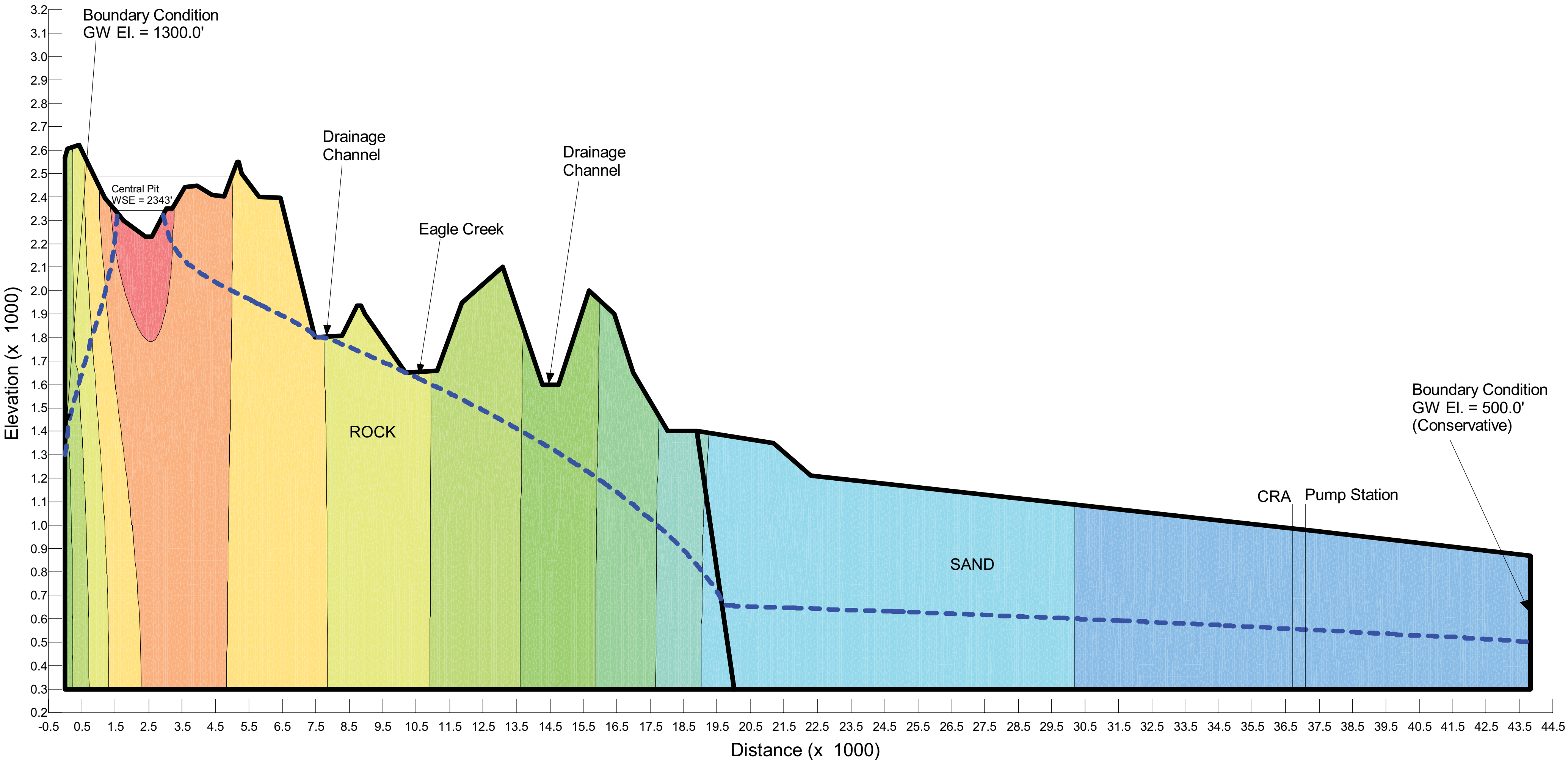
Mesh: 5626 Nodes, 5252 Elements

Enter a new Global Element Size to adjust the entire mesh size. Otherwise, select regions, lines, points, or layers and adjust the appropriate mesh properties.


Boundary Condition
GW El. = 1300.0'
Central Pit
WSE = 2485'
Drainage
Channel
Eagle Creek
Drainage
Channel
ROCK
Estimated Existing Ground Water Level
SAND
CRA
Pump Station
Boundary Condition
GW El. = 500.0'
(Conservative)
Elevation (x 1000)
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
-0.5
0.5
1.5
2.5
3.5
4.5
5.5
6.5
7.5
8.5
9.5
10.5
11.5
12.5
13.5
14.5
15.5
16.5
17.5
18.5
19.5
20.5
21.5
22.5
23.5
24.5
25.5
26.5
27.5
28.5
29.5
30.5
31.5
32.5
33.5
34.5
35.5
36.5
37.5
38.5
39.5
40.5
41.5
42.5
43.5
44.5
Distance (x 1000)



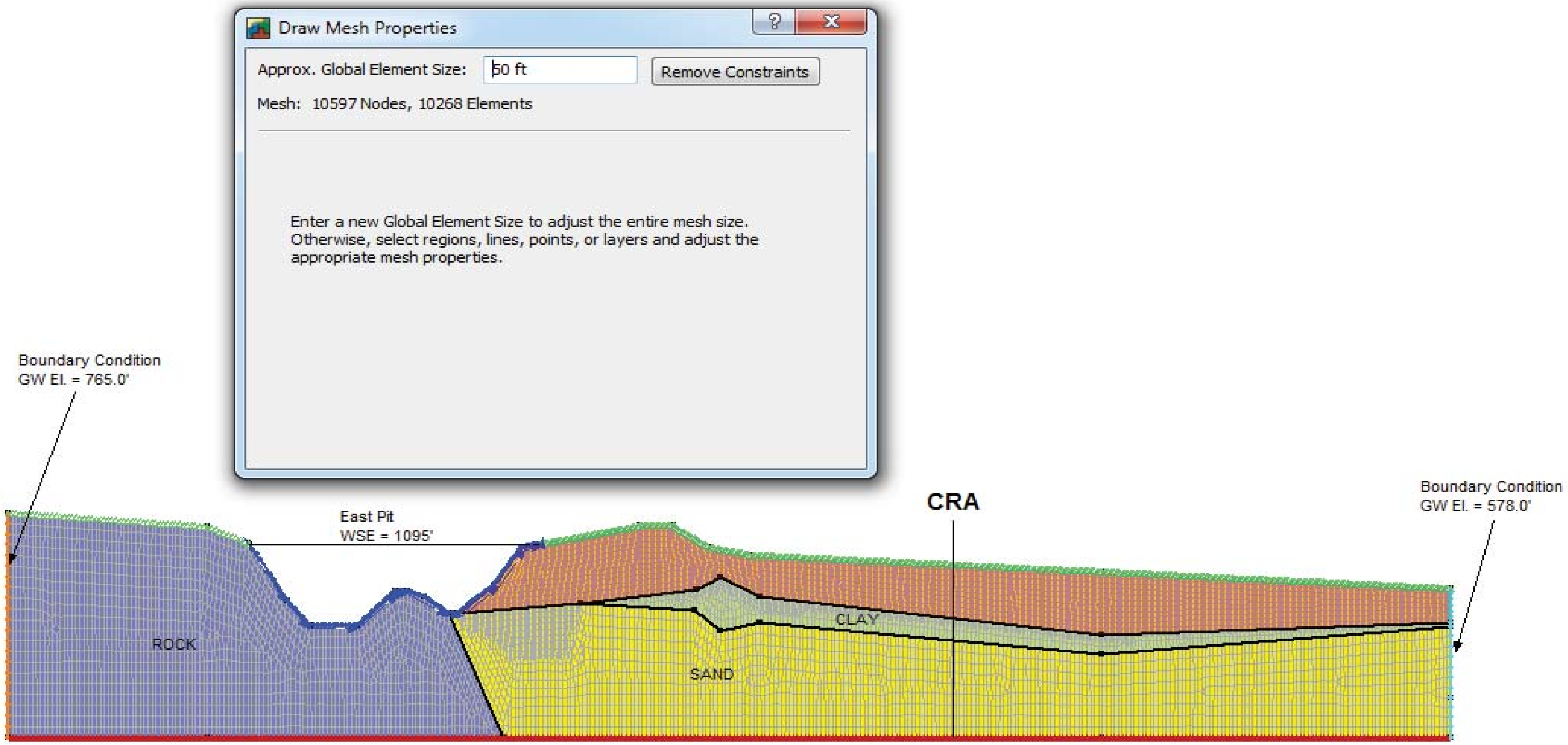
Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.



Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 200 feet of head.

Eagle Mountain Pumped Storage Project
Lower Reservoir - SEEP/W Output

Model Mesh Properties - Lower Reservoir (East-West)

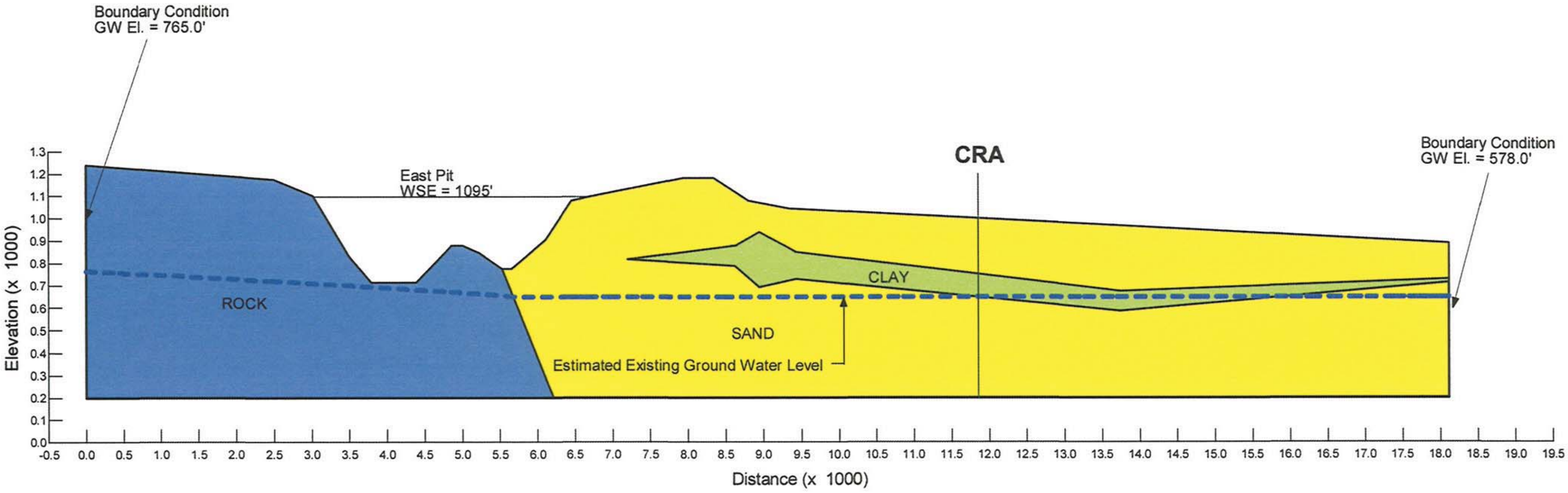


Draw Mesh Properties

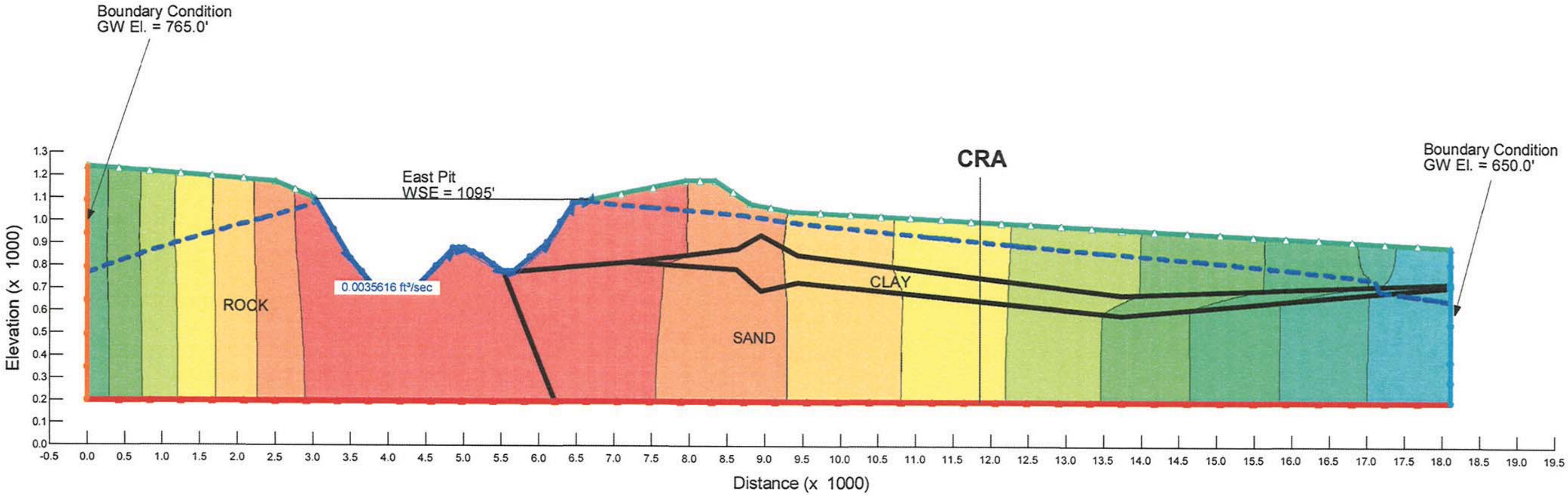
Approx. Global Element Size: 50 ft

Mesh: 10597 Nodes, 10268 Elements

Enter a new Global Element Size to adjust the entire mesh size. Otherwise, select regions, lines, points, or layers and adjust the appropriate mesh properties.

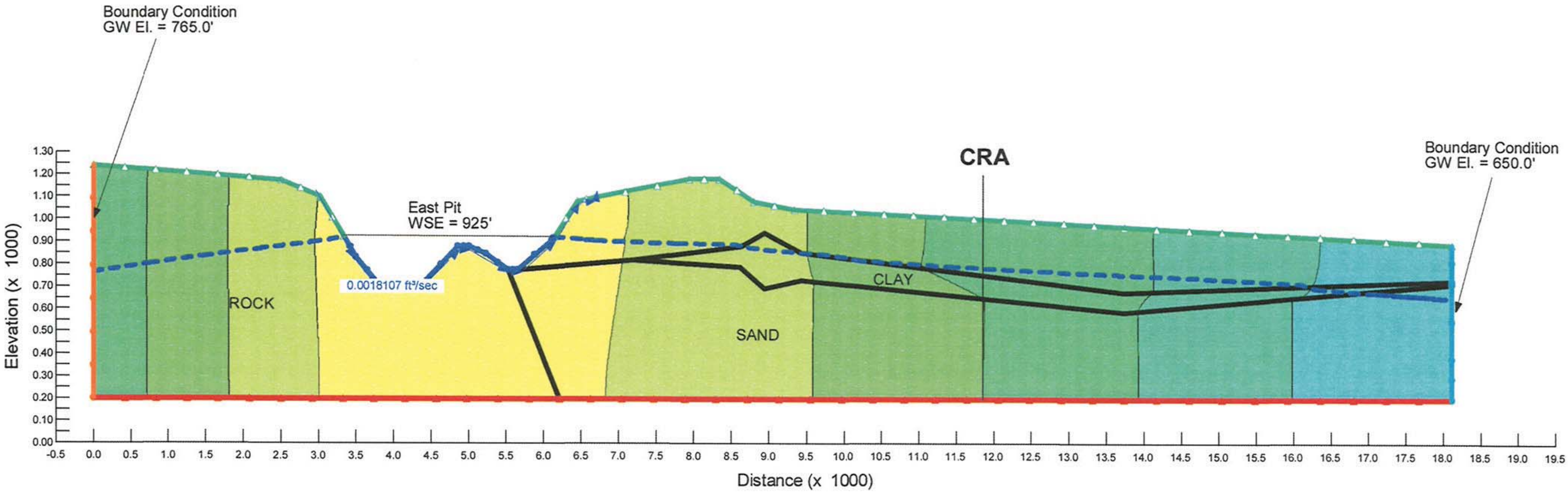


EXISTING CONDITIONS



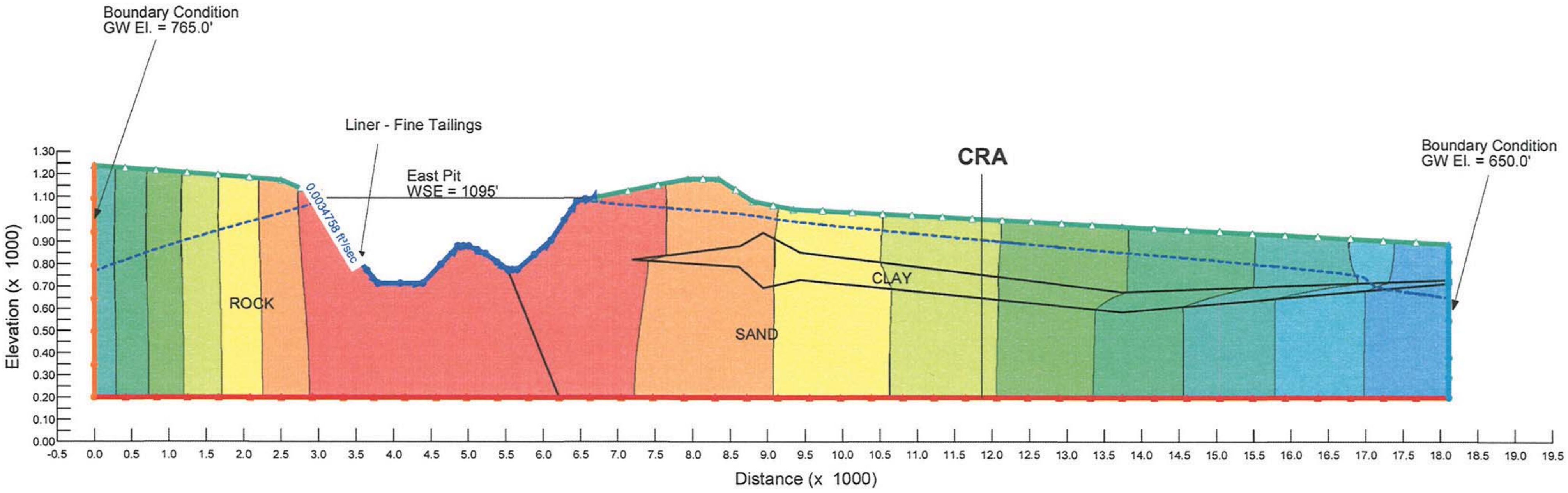
NO LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.



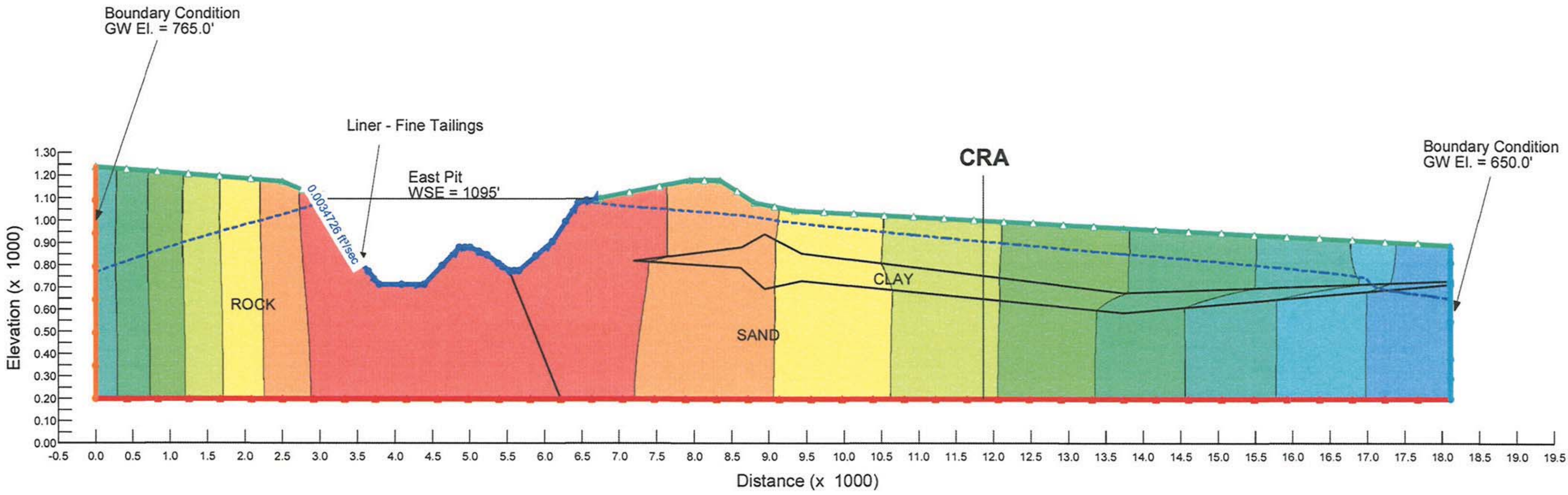
NO LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.



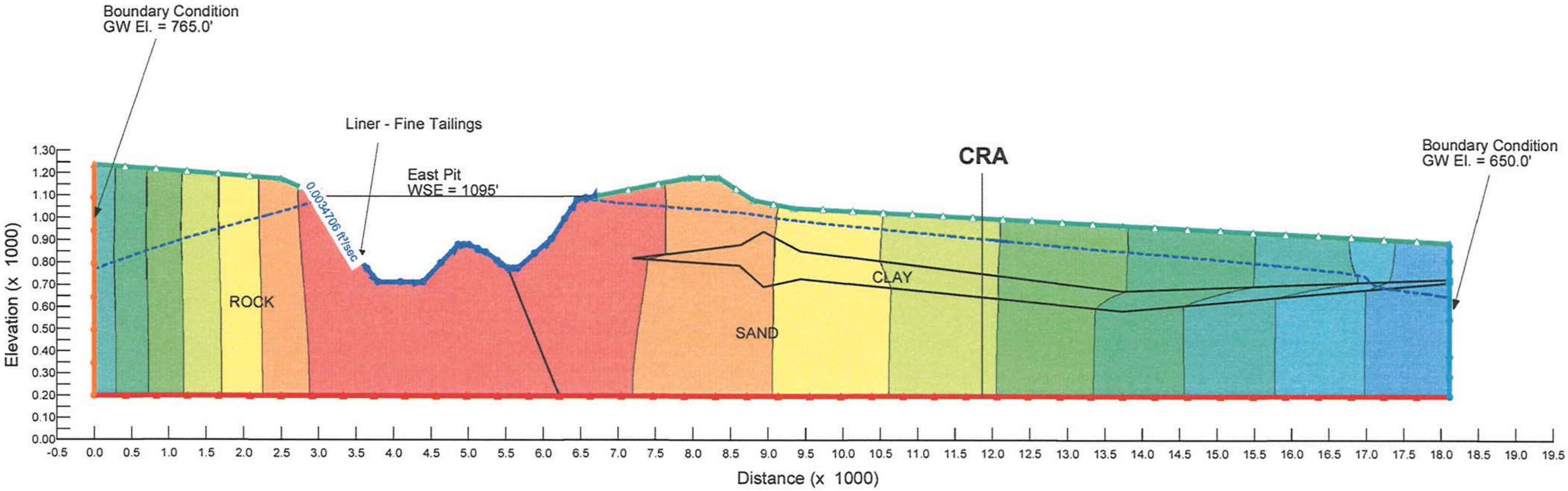
3' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.



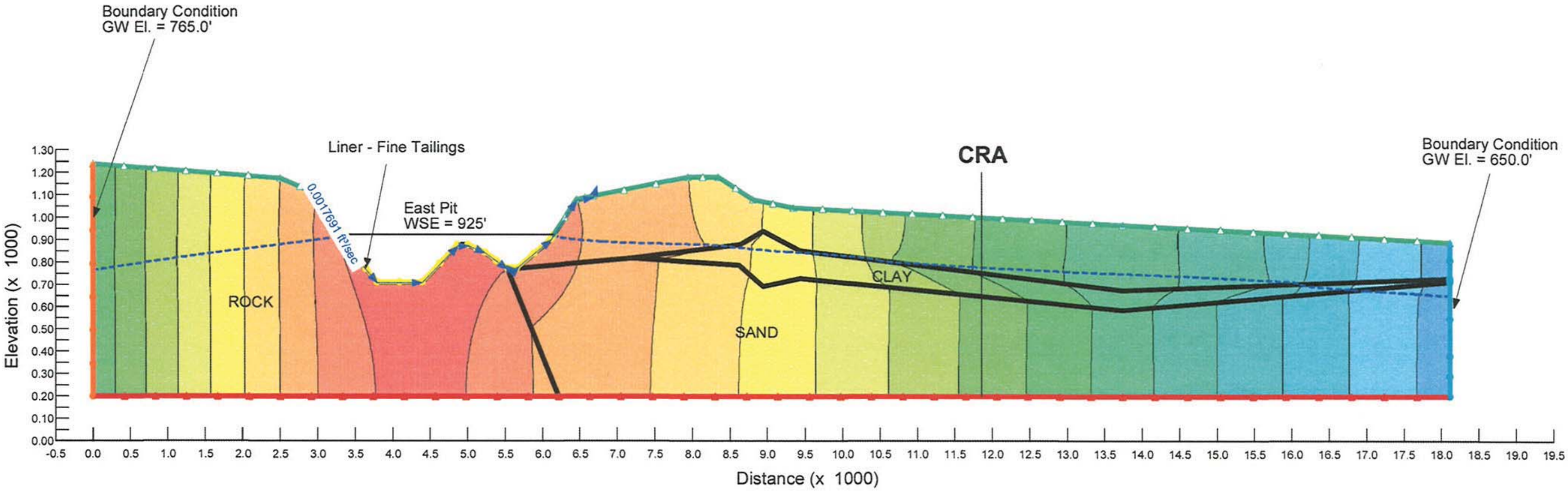
5' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.



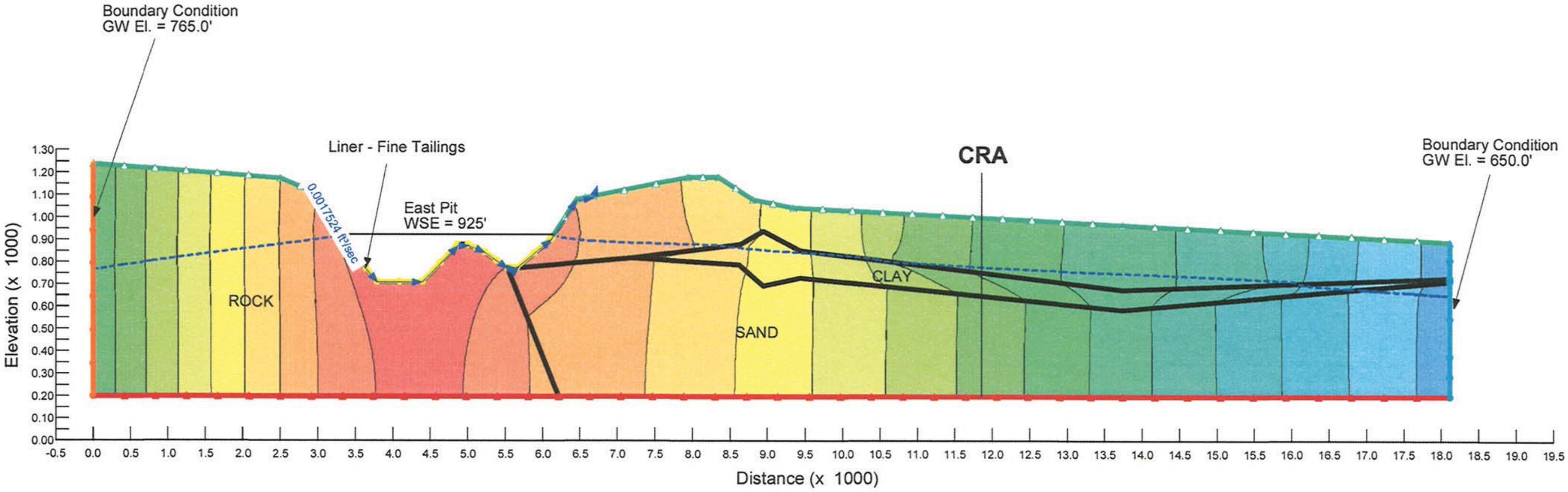
8' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.



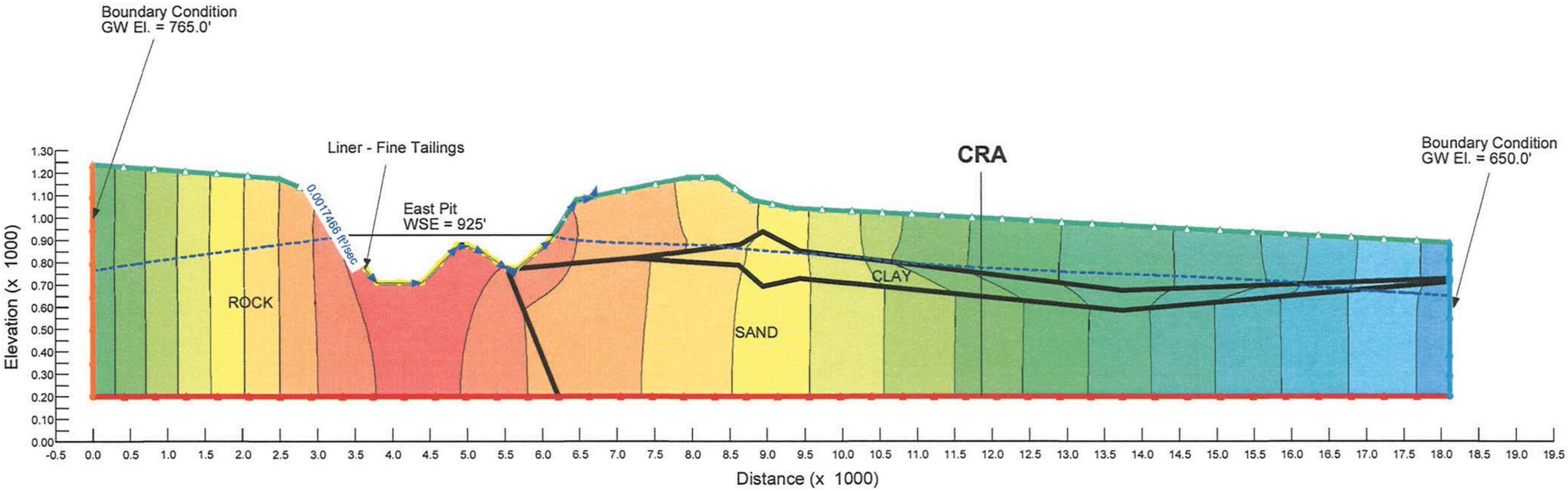
3' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 20 feet of head.



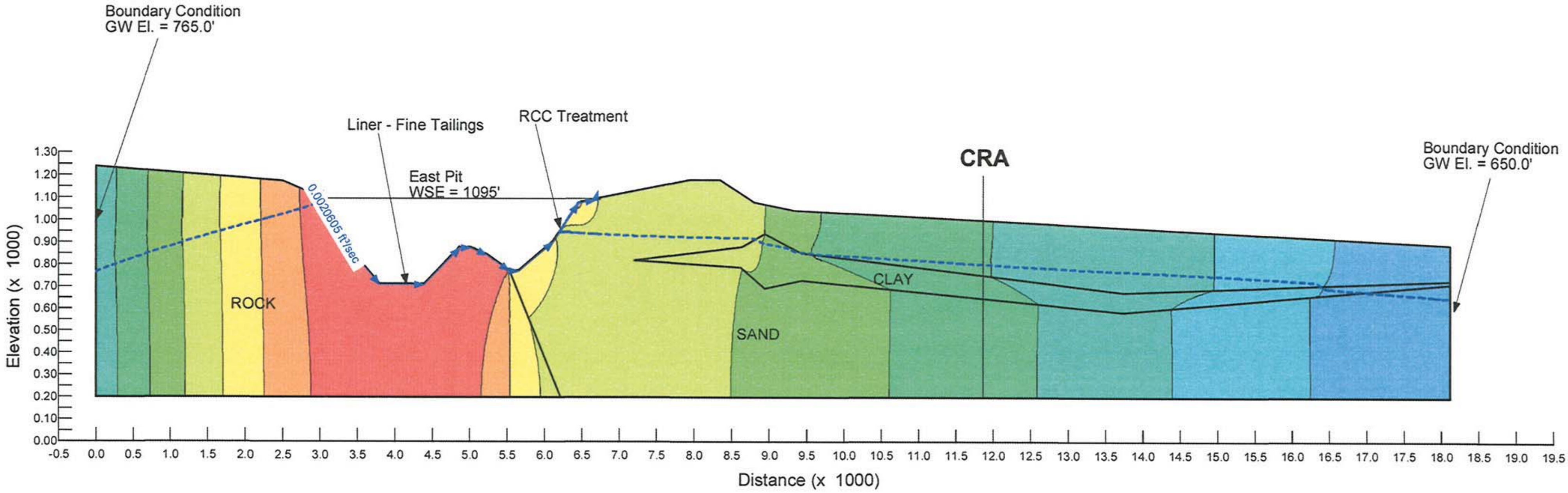
5' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 20 feet of head.



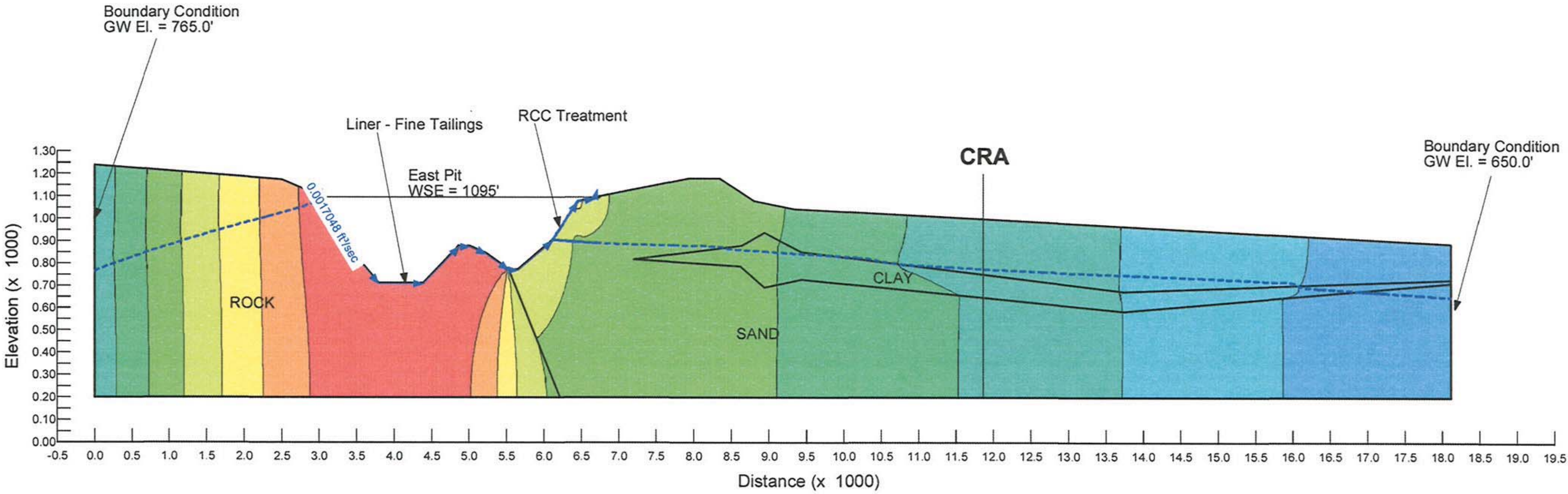
8' LINER

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 20 feet of head.



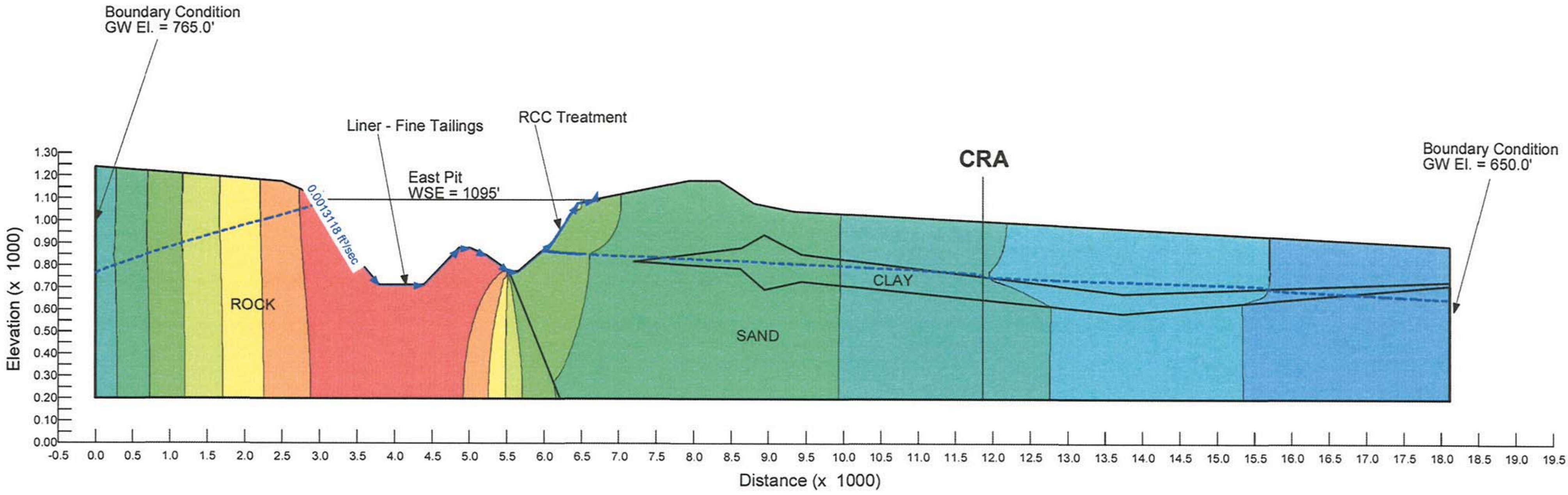
3' LINER W/ GROUTING AND RCC TREATMENT

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.



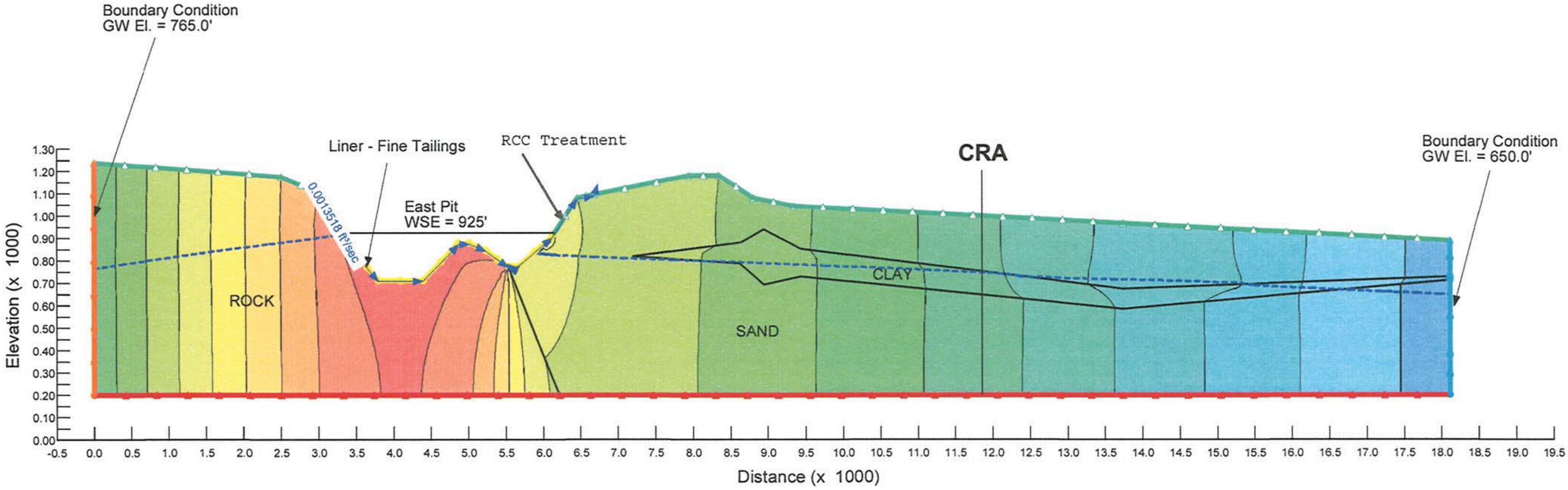
5' LINER W/ GROUTING AND RCC TREATMENT

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.



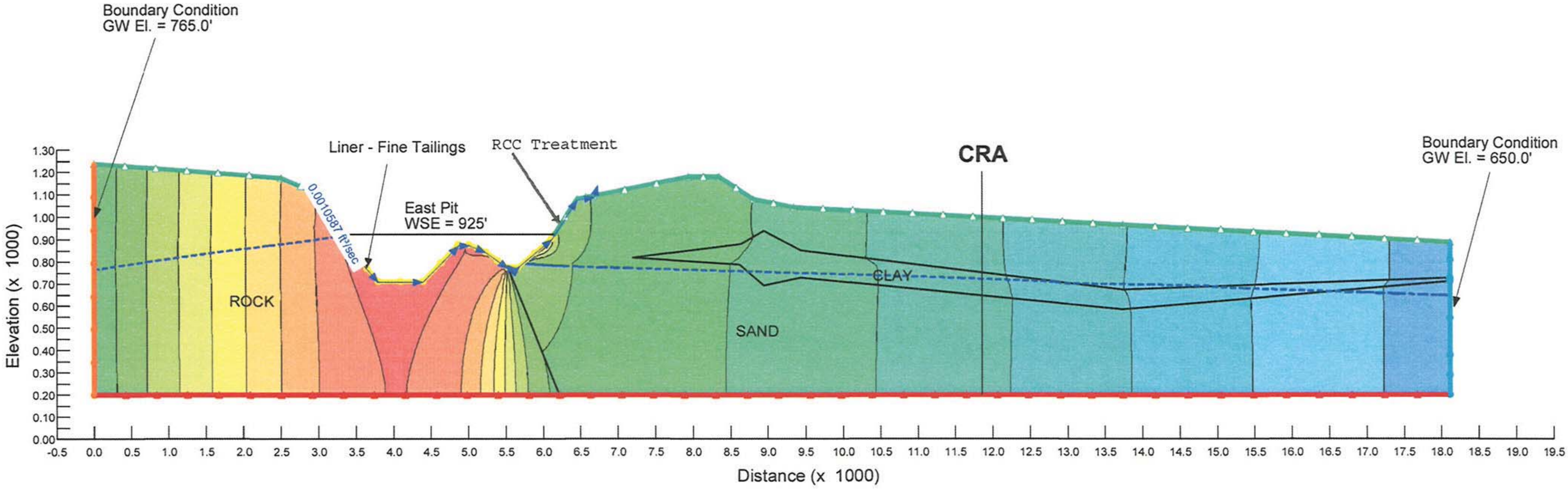
8' LINER W/ GROUTING AND RCC TREATMENT

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.



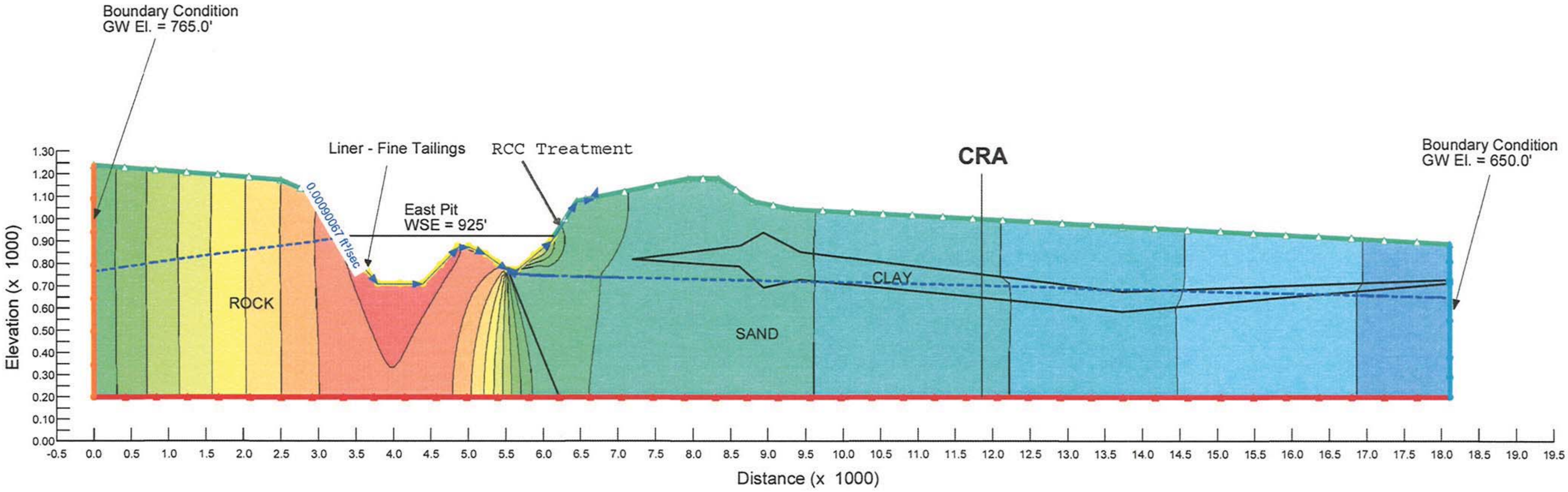
3' LINER W/ GROUTING AND RCC TREATMENT

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 20 feet of head.



5' LINER W/ GROUTING AND RCC TREATMENT

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 20 feet of head.



8' LINER W/ GROUTING AND RCC TREATMENT

Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 20 feet of head.

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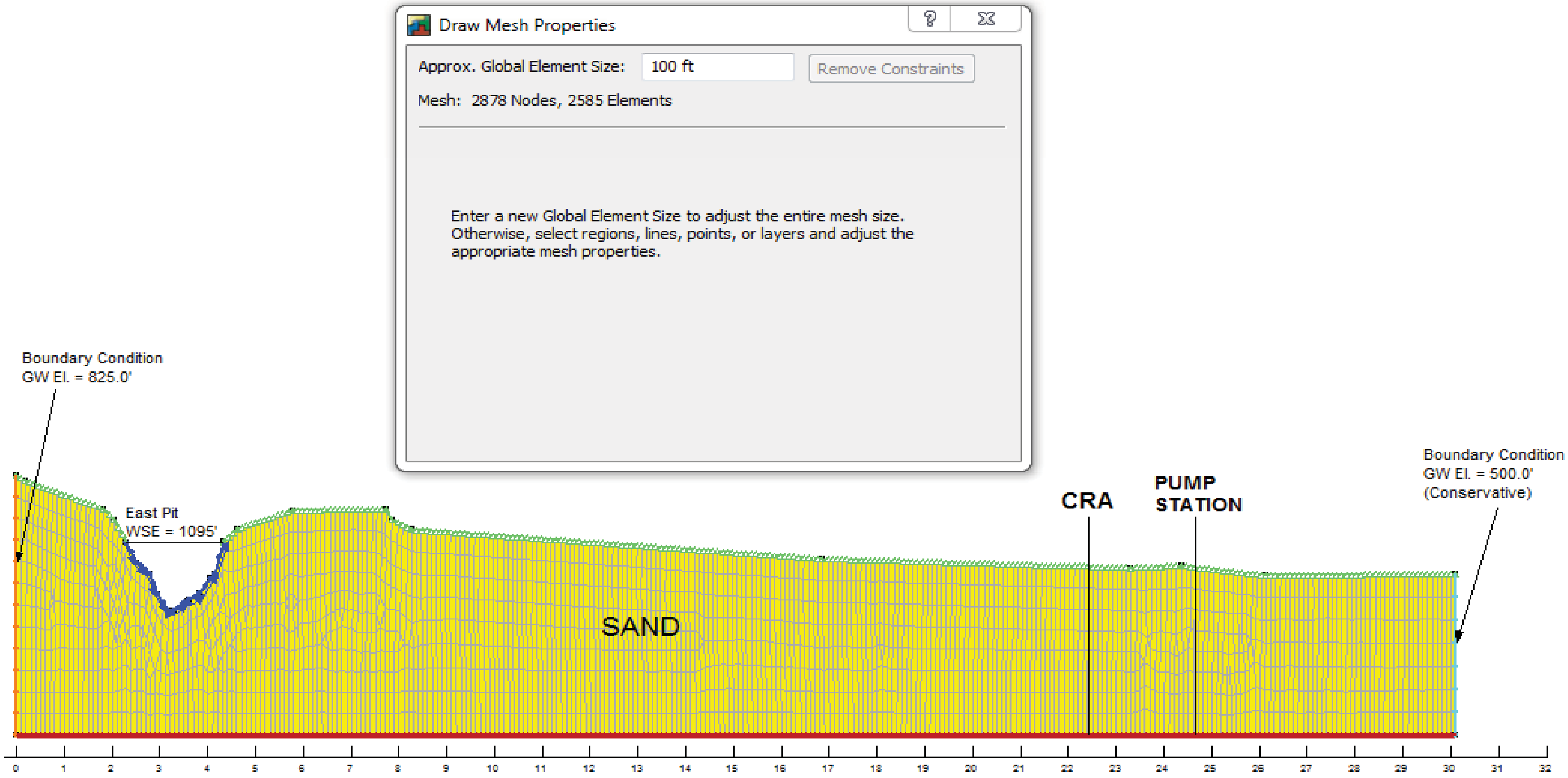
Model Mesh Properties - Lower Reservoir (North-South)

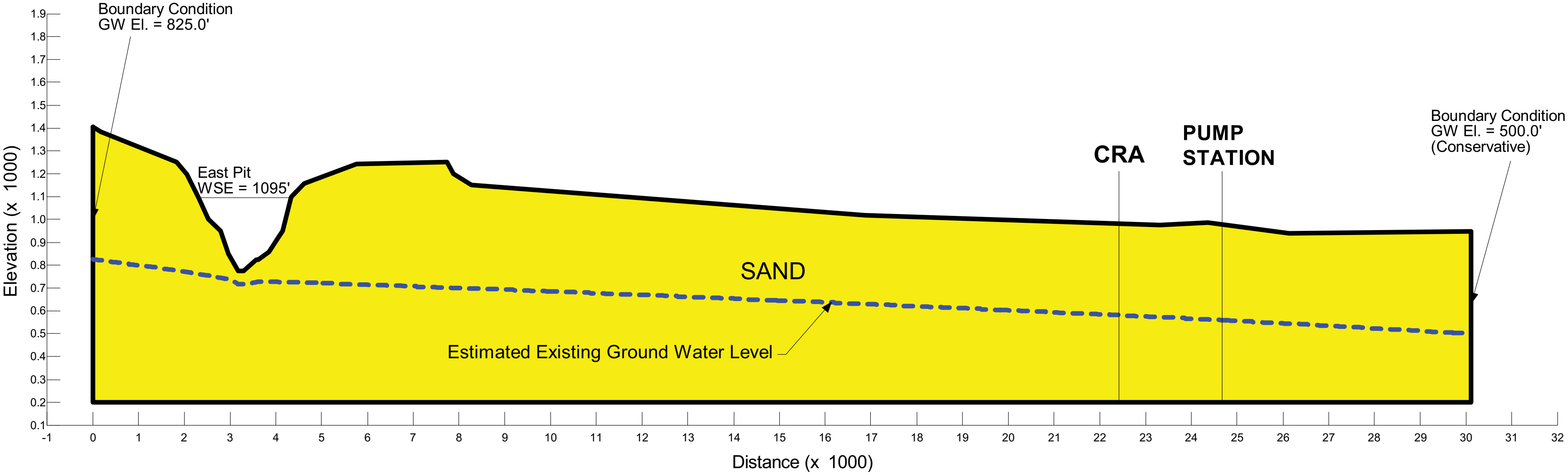


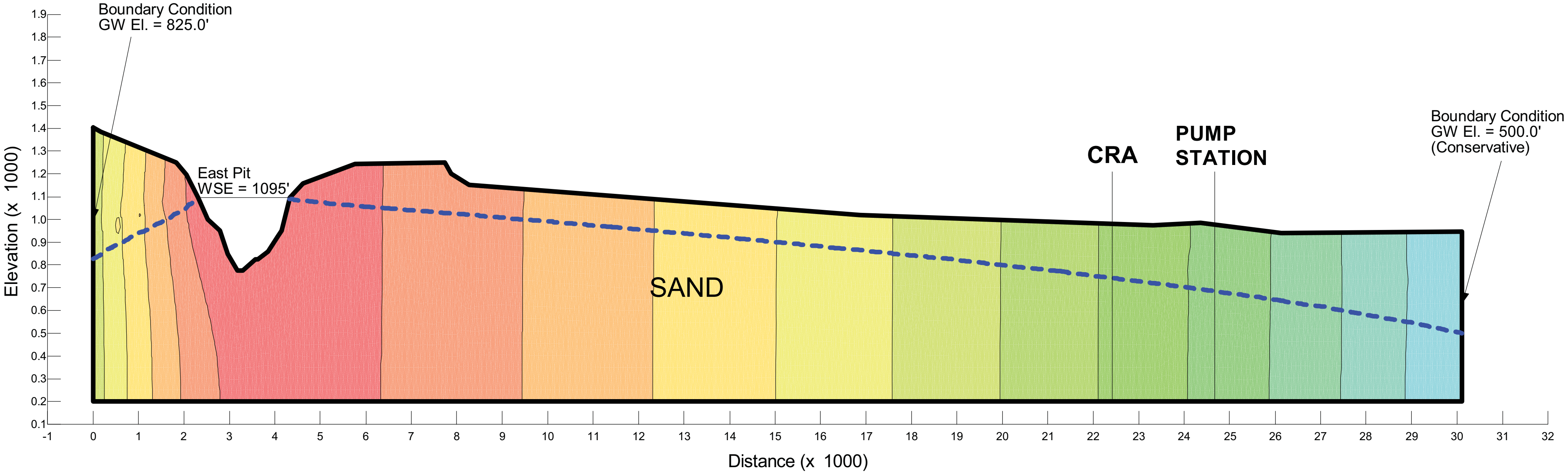
Draw Mesh Properties

Approx. Global Element Size: 100 ft

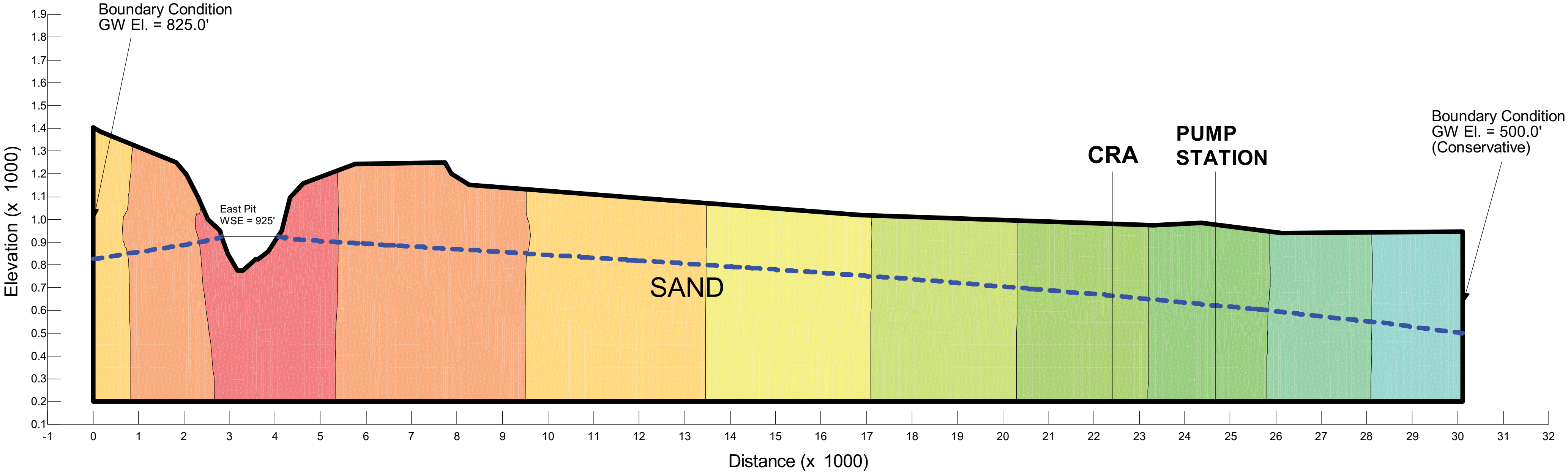
Mesh: 2878 Nodes, 2585 Elements

Enter a new Global Element Size to adjust the entire mesh size. Otherwise, select regions, lines, points, or layers and adjust the appropriate mesh properties.


Boundary Condition
GW El. = 825.0'
East Pit
WSE = 1095'
CRA
PUMP
STATION
Boundary Condition
GW El. = 500.0'
(Conservative)
SAND
Estimated Existing Ground Water Level
Elevation (x 1000)
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Distance (x 1000)



Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.



Note: The color contouring displayed on the figure illustrates the total head across the cross section. The contour intervals shown are equal to 50 feet of head.

SEEP/W Input
Materials Properties Data

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Summary of SEEP/W Material Properties

Material	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (ft/sec)	Conductivity Ratio
Rock – Upper Reservoir (Moderately Fractured)	1.00E-04	3.28E-06	1
Rock – Lower Reservoir (Slightly Fractured)	1.00E-05	3.28E-07	1
Sand	5.00E-03	1.64E-04	0.25
Clay (sandy)	1.00E-05	3.28E-07	1.00
Liner - (fine tailings)	2.16E-06	7.09E-08	1.00
RCC Treatment	1.00E-08	3.28E-10	1.00

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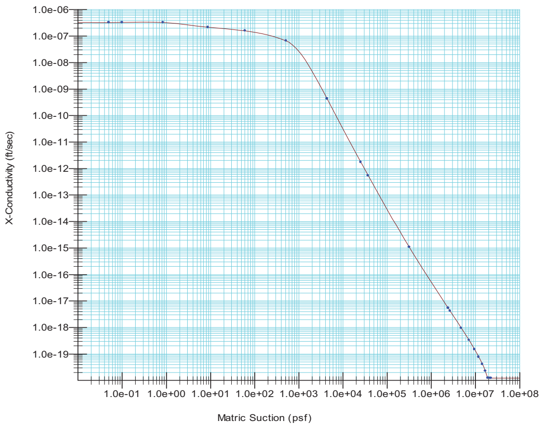
Material Properties - Hydrualic Conductivity Functions

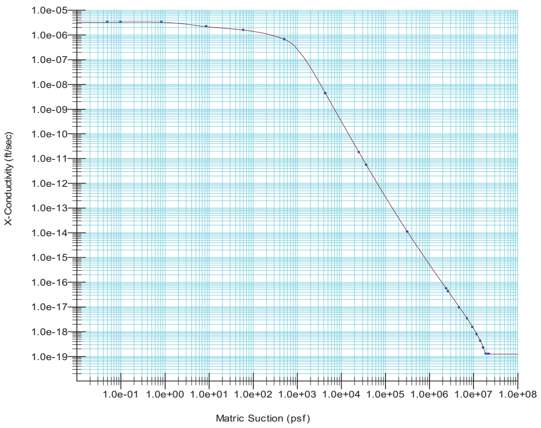
Rock - Lower Reservoir Ratio = 1.0

Glacial Till (Compacted), Ksat = 3.28e-07 ft/s



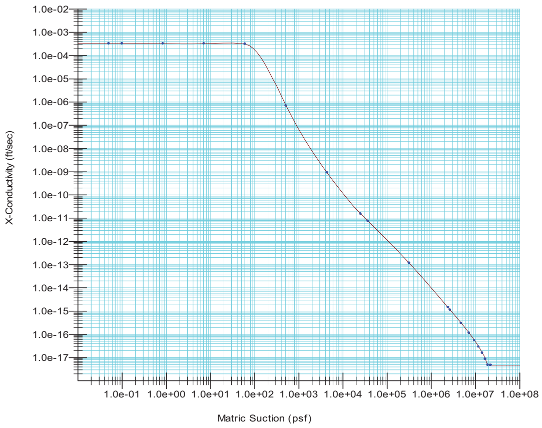
Rock - Upper Reservoir Ratio = 1.0

Glacial Till (Compacted), Ksat = 3.28e-06 ft/s



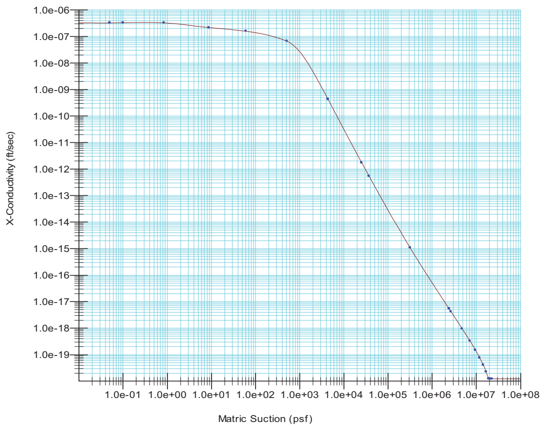
Sand Ratio = 0.25

Uniform sand, Ksat = 3.28e-4 ft/s



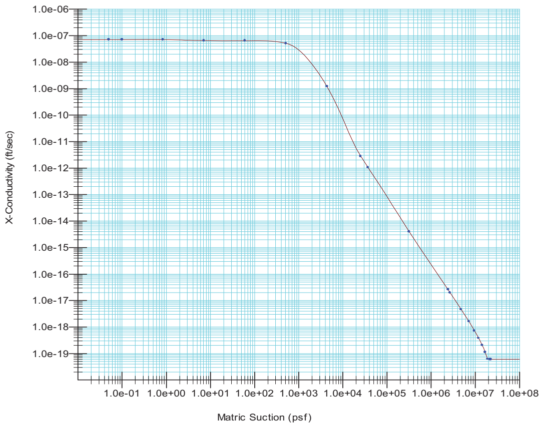
Clay Ratio = 1.0

Glacial Till (Compacted), Ksat = 3.28e-07 ft/s



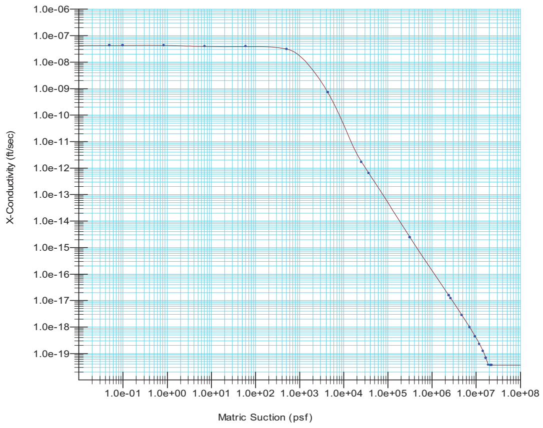
3' Liner Ratio = 1.0

3' Liner, Ksat = 7.09e-08 ft/s (3)



5' Liner Ratio = 1.0

5' Liner, Ksat = 4.254e-08 ft/s (2)



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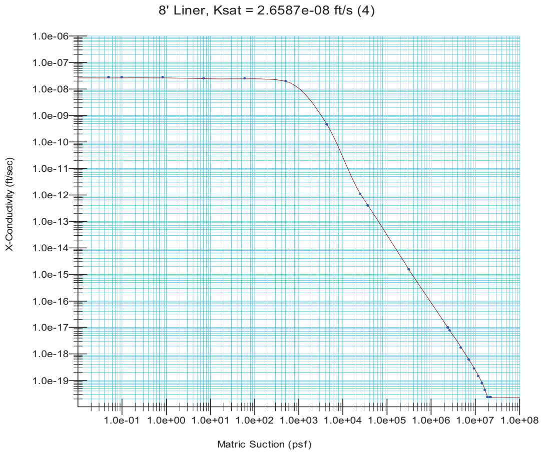
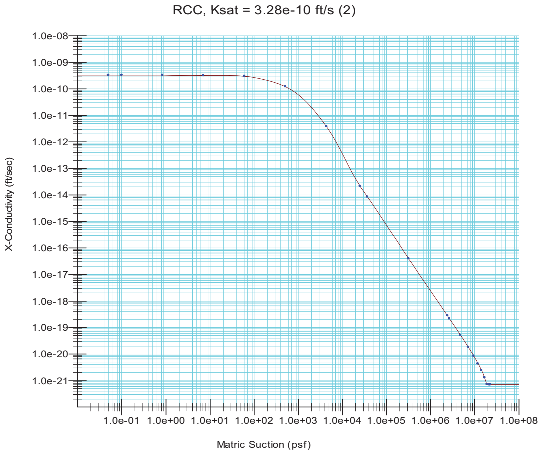
Material Properties - Hydrualic Conductivity Functions

8' Liner Ratio = 1.0



RCC Liner Ratio = 1.0



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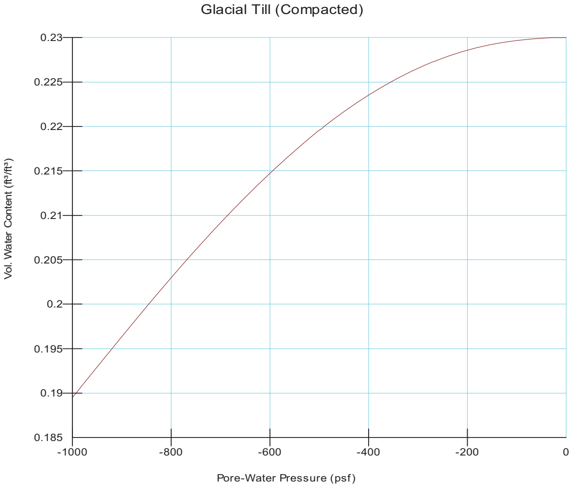
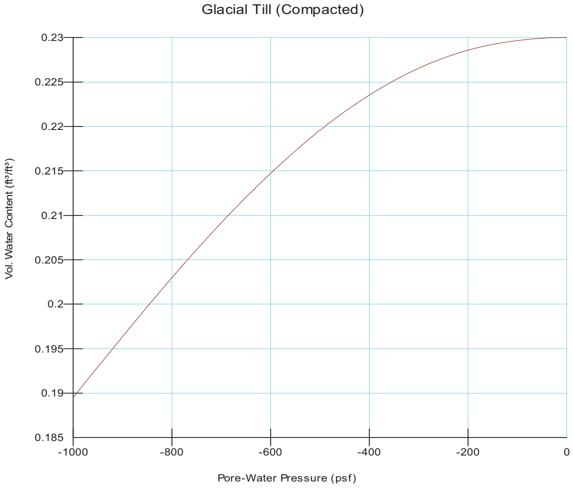
Material Properties - Volumetric Water Content Functions

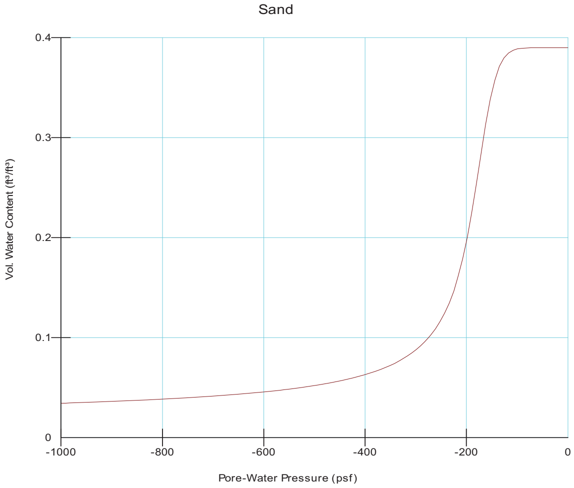
Rock - Lower Reservoir Ratio = 1.0



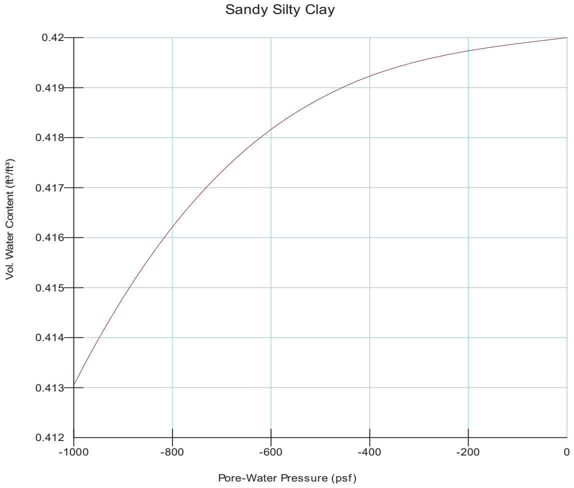
Rock - Upper Reservoir Ratio = 1.0



Sand Ratio = 0.25



Clay Ratio = 1.0



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Chuckwalla Report, Hydraulic Conductivities Summary

Boring	Description	USCS	Depth	Hydraulic Conductivity (cm/sec)
C-1	Sand	SP	201	1.00E-05
C-1	Clayey Sand	SC	201	2.10E-05
C-1	Silty Sand	SM	322	3.00E-06
C-5	Fat Clay	CH	142	9.20E-10
C-5	Clayey Sand	SC-SM	62	2.70E-07
C-5	Silty Sand	SM	62	3.00E-07
C-9	Silty sand	SM	145	3.50E-05
TP#2	Silty Sand	SM	14	1.20E-04
TP#3	Silty Sand	SM	5	3.90E-04
				Average
		SM		**9.14E-05**
		SC		**1.06E-05**

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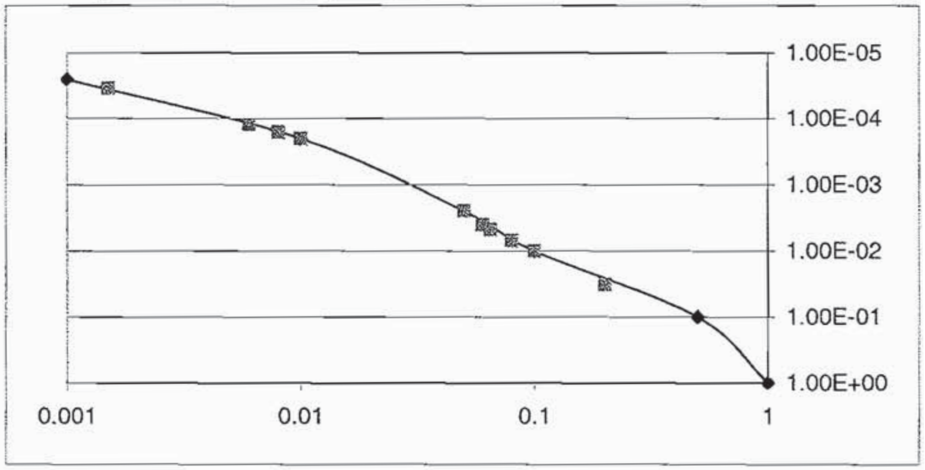
Emperical

Boring	Description	USCS	Depth	D5 (mm)	Hydraulic Conductivity (cm/sec)
C-1	Sand w/ Silt	SP-SM	17	0.08	7.00E-03
C-1	Sand w/ Silt	SP-SM	58	0.06	4.00E-03
C-1	Silty Sand	SM	101	0.0015	3.47E-05
C-1	Sand w/ Silt	SP-SM	110	0.0015	3.47E-05
C-1	Sand w/ Silt	SP-SM	123	0.008	1.61E-04
C-1	Sand w/ Silt	SP-SM	423	0.06	4.00E-03
C-5	Sand w/ Grave	SW	59	0.2	3.25E-02
C-5	Gravel w/ S&S	GP-GM	81	0.05	2.50E-03
C-5	Sand w/ Silt	SP-SM	101	0.1	1.00E-02
C-5	Gravel w/ S&S	GP-GM	121	0.065	4.75E-03
C-5	Sand w/ Silt	SP-SM	280	0.006	1.22E-04
C-9	Sand w/ Silt	SW-SM	17	0.05	2.50E-03
C-10	Sand w/ Silt	SP-SM	8	0.01	2.00E-04
C-10	Sand w/ Silt	SP-SM	16	0.06	4.00E-03
C-10	Sand	SP	78	0.08	7.00E-03
C-10	Sand w/ Silt	SP	130	0.05	2.50E-03
C-1	Sand	SP	201	--	1.00E-05
				Average	**4.78E-03**

Lookup Table

D5 (mm)	Hydraulic Conductivity (cm/sec)	Increment
0.001	2.50E-05	0.019444444
0.01	2.00E-04	0.057500000
0.05	2.50E-03	0.150000000
0.1	1.00E-02	0.225000000
0.5	1.00E-01	1.800000000
1	1.00E+00	1.000000000



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Liner - Fine Tailings

Hydraulic Conductivities - cm/sec

Test Type	Min	Max	Average	
Field	9.20E-09	4.30E-07	2.20E-07	
Lab	5.80E-09	8.20E-06	4.10E-06	
Average =	**7.50E-09**	**4.32E-06**	**2.16E-06**	cm/sec
	2.46E-10	1.42E-07	7.09E-08	ft/sec

BOREHOLE NO.	LOCATION		GROUND ELEV. FT	DEPTH DRILLED FT	BOTTOM ELEV FT	DEPTH TO BEDROCK FT	CASING BOTTOM		DEPTH OF SCREENED INTERVAL		HOLE SIZE IN	DRILLING DATES		HEIGHT OF CASING FT	DEPTH TO 1ST WATER FT	ELEV. OF 1ST WATER FT	5/6/92 SWL ELEV. FT	5/20/92 SWL ELEV. FT	6/3/92 SWL ELEV. FT	6/17/92 SWL ELEV. FT	7/1/92 SWL ELEV. FT	7/15/92 SWL ELEV. FT.	7/29/92 SWL ELEV. FT.	8/13/92 SWL ELEV. FT	8/26/92 SWL ELEV. FT.	BOREHOLE NO.	REMARKS
	NORTHING STATION	EASTING OFFSET					DEPTH	ELEV.	FROM	TO		BEGIN	END														
MON. WELLS																										MON. WELLS	
MW-1	619659.37	2240168.01	1045.00	400	645.00	N/A	365	660.00	325	385	10	4/27/89	3/26/90	2.29	338.24	706.79	706.15	706.37	705.57	705.78	705.95	706.60	706.44	705.15	705.15	MW-1	MUD ROTARY SEE NOTE (1)
MW-2	618081.48	2210648.20	1083.01	455	628.01	N/A	455	628.01	394	455	10	3/26/90	4/4/90	2.03	364.9	685.11	686.01	685.84	685.84	685.25	685.28	685.16	684.25	683.84	683.93	MW-2	AIR ROTARY (2)
MW-3	618977.39	2232454.20	1048.84	380	668.84	11	350	698.84	299	350	6	4/4/90	4/10/90	1.25	283.43	765.41	758.64	757.84	754.01	756.06	755.72	755.25	755.34	756.01	753.93	MW-3	REVERSE CIRC. HAMMER (3)
MW-4	618642.25	2207376.45	795.73	140	655.73	0	140	655.73	80	140	10	3/20/91	3/25/91	4.17	90.44	705.29	703.90	703.89	703.69	703.19	702.69	703.57	703.61	702.61	702.73	MW-4	REVERSE CIRC. HAMMER (3)
MW-5	618340.71	2238160.12	911.26	245	666.26	235	240	671.26	180	240	10	3/24/91	3/27/91	2.00	208.74	703.12	696.78	699.79	698.56	698.32	696.71	699.34	699.07	697.86	696.73	MW-5	REVERSE CIRC. HAMMER (3)
MW-6	616696.05	2232508.17	1347.89	640	707.89	460	620	727.89	560	620	10	3/21/91	4/9/91	2.75	586.58	761.31	772.14	772.22	772.15	771.77	768.54		769.39	769.56	771.89	MW-6	REVERSE CIRC. HAMMER (3)
MW-7	618416.86	2228597.46	1605.82	765	820.82	0					10.625	9/11/91	9/14/91	2.33	690	915.82		916.45	914.46	915.9	915.82	915.74	970.73	915.42	916.9	MW-7	AIR HAMMER (2)
MW-8(OLD)	619359.68	2223019.00	1768.54	964	804.54	1	N/A	N/A	N/A	N/A	6.25	9/26/91	9/30/91	N/A	910	858.54										MW-8(OLD)	AIR HAMMER (2) (4) (15)
MW-8(NEW)	619359.68	2223019.00	1768.54	871	897.54	11	840	928.54	781.5	843.5	13.5	3/31/92	4/21/92	4.46	868	900.54		938.53	937.56	935.6	936.84	936.08	939.75	933.92	937.04	MW-8(NEW)	AIR HAMMER (5)
MW-9	619812.02	2228256.54	2296.32	1544	752.32	1	N/A	N/A	N/A	N/A	6.5	10/12/91	10/31/91	N/A												MW-9	AIR HAMMER (2) (4)
MW-10	622825.28	2221619.43	2311.35	1213.7	1097.65	7	1173	1138.35	1069	1173	13.5	2/16/92	3/9/92	3.22	506	1805.35	1464.85	1446.44	1429.06	1427.27	1415.27	1271.06	1285.23	1285.32	1292.82	MW-10	MUD ROTARY (5)
MW-11	617755.19	2221467.83	1783.25	1130	653.25	20	1115	668.25	862.7	916.7	13.5	3/1/92	3/23/92	0.92	925	858.25		1067		944.17		943.17	916.92	918.25	942.96	MW-11	MUD ROTARY AND AIR HAMMER (5) (12)
MW-12	624274.96	2239034.30	1206.77	550	656.77	37	430	776.77	365	430	13.5	3/22/92	3/25/92	3.17	490	716.77	683.65	662.72	658.11	657.91	655.44	654.56	652.62	646.44	646.4	MW-12	AIR HAMMER (5)
MW-13	619089.2	2222153.31	1051.48	420	631.48	3	364.7	686.78	260	364.7	13.75	4/13/92	4/28/92	4.58	310.0	741.48	776.23	774.11	757.74	762.77	763.61	761.89	756.64	760.94	758.4	MW-13	AIR HAMMER (5)
COREHOLES																										COREHOLES	
CH-2	621263.17	2225149.1	2288.21	1179	1109.21	10	1179	1106.06	N/A	N/A	3.8	2/21/92	5/13/92	2.92	1120	1168.21				1120.33	1116.92	1115.87	1121.44		1117.79	CH-2	CORED (5) (14)
CH-3	619921.91	2228530.79	1758.67	661	1077.67	10	N/A	N/A	N/A	N/A	3.5	3/6/92	3/21/92	N/A	A	N/A										CH-3	CORED (4) (5) (15)
CH-3A	619921.91	2228530.79	1758.67	904.5	854.17	10	900	858.57	N/A	N/A	3.0/3.8	3/21/92	4/10/92	1.03	859	899.67	976.75		903.36	907.33	908.87	907.59	912.63	908.92	906.09	CH-3A	CORED/ TRICONE 0-122' (14)
CH-4	623160.42	2239115.46	1905.98	930	975.98	10	930	975.98	N/A	N/A	3.0/3.8	3/12/92	3/28/92	1.42	875	1030.98	1505.73	1501.73	1505.29	1496.05	1490.65	1491.85	1487.14	1487.9	1485.36	CH-4	CORED (5) (7) (14)
CH-5A	619921.91	2234464.36	1657.20	900	757.2	13	900	757.2	N/A	N/A	3.0/3.8	4/8/92	4/28/92	1.50	791	866.2										CH-5A	CORED (5) (14)
CH-10	622986.74	2221686.07	2307.76	1389	918.76	7	1389	918.76	N/A	N/A	3.5	3/13/92	3/5/92	0.25	1309	998.76				1250.58		1315.51				CH-10	CORED (5) (14)
CH-11	617737.38	2221490.84	1781.59	1100	681.59	19	1100	681.59	N/A	N/A	3.8	4/14/92	4/29/92	N/A	910	871.59										CH-11	CORED (5) (14) (15)
CH-12	624300.32	2236997.22	1207.69	545	662.69	37	525	682.69	N/A	N/A	3.8	5/12/92	5/17/92	N/A	475	732.69										CH-12	CORED (5) (14)
PIEZOM.																										PIEZOM.	
P-1	618311.22	2236615.26	876.70	270	606.7	15	257	619.7	207	257	5.625	3/20/92	3/22/92	2.75	200	676.7	699.37	700.27	700.49	699.45	698.24	698.79	698.41	697.37	697.66	P-1	AIR HAMMER (6)
P-2	619059.91	2228647.01	1744.16	960	784.16	20	955	789.16	905	955	6.5-6.25	3/23/92	3/26/92	2.00	855	889.16	917.49	917.49	917.62	917.7	918.91	920.25	922.32	916.53	920.01	P-2	AIR HAMMER (6)
3	613956.93	2234636.70	1241.77	675	566.77	181	663	578.77	613	663	6	3/27/92	4/22/92	1.83	560	681.77	736.49	736.31	735.4	735.19	735.27	734.97	733.52	733.02	733.31	P-3	AIR HAMMER & SIM-CASE (6)
4	615377.15	2230790.68	1384.50	625	759.5	34	625	759.5	575	625	5.5	4/9/92	4/28/92	1.08	554	830.5					913.25	919.25	833.24	916.83	918.87	P-4	AIR HAMMER & SIM-CASE (5)
P-5	614425.38	2230849.39	1387.00	625	762	37	675	712	575	625	5.5	4/11/92	4/28/92	2.00	525	862						918.08	841.75	915.75	917.75	P-5	AIR HAMMER & SIM-CASE (6)
P-6	619199.92	2232275.89	1052.51	425	627.51	0	409	643.51	309	409	5.5	4/22/92	4/26/92	2.83	285	767.51	791.36	790.88	786.02	782.38	779.51	775.76	772.42	769.01	766.74	P-6	AIR HAMMER (6)
P-7	619091.96	2232390.67	1050.96	425	625.96	0	423	627.6	373	423	5.5	4/24/92	4/26/92	2.42	275	775.96	756.29	765.39	755.79	752.75	754.34	753.67	758.28	754.38	751.84	P-7	AIR HAMMER (6)
P-8	619090.92	2232337.93	1050.60	400	650.6	0	373	677.6	323	373	5.5	4/25/92	4/26/92	2.29	155	895.6	779.02	780.71	774.68	767.1	766.14	784.35	763.53	753.14	762.6	P-8	AIR HAMMER (6)
P-9			1030*	525	505*	260	520	510	470	520	5.625	4/29/92	5/6/92	0.75	475	555*		600.*	599.58*	600.25	600.25	600.46	598.5	601.75	599.58	P-9	AIR HAMMER & SIM-CASE (6)
P-10			1120*	675	445*	180	675	445	625	675	5.625	5/7/92	5/11/92	2.33	570	550*		591*	591.21*	591.41	591.15	591.68	590.25	592.41	590.67	P-10	AIR HAMMER & SIM-CASE (6)
P-11			930*	485	445*	N/A	470	372	350	470	5.5	5/12/92	5/18/92	3.38	425	505*		576*	577.31*	577.05	577.67	578.57	577.8	580.34	578	P-11	AIR HAMMER & SIM-CASE (6)
P-12			842*	500	342*	N/A	500	342	450	500	5.625	5/20/92	6/3/92	2.69	420	422*				509.35	502.75	503.95	502.06	500.81	500.61	P-12	AIR HAMMER & SIM-CASE (6)
P-13			1328*	725	635*	0	725	635	675	725	5.5	6/7/92	6/8/92	2.41	650	678*				800.25	800.71	801	803.06	802.41**	801.66	P-13	AIR HAMMER (5)

NOTES:

* APPROXIMATE ELEVATIONS - NOT YET SURVEYED

(1) PIONEER DRILLING

(2) BEYLIK DRILLING

(3) LAYNE ENVIRONMENTAL DRILLING

(4) NOT CONSTRUCTED

(5) TONTO DRILLING

(6) HARRIS DRILLING

(7) WELL WAS ARTESIAN WHEN DRILLD

(11) VIDEO LOG

(12) E-LOG, GAMMA LOG, CALIPER LOG, SONIC LOG

(13) E-LOG, GAMMA LOG

(14) PHOTOS TAKEN OF CORE

(15) HOLE ABANDONED

** READING ACCURATE TO WITHIN ONE FOOT

BOREHOLE DATA SUMMARY SHEET
UPDATED 8/27/92
Eagle Mountain Landfill, Riverside County, California
MINE RECLAMATION CORPORATION
GSiwazar

Page 2

BOREHOLE NO.	LOCATION		GROUND ELEV. FT	DEPTH DRILLED FT	BOTTOM ELEV FT	DEPTH TO BEDROCK FT	CASING BOTTOM		DEPTH OF SCREENED INTERVAL		HOLE SIZE IN	DRILLING DATES		HEIGHT OF CASING FT	DEPTH TO 1ST WATER FT	ELEV. OF 1ST WATER FT	5/6/92 SWL ELEV. FT	5/20/92 SWL ELEV. FT	6/3/92 SWL ELEV. FT	6/17/92 SWL ELEV. FT	7/1/92 SWL ELEV. FT	7/15/92 SWL ELEV. FT.	7/29/92 SWL ELEV. FT.	8/13/92 SWL ELEV. FT.	8/25/92 SWL ELEV. FT.	BOREHOLE NO.	REMARKS
	NORTHING STATION	EASTING OFFSET					DEPTH	ELEV.	FROM	TO		BEGIN	END														
DESERT [illegible]																										DESERT [illegible]	
DH-420	617787.38	2240015.1	1082.73											2.1						653.9	660.11	660.44	655.44	658.44	660.38	DH-420	
DH-421	617652.42	2244332.57	975.52	1075	-99.48	570						11/27/54	12/5/55	1.56			686.18	685.96	686.33	686.1	686.02	686.33	685.9	687.6	685.97	DH-421	
DH-411	617104.26	2246748.33	928.48											0.58			673.19	673.03	673.17	672.8	672.73	672.67	672.03	670.74	671.82	DH-411	
DH-H	616745.60	2247830.25	910.48	1530	-619.52	961						11/23/54	1/22/55	1.08			654.73	654.58	654.54	654.71	656.89	655.6	654.66	655.31	655.05	DH-H	
DH-X1	616114.59	2250438.42	871.29	1280	-398.71	1270						1/3/55	1/24/55	1.58			645.45	645.49	645.54	645	647.04	646.45	645.29	648.95	644.21	DH-X1	
DH-Y	617546.81	2247822.56	915.18	1548.6	-633.42	1156						2/3/55	12/10/55	0.67			665.75	675.56	675.83	675.5	675.33	675.65	674.56	676.75	674.5	DH-Y	
DH-410	617075.65	2244534.30	972.41											0.63			670.12	669.62	669.92	669.65	671.29	669.98	669.04	670.54	668.48	DH-410	
DH-415	616669.21	2244550.52	978.71											0.25			682.66	682.71	683.17	682.86	683.04	682.73	682.53	684.5	682.88	DH-415	
DH-424	617792.85	2240812.57	1064.42											0.17			690.67	686.76	690.88	688.51	688.42	688 **		687.13	687.65	686.13	DH-424
MISC. WELLS																										MISC. WELLS	
SCHOOL			1240*	749.5	490.5*	211.5	740	500*						1.75				722*	719*	718.75*	718.08*	718.46*	718.62*	716.25	718.33	SCHOOL	ROTARY
CW#1			742*	1328	-586*																					CW#1	MUD ROTARY
CW#2			793*	887	-94*		535	258*	331	527				1.00						469.5*	470.42*	469*	469.34*	471.92	469.83	CW#2	MUD ROTARY
CW#3			737*	699	38*		570	167*	273	562				3									474.67*	476.17	475.04	CW#3	MUD ROTARY
CW#4			699*	660	39*		500	199*	170	410																CW#4	MUD ROTARY
KAISER MW	614520.28	2244687.13	978.49											2.25			668.41	669.16	666.41	666.03	668.59		668.86	668.06	667.74	667.98	KAISER MW

NOTES: * APPROXIMATE ELEVATIONS
** READING ACCURATE TO WITHIN ONE FOOT

BOREHOLE DATA SUMMARY SHEET
UPDATED 8/27/92
Eagle Mountain Landfill, Riverside County, California
MINE RECLAMATION CORPORATION
GSi/water

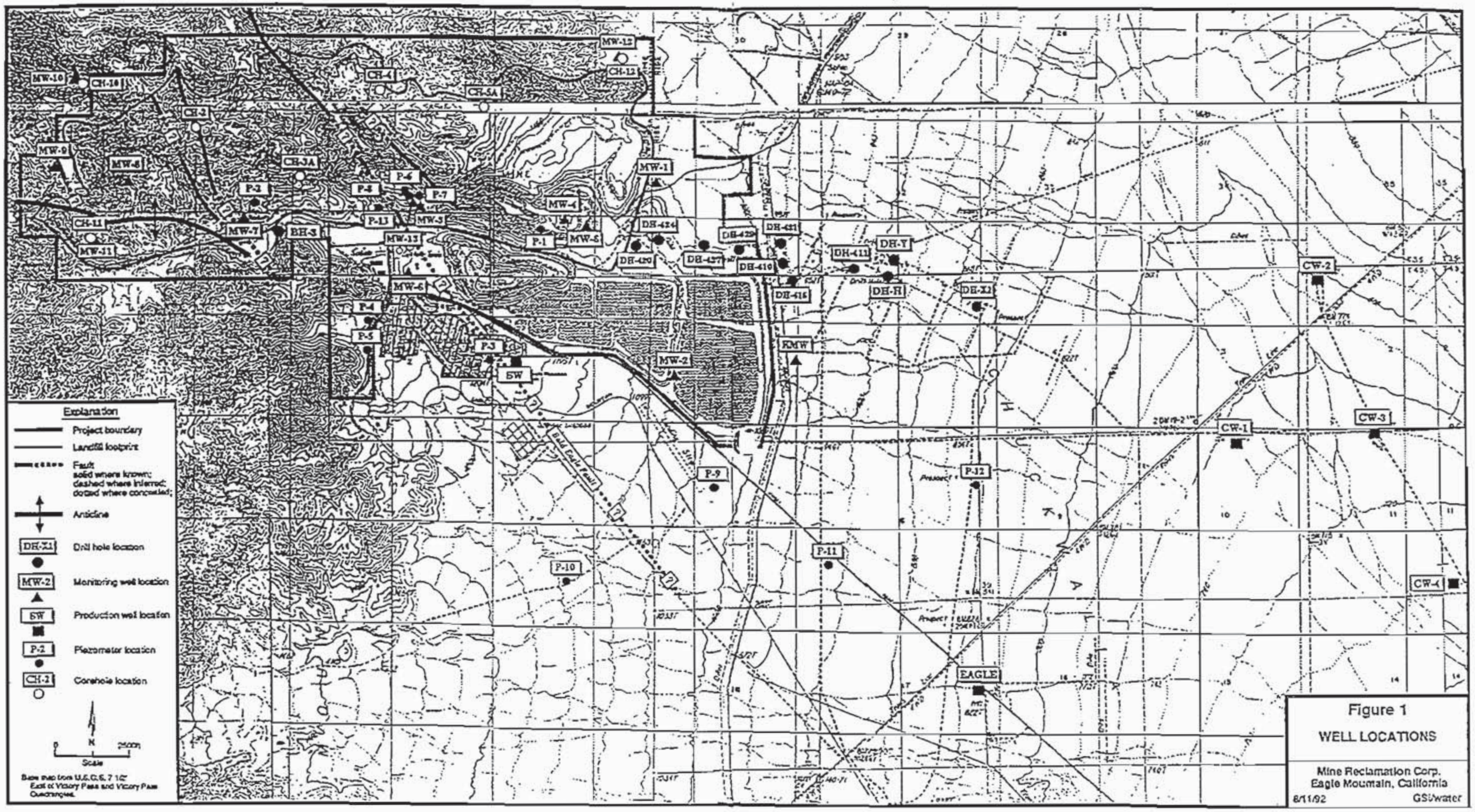
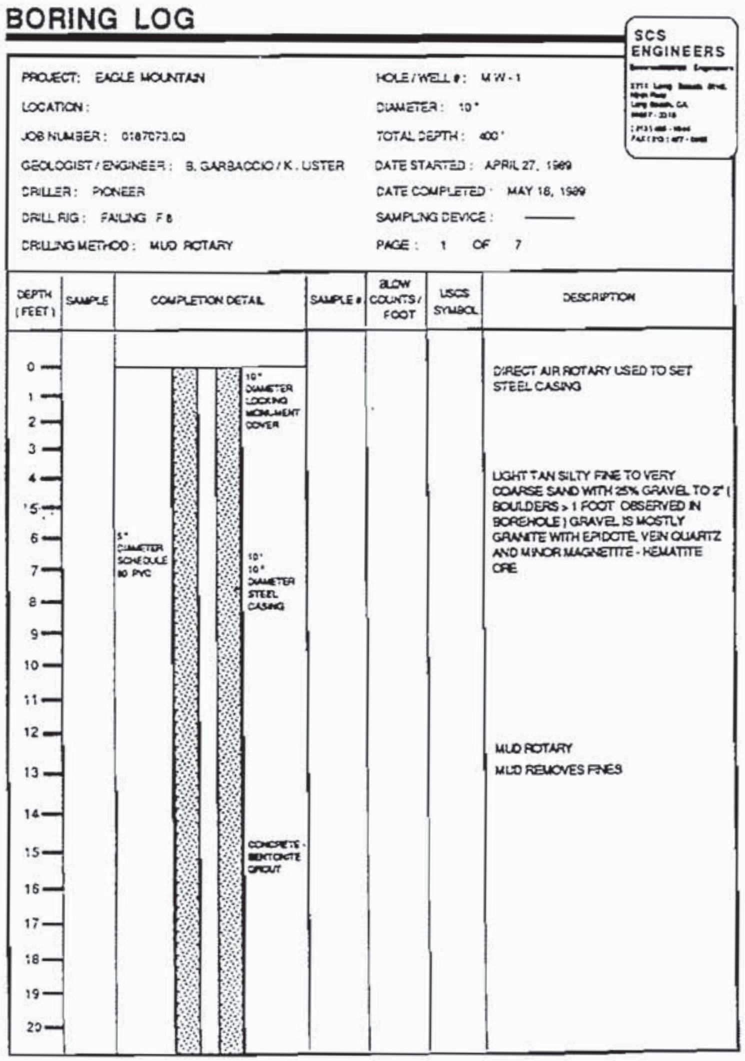


Figure 1

WELL LOCATIONS

Mine Reclamation Corp.
Eagle Mountain, California
8/11/92 GSI/water



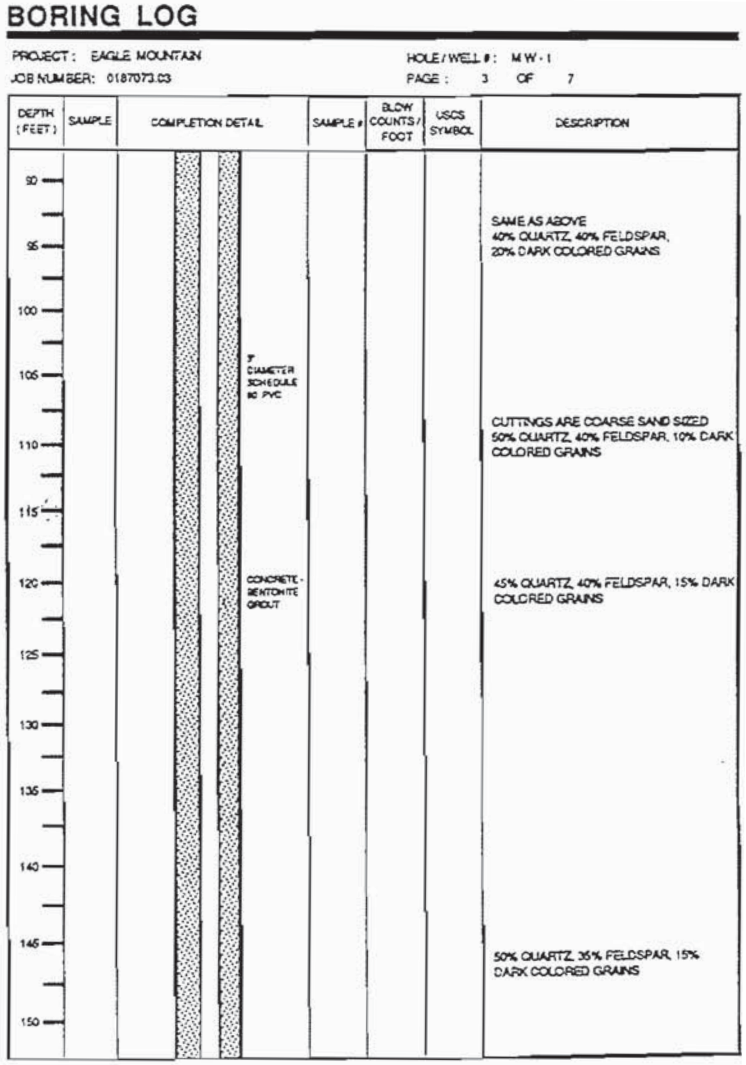
BORING LOG

SCS ENGINEERS

PROJECT: EAGLE MOUNTAIN
LOCATION:
JOB NUMBER: 0187073.03
GEOLOGIST / ENGINEER: B. GARBACCIO / K. USTER
DRILLER: PIONEER
DRILL RIG: FAILING F 8
DRILLING METHOD: MUD ROTARY

HOLE / WELL #: M W - 1
DIAMETER: 10"
TOTAL DEPTH: 400'
DATE STARTED: APRIL 27, 1989
DATE COMPLETED: MAY 18, 1989
SAMPLING DEVICE: ———
PAGE: 1 OF 7

DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
0						DIRECT AIR ROTARY USED TO SET STEEL CASING
4						LIGHT TAN SILTY FINE TO VERY COARSE SAND WITH 25% GRAVEL TO 2" (BOULDERS > 1 FOOT OBSERVED IN BOREHOLE) GRAVEL IS MOSTLY GRANITE WITH EPIDOTE, VEIN QUARTZ AND MINOR MAGNETITE - HEMATITE ORE
12						MUD ROTARY MUD REMOVES FINES

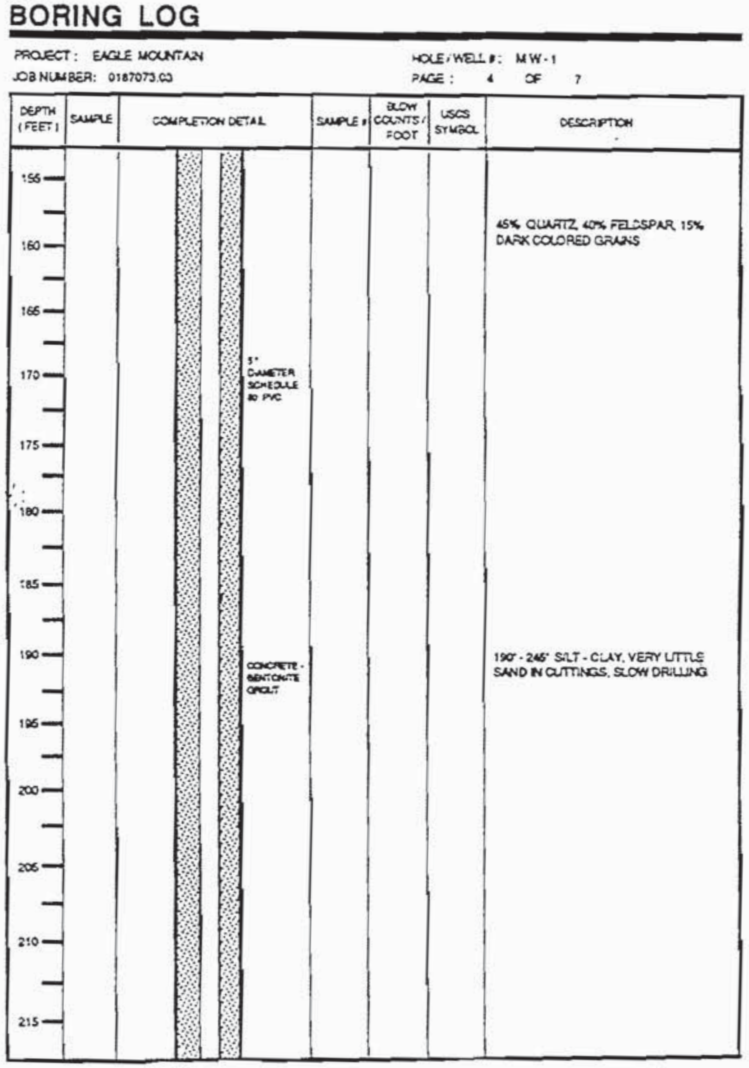


BORING LOG

PROJECT: EAGLE MOUNTAIN
JOB NUMBER: 0187073.03

HOLE / WELL #: M W - 1
PAGE: 3 OF 7

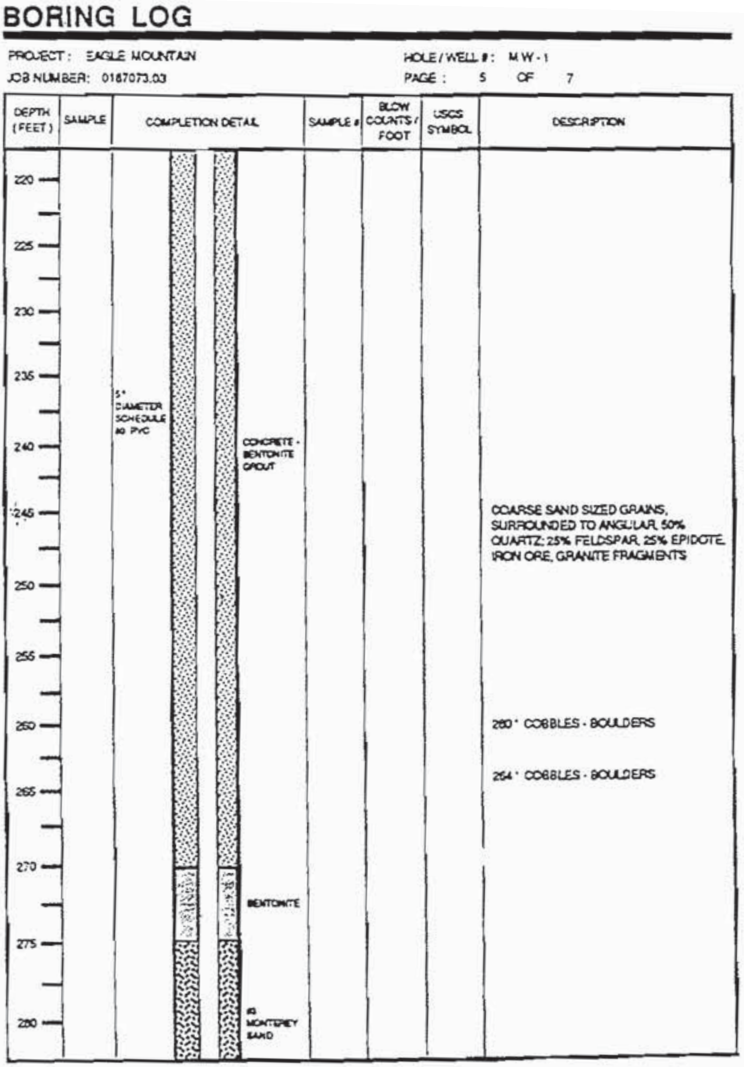
DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
95						SAME AS ABOVE 40% QUARTZ, 40% FELDSPAR, 20% DARK COLORED GRAINS
110						CUTTINGS ARE COARSE SAND SIZED 50% QUARTZ, 40% FELDSPAR, 10% DARK COLORED GRAINS
120						45% QUARTZ, 40% FELDSPAR, 15% DARK COLORED GRAINS
145						50% QUARTZ, 35% FELDSPAR, 15% DARK COLORED GRAINS



BORING LOG

PROJECT: EAGLE MOUNTAIN
JOB NUMBER: 0187073.03
HOLE / WELL #: MW-1
PAGE: 4 OF 7

DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
155						45% QUARTZ, 40% FELDSPAR, 15% DARK COLORED GRAINS
160						
165						
170		5" DIAMETER SCHEDULE 80 PVC				
175						
180						
185						
190		CONCRETE - BENTONITE GROUT				190' - 245' SILT - CLAY, VERY LITTLE SAND IN CUTTINGS, SLOW DRILLING
195						
200						
205						
210						
215						



BORING LOG

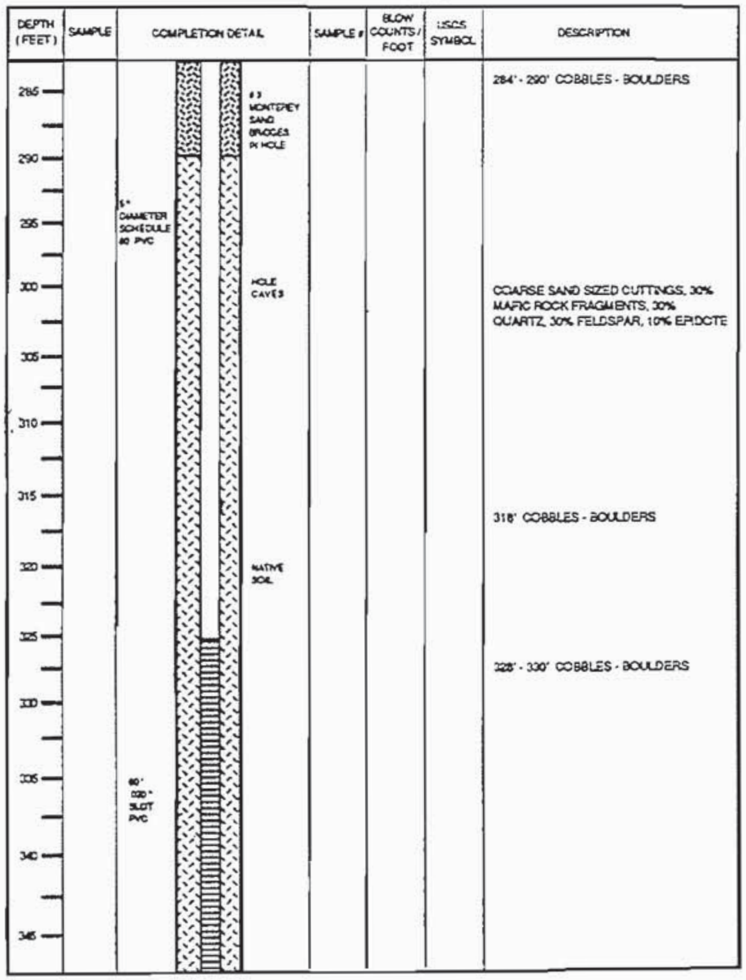
PROJECT: EAGLE MOUNTAIN
JOB NUMBER: 0187073.03
HOLE / WELL #: MW-1
PAGE: 5 OF 7

DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
220						
225						
230						
235		5" DIAMETER SCHEDULE 80 PVC				
240		CONCRETE - BENTONITE GROUT				
245						COARSE SAND SIZED GRAINS, SURROUNDED TO ANGULAR, 50% QUARTZ; 25% FELDSPAR, 25% EPIDOTE, IRON ORE, GRANITE FRAGMENTS
250						
255						
260						260' COBBLES - BOULDERS 264' COBBLES - BOULDERS
265						
270		BENTONITE				
275						
280		#3 MONTEREY SAND				

BORING LOG

PROJECT: EAGLE MOUNTAIN
JOB NUMBER: 0187073.03

HOLE / WELL #: MW - 1
PAGE: 6 OF 7



284' - 290' COBBLES - BOULDERS

COARSE SAND SIZED CUTTINGS, 30% MAFIC ROCK FRAGMENTS, 30% QUARTZ, 30% FELDSPAR, 10% EPIDOTE

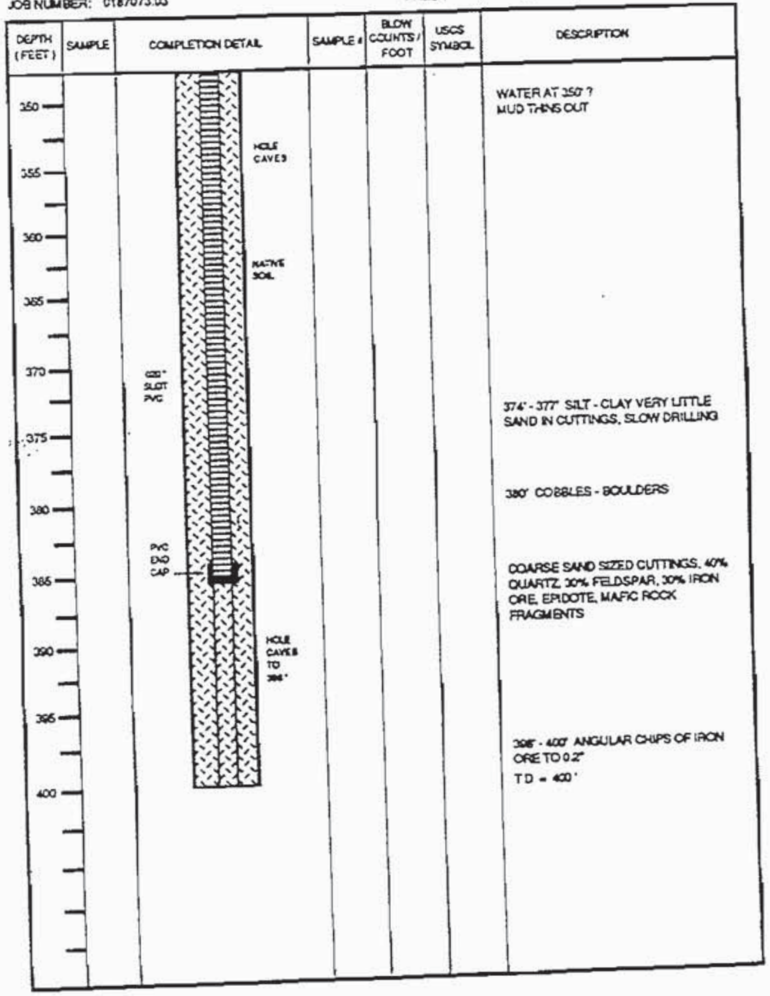
318' COBBLES - BOULDERS

328' - 330' COBBLES - BOULDERS

BORING LOG

PROJECT: EAGLE MOUNTAIN
JOB NUMBER: 0187073.03

HOLE / WELL #: MW - 1
PAGE: 7 OF 7



WATER AT 350' ?
MUD THINS OUT

374' - 377' SILT - CLAY VERY LITTLE SAND IN CUTTINGS, SLOW DRILLING

380' COBBLES - BOULDERS

COARSE SAND SIZED CUTTINGS, 40% QUARTZ, 30% FELDSPAR, 30% IRON ORE, EPIDOTE, MAFIC ROCK FRAGMENTS

398' - 400' ANGULAR CHIPS OF IRON ORE TO 0.2"

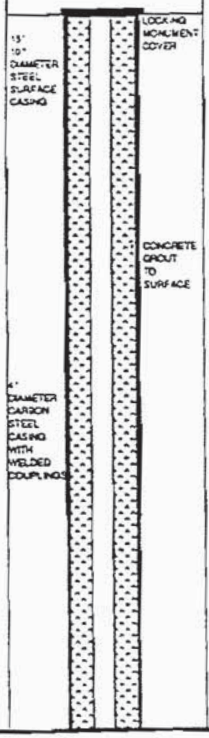
TD = 400'

BORING LOG

SCS ENGINEERS

PROJECT: EAGLE MOUNTAIN
LOCATION:
JOB NUMBER: 0187073.09
GEOLOGIST / ENGINEER B. GARBACCIO
DRILLER BEYUK
DRILL RIG. PORTADRILL
DRILLING METHOD. AIR ROTARY / MUD ROTARY

HOLE / WELL #: BH 4 / MW 2
DIAMETER: 10"
TOTAL DEPTH 455'
DATE STARTED. MARCH 26, 1990
DATE COMPLETED: APRIL 4, 1990
SAMPLING DEVICE CYCLONE
PAGE: 1 OF 9

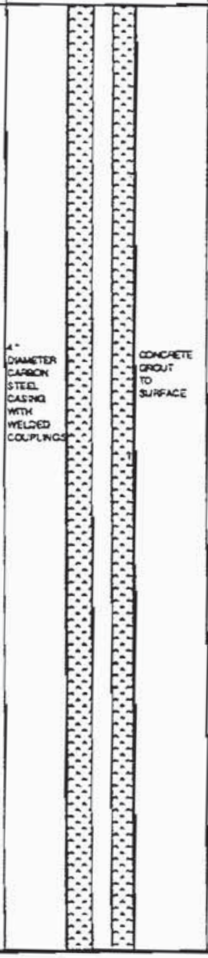


DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
						START WITH AUGER TO SET SURFACE CASING
0						
1					SC - GC	0 - 15' - TAN - LIGHT BROWN CLAYEY SAND WITH GRAVEL, COBBLES AND BOULDERS (TO 6" OBSERVED); SUBANGULAR TO SUBROUNDED; GRANITE, QUARTZITE, IRON ORE; DRY
2						
3						
4						
5						
6						
7						
8						
9						15' - 60' - DRILLED WITH 8" DOWNHOLE HAMMER
10						
11						
12						CUTTINGS SEGREGATE IN CYCLONE
13						
14						
15					SP	SAND WITH GRAVEL TO 1" OBSERVED, GRANITE WITH GREENSCHIST ALTERATION, CALC SILICATE ROCK, QUARTZITE, IRON ORE; NO CEMENT, SMALLER FRACTION IS MORE ANGULAR (FRAGMENTS OF LARGER ROCKS)
16						
17						
18						
19						
20						20' - SLIGHT CAVING

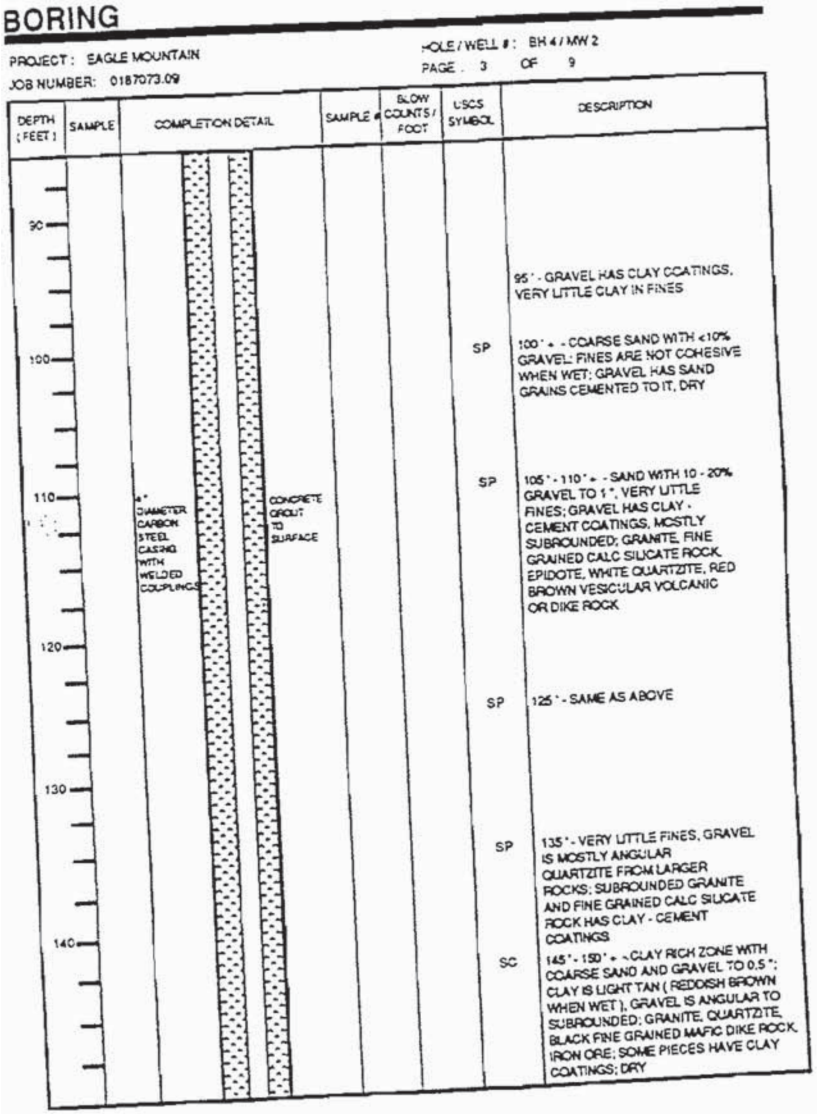
BORING

PROJECT: EAGLE MOUNTAIN
JOB NUMBER: 0187073.09

HOLE / WELL #: BH 4 / MW 2
PAGE. 2 OF 9



DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
30						
40					SP	40' - FINES ARE LOST FROM CYCLONE COARSE SAND AND GRAVEL TO 2" OBSERVED, ANGULAR TO SUBROUNDED, GRANITE, IRON ORE, QUARTZITE; NO CEMENT OR CLAY OBSERVED
						40' - 45' - BEGIN TO GET INTO CEMENTED ZONE, SEVERAL OF THE 0.1 - 0.2" GRAVEL GRAINS HAVE TAN CLAY COATINGS
50						
60					SP - GW	60' - SWITCH TO 5" TRICONE BIT
						SAND AND GRAVEL TO 1" OBSERVED, ANGULAR TO SUBROUNDED, WHOLE CLASTS AND PIECES OF LARGER ROCKS, NO CLAY OR CEMENT; GRANITE, QUARTZITE, IRON ORE, PALE GREEN MARBLE, EPIDOTE; DRY
70						
						75' - TRACE CEMENT ON 0.1 - 0.2" GRAVEL
80						80' - 85' - SMALL PIECES OF GRAVEL ARE PARTLY COATED WITH CLAY CEMENT, LARGE QUANTITY OF FINE BROWN CLAY IN DUST FROM CYCLONE, COHESIVE WHEN WET; DRY

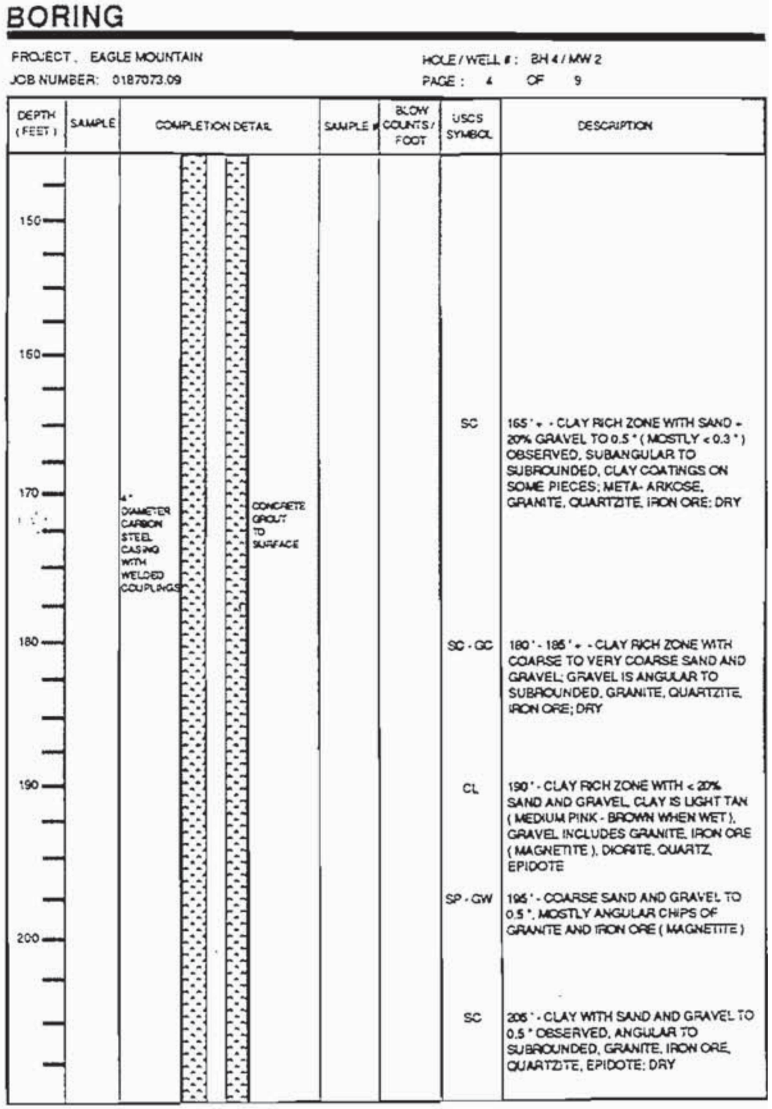


BORING

PROJECT: EAGLE MOUNTAIN
JOB NUMBER: 0187073.09

HOLE / WELL #: BH 4 / MW 2
PAGE 3 OF 9

DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
90						
						95' - GRAVEL HAS CLAY COATINGS, VERY LITTLE CLAY IN FINES
100					SP	100' + - COARSE SAND WITH <10% GRAVEL: FINES ARE NOT COHESIVE WHEN WET; GRAVEL HAS SAND GRAINS CEMENTED TO IT, DRY
					SP	105' - 110' + - SAND WITH 10 - 20% GRAVEL TO 1", VERY LITTLE FINES; GRAVEL HAS CLAY - CEMENT COATINGS, MOSTLY SUBROUNDED; GRANITE, FINE GRAINED CALC SILICATE ROCK, EPIDOTE, WHITE QUARTZITE, RED BROWN VESICULAR VOLCANIC OR DIKE ROCK
110		4" DIAMETER CARBON STEEL CASING WITH WELDED COUPLINGS CONCRETE GROUT TO SURFACE				
120						
					SP	125' - SAME AS ABOVE
130						
					SP	135' - VERY LITTLE FINES, GRAVEL IS MOSTLY ANGULAR QUARTZITE FROM LARGER ROCKS; SUBROUNDED GRANITE AND FINE GRAINED CALC SILICATE ROCK HAS CLAY - CEMENT COATINGS
140						
					SC	145' - 150' + - CLAY RICH ZONE WITH COARSE SAND AND GRAVEL TO 0.5"; CLAY IS LIGHT TAN (REDDISH BROWN WHEN WET), GRAVEL IS ANGULAR TO SUBROUNDED; GRANITE, QUARTZITE, BLACK FINE GRAINED MAFIC DIKE ROCK, IRON ORE; SOME PIECES HAVE CLAY COATINGS; DRY

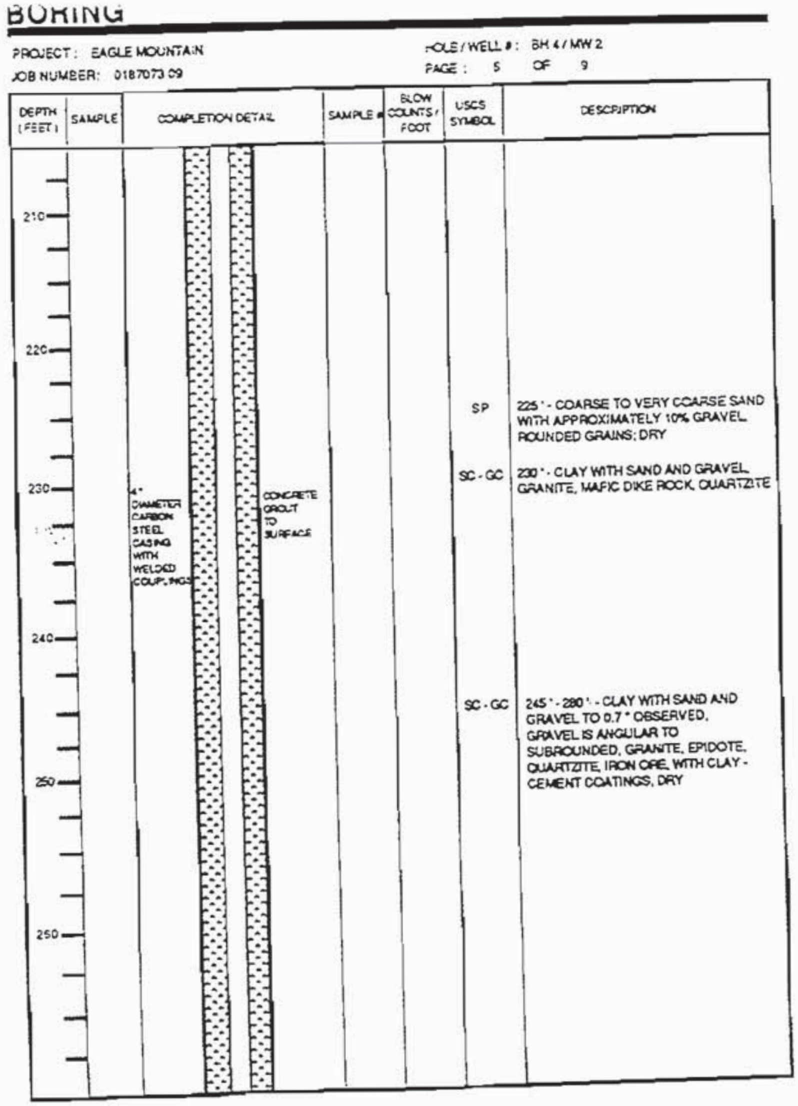


BORING

PROJECT. EAGLE MOUNTAIN
JOB NUMBER: 0187073.09

HOLE / WELL #: BH 4 / MW 2
PAGE: 4 OF 9

DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
150						
160						
					SC	165' + - CLAY RICH ZONE WITH SAND - 20% GRAVEL TO 0.5" (MOSTLY < 0.3") OBSERVED, SUBANGULAR TO SUBROUNDED, CLAY COATINGS ON SOME PIECES; META- ARKOSE, GRANITE, QUARTZITE, IRON ORE; DRY
170		4" DIAMETER CARBON STEEL CASING WITH WELDED COUPLINGS CONCRETE GROUT TO SURFACE				
180					SC - GC	180' - 185' + - CLAY RICH ZONE WITH COARSE TO VERY COARSE SAND AND GRAVEL; GRAVEL IS ANGULAR TO SUBROUNDED, GRANITE, QUARTZITE, IRON ORE; DRY
190					CL	190' - CLAY RICH ZONE WITH < 20% SAND AND GRAVEL, CLAY IS LIGHT TAN (MEDIUM PINK - BROWN WHEN WET), GRAVEL INCLUDES GRANITE, IRON ORE (MAGNETITE), DIORITE, QUARTZ, EPIDOTE
					SP - GW	195' - COARSE SAND AND GRAVEL TO 0.5", MOSTLY ANGULAR CHIPS OF GRANITE AND IRON ORE (MAGNETITE)
200						
					SC	205' - CLAY WITH SAND AND GRAVEL TO 0.5" OBSERVED, ANGULAR TO SUBROUNDED, GRANITE, IRON ORE, QUARTZITE, EPIDOTE; DRY

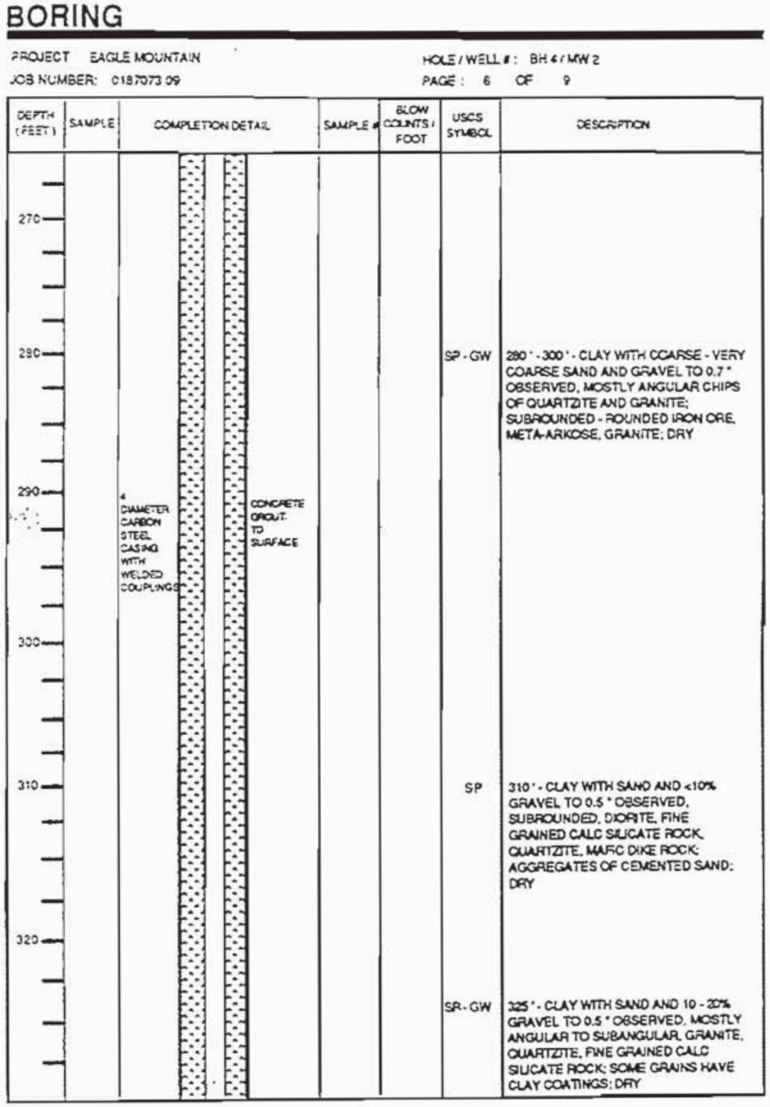


BORING

PROJECT : EAGLE MOUNTAIN
JOB NUMBER: 0187073 09

HOLE / WELL # : BH 4 / MW 2
PAGE : 5 OF 9

DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
210						
220						
					SP	225 ' - COARSE TO VERY COARSE SAND WITH APPROXIMATELY 10% GRAVEL ROUNDED GRAINS; DRY
					SC - GC	230 ' - CLAY WITH SAND AND GRAVEL GRANITE, MAFIC DIKE ROCK, QUARTZITE
230		4 " DIAMETER CARBON STEEL CASING WITH WELDED COUPLINGS CONCRETE GROUT TO SURFACE				
240						
					SC - GC	245 ' - 280 ' - CLAY WITH SAND AND GRAVEL TO 0.7 " OBSERVED, GRAVEL IS ANGULAR TO SUBROUNDED, GRANITE, EPIDOTE, QUARTZITE, IRON ORE, WITH CLAY - CEMENT COATINGS, DRY
250						
250						

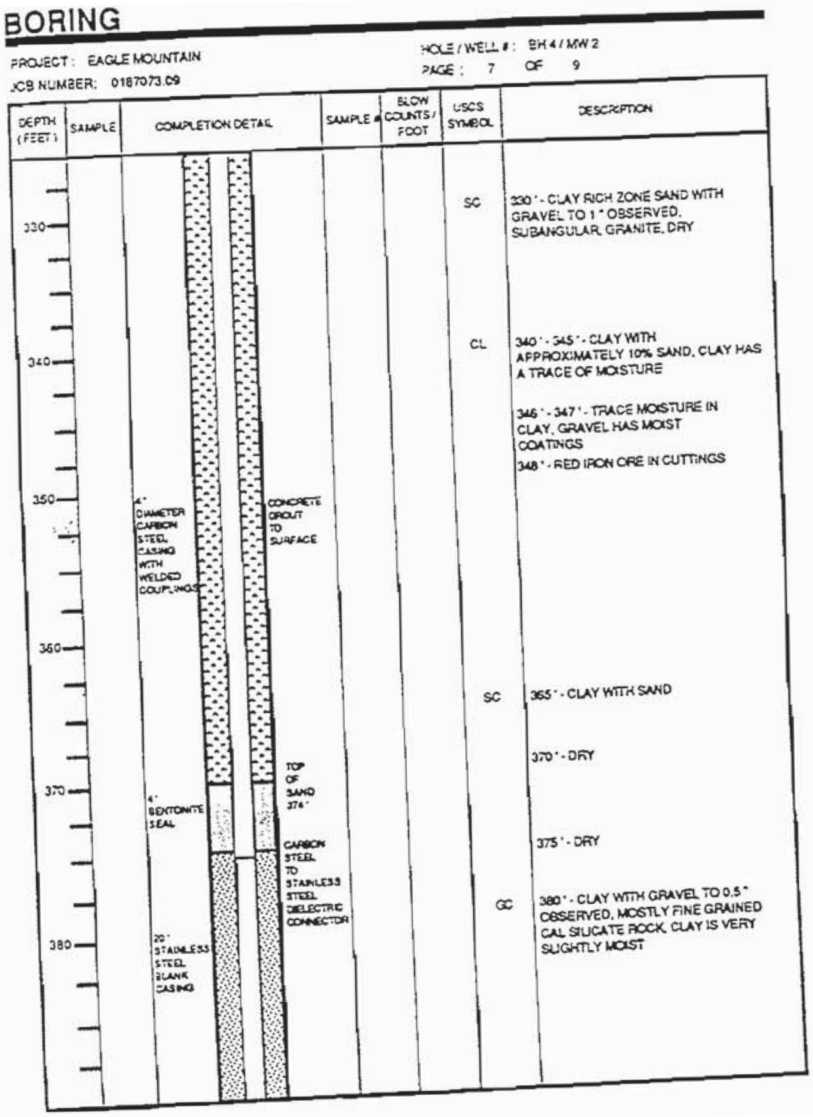


BORING

PROJECT EAGLE MOUNTAIN
JOB NUMBER: 0187073 09

HOLE / WELL # : BH 4 / MW 2
PAGE : 6 OF 9

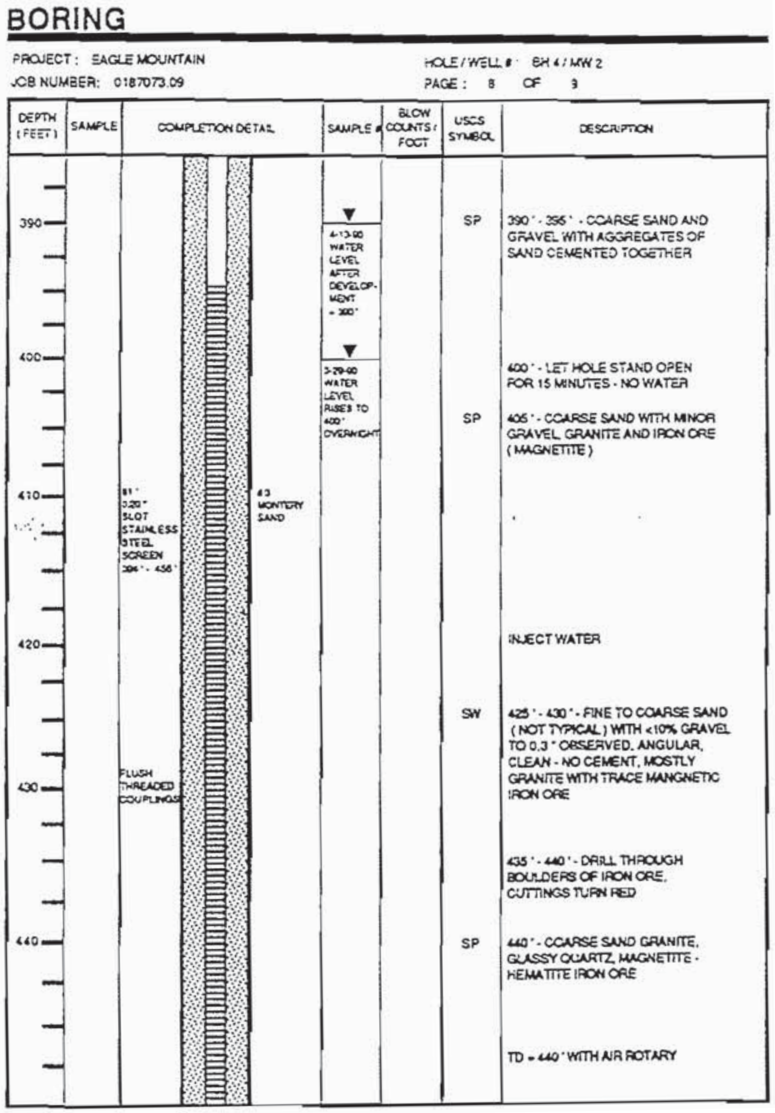
DEPTH (FEET)	SAMPLE	COMPLETION DETAIL	SAMPLE #	BLOW COUNTS / FOOT	USCS SYMBOL	DESCRIPTION
270						
280					SP - GW	280 ' - 300 ' - CLAY WITH COARSE - VERY COARSE SAND AND GRAVEL TO 0.7 " OBSERVED, MOSTLY ANGULAR CHIPS OF QUARTZITE AND GRANITE; SUBROUNDED - ROUNDED IRON ORE, META-ARKOSE, GRANITE; DRY
290		4 DIAMETER CARBON STEEL CASING WITH WELDED COUPLINGS CONCRETE GROUT TO SURFACE				
300						
310					SP	310 ' - CLAY WITH SAND AND <10% GRAVEL TO 0.5 " OBSERVED, SUBROUNDED, DIORITE, FINE GRAINED CALC SILICATE ROCK, QUARTZITE, MAFIC DIKE ROCK; AGGREGATES OF CEMENTED SAND; DRY
320						
					SR - GW	325 ' - CLAY WITH SAND AND 10 - 20% GRAVEL TO 0.5 " OBSERVED, MOSTLY ANGULAR TO SUBANGULAR, GRANITE, QUARTZITE, FINE GRAINED CALC SILICATE ROCK; SOME GRAINS HAVE CLAY COATINGS; DRY



BORING

PROJECT: EAGLE MOUNTAIN
JOB NUMBER: 0187073.09
HOLE / WELL #: BH 4 / MW 2
PAGE: 7 OF 9

USCS SYMBOL	DESCRIPTION
SC	330' - CLAY RICH ZONE SAND WITH GRAVEL TO 1" OBSERVED, SUBANGULAR GRANITE, DRY
CL	340' - 345' - CLAY WITH APPROXIMATELY 10% SAND, CLAY HAS A TRACE OF MOISTURE
	346' - 347' - TRACE MOISTURE IN CLAY, GRAVEL HAS MOIST COATINGS
	348' - RED IRON ORE IN CUTTINGS
SC	365' - CLAY WITH SAND
	370' - DRY
	375' - DRY
GC	380' - CLAY WITH GRAVEL TO 0.5" OBSERVED, MOSTLY FINE GRAINED CAL SILICATE ROCK, CLAY IS VERY SLIGHTLY MOIST



BORING

PROJECT: EAGLE MOUNTAIN
JOB NUMBER: 0187073.09
HOLE / WELL #: BH 4 / MW 2
PAGE: 8 OF 9

USCS SYMBOL	DESCRIPTION
SP	390' - 396' - COARSE SAND AND GRAVEL WITH AGGREGATES OF SAND CEMENTED TOGETHER
	400' - LET HOLE STAND OPEN FOR 15 MINUTES - NO WATER
SP	405' - COARSE SAND WITH MINOR GRAVEL, GRANITE AND IRON ORE (MAGNETITE)
	INJECT WATER
SW	425' - 430' - FINE TO COARSE SAND (NOT TYPICAL) WITH <10% GRAVEL TO 0.3" OBSERVED, ANGULAR, CLEAN - NO CEMENT, MOSTLY GRANITE WITH TRACE MANGNETIC IRON ORE
	435' - 440' - DRILL THROUGH BOULDERS OF IRON ORE, CUTTINGS TURN RED
SP	440' - COARSE SAND GRANITE, GLASSY QUARTZ, MAGNETITE - HEMATITE IRON ORE
	TD = 440' WITH AIR ROTARY

Site / Location CENTRAL PIT	Spud date 02/16/92	Borehole Dia 14"	Ground Elevation 2311.35'	Borehole No. MW - 10
Coordinates / Stationing	Completion Date 03/09/92	Logged By B. WILCOXCN, R. REYNOLDS, B MARSH		Bottom of Borehole (bgs) 1450'
Drill Make and Model INGERSOLL-RAND T 4 W	Drilling Method HAMMER / ROTARY	Drill Fluid AIR / MUD	Top of Bedrock (bgs) 7'	First Encountered Water (1301
Drilling Contractor TONTO DRILLING SERVICES	Surf Csg OD/ID/Depth 18" / 15 1/2" /40'	Total Core Recovery % N/A	Total Number of Core Boxes N/A	Static Water Level

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
Foreman: Wayne Beaupre Drill Crew A (Morning) Driller: Frank Night Helpers: Jim Wier Jason Verdi Drill Crew B (Afternoon) Driller: Mitch Bronson Helpers: Rick Gostovich Walt McKinney No samples taken for the first 310 feet.	18" tri cone							No samples taken before 310'.
310' depth at 5:00 p.m., added 20' rod, and resumed drilling at 5:05 p.m. on 02/16/92.			310' 20' in 55 min			310		310.0 - 320.0' IRON ORE: Dark gray, magnetite-rich; compact, hard, extremely strong; containing minor quartzite, calc-silicates
						320		320.0 - 350.0' QUARTZITE Yellow/brown, fine grained; very hard, very strong, minor calc-silicates and disseminated magnetite/hematite/goethite grains.
330' depth at 6:00 p.m., added 20' rod, and resumed drilling at 6:15 p.m. on 02/18/92.			330' 20' in 1 hr 30 min			330		
	14" Air Hammer					340		350.0 - 380.0' IRON ORE: Dark gray, brown, magnetite-rich; hard, strong, minor green/brown calc-silicates, actinolite; trace yellow/brown quartzite.
350' depth at 7:45 p.m., added 20' rod, and resumed drilling at 8:00 p.m. on 02/18/92.			350' 20' in 2 hrs			350		
						360		
370' depth at 10:00 p.m., added 20' rod and resumed drilling [illegible]/19/52.			370'			370		

Seal: IRVING DEAN AFFELDT No 1108 CERTIFIED ENGINEERING GEOLOGIST

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/1
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE
1 OF

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	14" Air Hammer		20' in 2 hrs 30 min			370		350.0 - 380.0' IRON ORE: Dark gray, brown, magnetite-rich; hard, extremely strong; minor green / brown calc-silicates, actinolite, trace yellow / brown quartzite.
						380		380.0 - 400.0' QUARTZ MONZONITE Light yellow to reddish brown, fine grained; hard, very strong; minor green calc-silicates (diopside / actinolite).
390' depth at 12:45 a.m., added 20' rod, and resumed drilling at 12:52 a.m. on 02/19/92.			390' 20' in 1 hr 15 min			390		
						400		400.0 - 420.0' IRON ORE: Dark gray to brown magnetite-hematite; hard, extremely strong; minor green calc-silicates (diopside / actinolite).
410' depth at 2:07 a.m., added 20' rod, and resumed drilling at 2:19 a.m. on 02/19/92.			410' 20' in 3 hrs 32 min			410		
						420		420.0 - 440.0' SKARN: Dark gray calc-silicates(diopside / actinolite); hard, moderately strong; trace dark gray iron ore.
430' depth at 5:51 a.m., added 20' rod, and resumed drilling at 6:01 a.m. on 02/19/92.			430' 20' in 29 min			430		
						440		440.0 - 450.0' QUARTZ MONZONITE Reddish brown, fine grained; very hard, very strong; minor dark green calc-silicates (diopside / actinolite).
450' depth at 6:30 a.m., added 20' rod, and resumed drilling at 6:42 a.m. on 02/19/92.			450'			450		450.0 - 450.0' MAFIC DIKE:

Seal: REGISTERED GEOLOGIST IRVING DEAN AFFELDT No 1108 CERTIFIED ENGINEERING GEOLOGIST

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM15010/2
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO
2 OF

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 6 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	14" Air Hammer		20' in 3 hr 5 mins			450		450.0 - 460.0' MAFIC DIKE: Gray green, propylitic alteration of feldspar, trace quartz.
						460		460.0 - 470.0' SKARN: Dark green calc-silicates (diopside /actinolite), with 50% magnetite-hematite ore
470' depth at 9:47 a.m., added 20' rod, and resumed drilling at 9:58 a.m. on 02/19/92.			470' 20' in 2 hrs 17 min			470		470.0 - 540.0' IRON ORE Dark gray magnetite-hematite, with silver / bronze colored mica (sericite ?) throughout hard, strong
						480		480.0 - 490.0' Minor dark green calc-silicates
490' depth at 12:15 p.m., added 20' rod, and resumed drilling at 2:10 p.m. on 02/19/92.			490' 20' in 5 hrs			490		490.0 - 500.0' Increase in dark green calc-silicates. Decrease in light green calc-silicates.
Deviation Survey = 1/2°.						500		500.0 - 540.0' Minor dark green calc-silicates
510' depth at 7:10 p.m., added 20' rod, and resumed drilling at 9:30 p.m. on 02/19/92.			510' 20' in 2 hrs			510		
						520		
530' depth at 11:30 p.m., added 20' rod, and resumed drilling at [illegible]			530'			530		

IRVING DEAN AFFELDT
No 1108

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/3
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

3 OF 15

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 6 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	14" Air Hammer		20' in 1 hr 25 min			530		470.0 - 590.0' IRON ORE Dark gray magnetite-hematite, with silver / bronze colored mica throughout hard, strong.
						540		
550' depth at 1:20 a.m., added 20' rod, and resumed drilling at 2:36 a.m. on 02/20/92.			550' 20' in 4 hrs 48 min			550		
						560		
570' depth at 6:12 a.m., added 20' rod, and resumed drilling at 6:20 a.m. on 02/20/92.			570' 20' in 2.0 hrs 7 min			570		
						580		
590' depth at 2:27 a.m., added 20' rod, and resumed drilling at 2:45 a.m. on 02/21/92.			590' 20' in 5 hrs 15 min			590		590.0 - 600.0' SKARN: Dark green calc-silicates (diopside /actinolite). hard, extremely strong; minor magnetite.
Deviation Survey = 1°.						600		600.0 - 620.0' QUARTZITE: Yellow / brown, fine grained; very hard, very strong; minor banding of calc-silicates.
610' depth at 8:00 p.m., added [illegible] resumed [illegible]			610'			610		

IRVING DEAN AFFELDT
No 1108

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/4
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE A-
4 OF 15

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	14" Air Hammer					610		600.0 - 620.0' QUARTZITE Yellow / brown, fine grained; very hard, very strong; minor banding of calc-silicates.
						620		620.0 - 630.0' ANDESITE Dark gray, porphyritic; hard, very strong; minor quartz monzonite.
			630'			630		630.0 - 640.0' QUARTZ MONZONITE Light yellow to reddish brown, fine grained; hard, very strong; minor epidote, trace calcite
						640		640.0 - 650.0' QUARTZITE Dark green / gray, fine grained; very hard very strong; minor epidote, tremolite, trace limonite.
650' depth at 9:50 p.m., added 20' rod, and resumed drilling at 11:01 p.m. on 02/22/92.			650' 20' in 12 hrs 14 min			650		650.0 - 670.0' ANDESITE Dark gray, porphyritic; hard, very strong; minor quartz monzonite.
Break in hydraulic hose, rig shut down. Resumed drilling at 6:16 p.m. on 02/22/92.						660		
670' depth at 11:00 p.m., added 20' rod, and resumed drilling at 11:15 p.m. on 02/22/92.			670' 20' in 15 hrs 45 min			670		670.0 - 690.0' QUARTZITE Light gray to dark gray green; very hard, very strong; minor limonite.
						680		
690' depth at 3:00 p.m., added 20' rod, and resumed drilling at [illegible] on 02/23/92.			690'			690		690.0 - 730.0' ANDESITE:

Irving Dean Affeldt
No 1108

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/5
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	13 3/4" Tri Cone		20' in 45 hrs			690		690.0 - 730.0' ANDESITE Medium-dark gray, fine grained; hard, very strong; minor iron ore and quartz monzonite, trace epidote and limonite stain.
						700		
710' depth at 12:30 p.m., added 20' rod, and resumed drilling at 7:45 a.m. on 02/25/92.			710' 20' in 3 hrs 45 min			710		
	13 1/2" Tri Cone					720		
730' depth at 11:00 a.m., added 20' rod, and resumed drilling at 11:15 a.m. on 02/25/92.			730' 20' in 5 hrs 25 min			730		730.0 - 750.0' IRON ORE Dark gray magnetite-hematite; hard, strong; minor epidote.
	12 3/4" Tri Cone					740		
750' depth at 4:35 p.m., added 20' rod, and resumed drilling at 4:50 p.m. on 02/25/92.			750' 20' in 2 hrs 25 min			750		750.0 - 760.0' ANDESITE: Medium-dark gray, fine grained; hard, very strong; minor iron ore and quartz monzonite, trace epidote and limonite stain.
						760		760.0 - 770.0' QUARTZITE Tan gray to gray green, fine grained; very hard, very strong; minor limonite staining.
770' depth at 7:15 p.m., added 20' rod, and resumed drilling at [illegible] on 02/25/92.			770'			770		770.0 - 780.0' ANDESITE.

Irving Dean Affeldt
No 1108

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/6
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	12 3/4" Tri Cone		20' in 25 hrs 30 min			770		770.0 - 780.0' ANDESITE Medium to dark gray, fine grained; hard, very strong; minor quartzite and limonite stain, trace iron ore and epidote.
						780		780.0 - 790.0' QUARTZ MONZONITE: Light yellow to reddish brown, fine grained; hard, very strong; minor iron ore, trace limonite stain.
790' depth at 10:00 p.m., added 20' rod, and resumed drilling at 12:01 a.m. on 02/25/92.			790' 20' in 8 hrs 27 min			790		790.0 - 810.0' QUARTZITE: Light gray green, fine grained; very hard, very strong; minor iron ore.
Deviation Survey = 2°	13 1/2" Tri Cone							
						800		
810' depth at 8:25 a.m., added 20' rod, and resumed drilling at 8:35 a.m. on 02/26/92.			810' 20' in 2 hrs 10 min			810		
						820		
830' depth at 10:45 a.m., stop to repair beam pump. Added 20' rod, and resumed drilling at 4:50 p.m. on 02/25/92.	13 3/4" Tri Cone		830' 20' in 2 hrs 57 min			830		810.0 - 850.0' ANDESITE. Dark green to gray tan, fine grained; hard, very strong; minor iron ore with disseminated pyrite, trace limonite.
						840		
850' depth at 4:30 p.m., added 20' rod and resumed drilling at [illegible] on 02/26/92.			850'			850		850.0 - 860.0' QUARTZITE:

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/7
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE
7 OF

IRVING DEAN AFFELDT
No 1108

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	13 3/4" Tri Cone		20' in 2 hrs 45 min			850		850.0 - 860.0' QUARTZITE. Light gray green, fine grained; hard, very strong; minor iron ore and andesite.
						860		860.0 - 890.0' ANDESITE. Light to dark green, fine grained; hard, very strong; minor limonite, iron ore, trace pyrite.
870' depth at 7:30 p.m., added 20' rod, and resumed drilling at 7:45 p.m. on 02/25/92.			870'			870		
						880		
			890'			890		890.0 - 970.0' QUARTZITE. Gray - green, fine grained; very hard, very strong; minor epidote
						900		
910' depth at 2:04 a.m., added 20' rod, and resumed drilling at 2:19 a.m. on 02/27/92.	13 1/2" Tri Cone		910' 20' in 3 hrs 16 min			910		
						920		920.0 - 930.0' Trace tremolite and pyrite.
850' depth at 5:35 a.m., added 20' rod, and resumed drilling at [illegible] on 02/27/92.			930'			930		

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/8
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE
8 OF

IRVING DEAN AFFELDT
No 1108

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	13 1/2" Tri Cone					930		890.0 - 970.0' QUARTZITE Gray - green, fine grained; very hard, very strong; minor epidote.
						940		
	13 3/4" Tri Cone					950		
						960		
						970		970.0 - 990.0' ANDESITE. Dark green, fine grained; hard, very strong; minor quartzite, trace limonite.
						980		
						990		990.0 - 1010.0' QUARTZITE Light green to gray, fine grained; very hard, very strong.
Deviation Survey = 1.5°						1000		1000.0 - 1010.0' Minor gray to light green andesite.
1010' depth at 3:17 a.m., added 20' [illegible] drilling [illegible]			1010'			1010		1010.0 - 1070.0' ANDESITE:

IRVING DEAN AFFELDT
No 1108

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/9
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO
9 OF 15

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	13 3/4" Tri Cone					1010		1010.0 - 1070.0' ANDESITE: Dark green to gray, fine grained; hard, very strong; trace limonite. 1010.0 - 1070.0' Slightly porphyritic trace magnetite.
Lost circulation						1020		
1030' depth at 6:25 a.m., 03/01/92						1030		
						1040		
						1050		1050.0 - 1060.0' Epidote, actinolite
						1060		1060.0 - 1070.0' Trace clear quartz.
						1070		1070.0 - 1090.0' IRON ORE: Dark gray magnetite-hematite; hard, strong; abundant pyrite, minor tremolite.
						1080		1080.0 - 1090.0' Trace andesite.
			1090'			1090		1090.0 - 1195.0' ANDESITE:

IRVING DEAN AFFELDT
No 1108

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/10
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE
10 OF

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	13 3/4" Tri Cone					1090		**1090.0 - 1195.0' ANDESITE** Dark green to black, fine grained; hard, very strong; minor magnetite and pyrite, trace quartz, epidote, tremolite, biotite.
						1100		
	13 1/2" Tri Cone							
						1110		
						1120		
						1130		
						1140		1140.0 - 1150.0' Medium gray-green; minor quartzite and epidote.
						1150		1150.0 - 1195.0' Dark gray - green.
						1160		1160.0 - 1195.0' Trace magnetite.
			1090'			1170		

IRVING DEAN AFFELDT
No 1108

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/11
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE
11 O

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	13 1/2" Tri Cone					1170		**1090.0 - 1195.0' ANDESITE** Dark green to black, fine grained; hard, very strong; minor magnetite and pyrite, trace quartz, epidote, tremolite, biotite.
						1180		
						1190		
								1195.0 - 1235.0' QUARTZITE Light green - gray, very fine grained; very hard, very strong; minor chlorite, trace biotite.
1200' depth at 6:40 p.m., on 03/02/92						1200		
						1210		1210.0 - 1235.0' Minor dark green to black andesite, trace limonite stain.
1220' depth at 12:01 a.m., on 03/03/92						1220		1220.0 - 1235.0' Trace magnetite.
						1230		
								1235.0 - 1430.0' ANDESITE Dark green to black, fine grained, hard, very strong, minor magnetite and epidote, trace limonite stain
1240' depth at 5:27 a.m., on 03/03/92						1240		
						1250		

IRVING DEAN AFFELDT
No 1108

DATE	04/92
JOB NO.	G125-19
DWG NO.	EM19010/12
DRAWN	J HATALA
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
MW-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO.
12 OF 15

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	13 1/2" Tri Cone					1250		<u>1235.0 - 1480.0' ANDESITE</u> Dark green to black, fine grained; hard, very strong; minor magnetite and epidote, trace limonite. 1250.0 - 1260.0' Minor quartzite, trace crystal calcite
1260' depth at 8:00 a.m., on 03/03/92.						1260		1260.0 - 1270.0' Abundant pink calcite, minor pink vein quartz.
						1270		1270.0 - 1280.0' Abundant pale green quartzite, minor amphibole, calcite.
1287' depth at 4:00 p.m., on 03/03/92.						1280		
						1290		1290.0 - 1300.0' 15% magnetite, trace pyrite.
1300' depth at 5:54 a.m., on 03/04/92.						1300		
						1310		
						1320		
						1330		

IRVING DEAN AFFELDT
№ 1108

DATE	04/92	**The PRA Group, Inc** CONSULTING ENGINEERS
JOB NO.	G125-19	BOREHOLE LOG MW-10 EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
DWG NO.	EM19010/13	
DRAWN	J HATALA	
CHK'D	R HARRIS	
APP'D	D AFFELDT	MINE RECLAMATION CORPORATION

13 OF 15

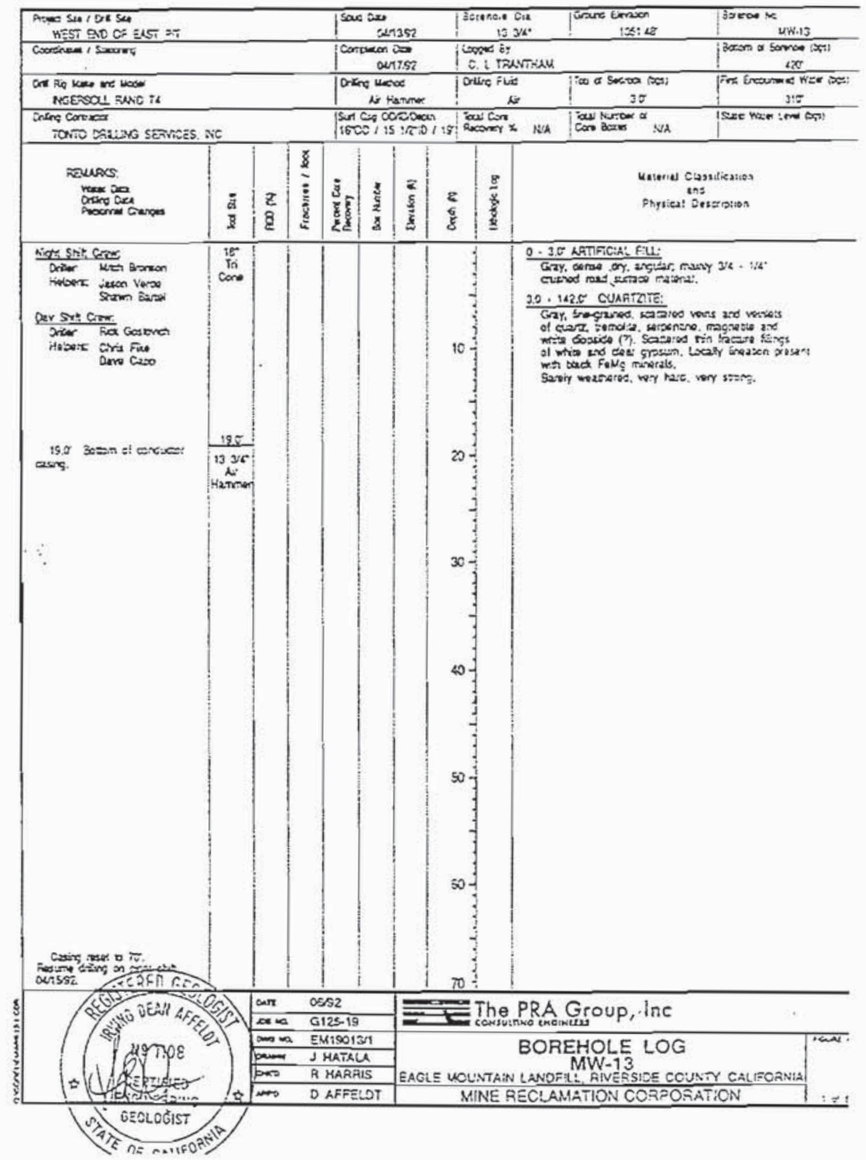
REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	Blows / RQD %	Advance / Recovery	Drill Rate (Min / 5 ft)	Elevation (ft)	Depth (ft)	Material Log	Material Classification and Physical Description
	13 1/2" Tri Cone					1330		<u>1235.0 - 1480.0' ANDESITE</u> Dark green to black, fine grained; hard, very strong; minor magnetite and epidote, trace limonite stain.
						1340		1340.0 - 1350.0' Trace pyrite, actinolite.
						1350		
						1360		
						1370		1370.0 - 1390.0' Abundant limonite, trace calcite.
						1380		
						1390		1390.0 - 1400.0' Abundant amphibole.
						1400		
						1410		1400.0 - 1410.0' Trace pyrite, rare calc-silicates.

IRVING DEAN AFFELDT
№ 1108
CERTIFIED ENGINEERING GEOLOGIST

DATE	04/92	**The PRA Group, Inc** CONSULTING ENGINEERS
JOB NO.	G125-19	BOREHOLE LOG MW-10 EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
DWG NO.	EM19010/14	
DRAWN	J HATALA	
CHK'D	R HARRIS	
APP'D	D AFFELDT	MINE RECLAMATION CORPORATION

FIGURE

14 OF



Project Site / Drill Site: WEST END OF EAST PIT
Spud Date: 04/13/92
Borehole Dia: 13 3/4"
Ground Elevation: 1351.48'
Borehole No: MW-13
Coordinates / Stationing:
Completion Date: 04/17/92
Logged By: C. L. TRANTHAM
Bottom of Borehole (bgs): 420'
Drill Rig Make and Model: INGERSOLL RAND T4
Drilling Method: Air Hammer
Drilling Fluid: Air
Top of Bedrock (bgs): 3.0'
First Encountered Water (bgs): 310'
Drilling Contractor: TONTO DRILLING SERVICES, INC
Surf Csg OD/ID/Depth: 16"OD / 15 1/2"ID / 19'
Total Core Recovery %: N/A
Total Number of Core Boxes: N/A
Static Water Level (bgs):

REMARKS:
Water Data
Drilling Data
Personnel Changes

Material Classification and Physical Description

Night Shift Crew:
Driller: Mitch Bronson
Helpers: Jason Verde
Shawn Bartel

Day Shift Crew:
Driller: Rick Gostovich
Helpers: Chris Fike
Dave Cazo

18" Tri Cone

19.0' Bottom of conductor casing.

19.0'
13 3/4" Air Hammer

Casing reset to 70'.
Resume drilling on [illegible]
04/15/92.

0 - 3.0' ARTIFICIAL FILL:
Gray, dense, dry, angular, mainly 3/4 - 1/4" crushed road surface material.

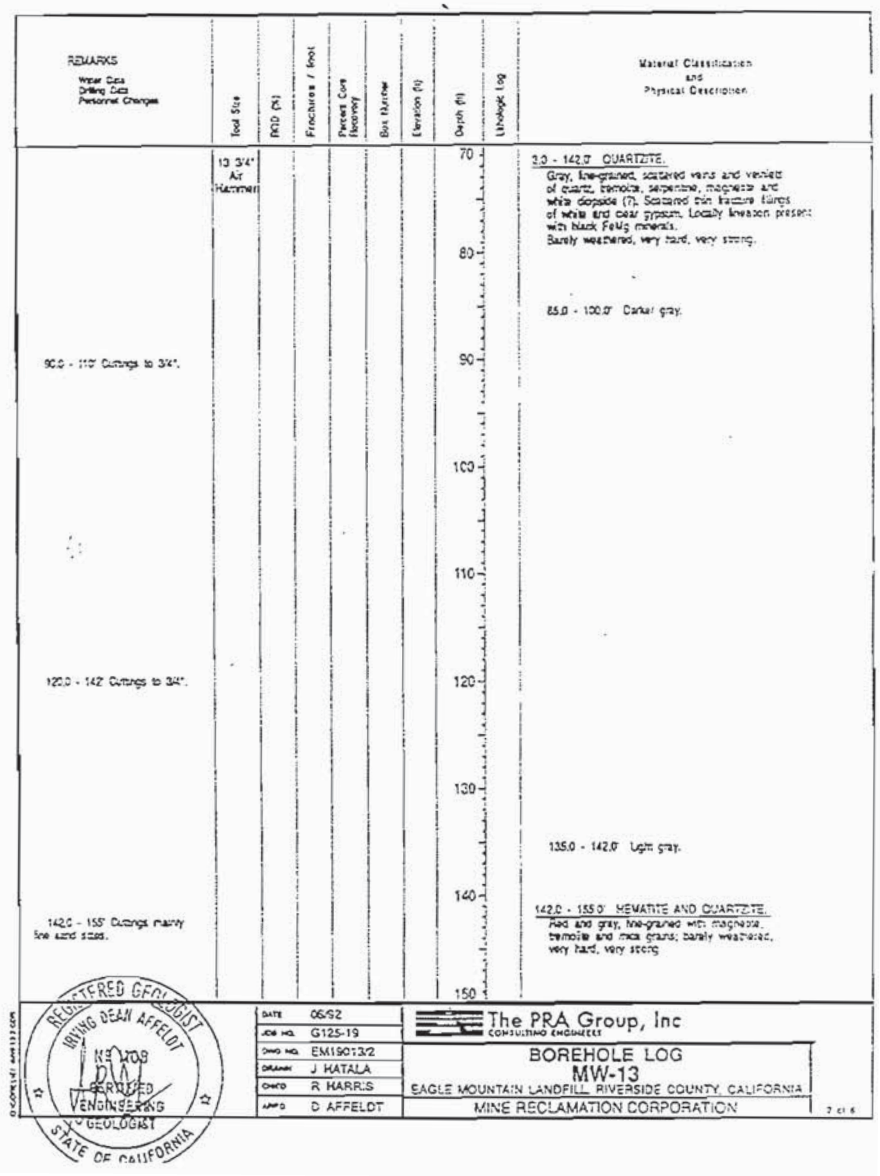
3.0 - 142.0' QUARTZITE:
Gray, fine-grained, scattered veins and veinlets of quartz, tremolite, serpentine, magnetite and white diopside (?). Scattered thin fracture fillings of white and clear gypsum. Locally lineation present with black FeMg minerals.
Barely weathered, very hard, very strong.

DATE 06/92
JOB NO. G125-19
DWG NO. EM19013/1
DRAWN J HATALA
CHK'D R HARRIS
APP'D D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
MW-13
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

IRVING DEAN AFFELDT
No. 1108



REMARKS
Water Data
Drilling Data
Personnel Changes

Material Classification and Physical Description

13 3/4" Air Hammer

90.0 - 110' Cuttings to 3/4".

120.0 - 142' Cuttings to 3/4".

142.0 - 155' Cuttings mainly fine sand sizes.

3.0 - 142.0' QUARTZITE.
Gray, fine-grained, scattered veins and veinlets of quartz, tremolite, serpentine, magnetite and white diopside (?). Scattered thin fracture fillings of white and clear gypsum. Locally lineation present with black FeMg minerals.
Barely weathered, very hard, very strong.

85.0 - 100.0' Darker gray.

135.0 - 142.0' Light gray.

142.0 - 155.0' HEMATITE AND QUARTZITE.
Red and gray, fine-grained with magnetite, tremolite and mica grains; barely weathered, very hard, very strong.

DATE 06/92
JOB NO. G125-19
DWG NO. EM19013/2
DRAWN J HATALA
CHK'D R HARRIS
APP'D D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
MW-13
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

2 of 6

IRVING DEAN AFFELDT
No. 1108

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
	13 3/4" Air Hammer						150		**142.0 - 155.0' HEMATITE QUARTZITE.** Red and gray, fine-grained.
155-210' Cuttings are mainly fine and medium-grained sand sizes.									**155.0 - 210.0' QUARTZITE.** Gray, fine-grained, scattered seams/layers and veinlets of magnetite, hematite, mica, actinolite, tremolite, white quartz, talc. Barely weathered, very hard, very strong
							160		
							170		
							180		180.0 - 190.0' Increased percent of magnetite in cuttings.
							190		190.0 - 210.0' Approximately 40% of cuttings are magnetite; trace mica and serpentine. Increased percent of magnetite with depth.
							200		
210-225' Cuttings are mostly fine and medium-grained sand sizes.							210		**210.0 - 2750.0' MAGNETITE, HEMATITE QUARTZITE INTERMIXED:** Dark gray, fine-grained, metallic black magnetite, reddish hematite and gray quartzite. Minor veinlets and fracture fillings of milky quartz, mica, actinolite, and serpentine. Barely weathered, moderately hard, very strong, brittle. Scattered iron stained fractures.
							220		
225-227' Cuttings are fine through coarse sand sizes.							230		

IRVING DEAN AFFELDT
No. 1108

DATE	06/92
JOB NO.	G125-19
DWG NO.	EM19013/3
DRAWN	J HATALA
CHKD	P. HARRIS
APPD	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
MW-13
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO
3 of 8

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
230' Cuttings predominantly fine and medium sand sizes.	13 3/4" Air Hammer						230		**210.0 - 2750.0' MAGNETITE, HEMATITE, QUARTZITE INTERMIXED:** Dark gray, fine-grained, brittle. 230.0 - 275.0' Mostly magnetite. 230.0 - 250.0' Pyrite fragments in cuttings.
							240		
							250		250.0 - 260.0' Decrease in percent magnetite and increase in percent hematite.
							260		
							270		**275.0 - 420.0' QUARTZITE:** Gray, fine-grained, scattered veinlets of magnetite. Some fracture filling with gypsum. Few brecciated pieces with quartz, feldspar and mica. Locally banding and lineation in the quartzite. Barely weathered, very hard, very strong. chlorite, epidote, calcite fd
							280		
							290		
							300		
310.0' Depth at end of night shift on 04/15/92. Encountered initial water at 310' [illegible] 04/17/92. dry							310		

IRVING DEAN AFFELDT
No. 1108

DATE	06/92
JOB NO.	G125-19
DWG NO.	EM19013/4
DRAWN	J HATALA
CHKD	R HARRIS
APPD	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
MW-13
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY CALIFORNIA
MINE RECLAMATION CORPORATION

4 of 4

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
310' Depth at 7:30 a.m., on 04/17/92. 315' Begin injecting some water.	12 1/4" Tri Cone						310		**275.0 - 420.0' QUARTZITE:** Gray, fine-grained, scattered veinlets of magnetite. Some fracture filling with gypsum. Few brecciated pieces with quartz, feldspar and mica. Locally banding and lineation in the quartzite. Barely weathered, very hard, very strong, chlorite, epidote, calcite fill.
320 - 330' Driller reports very tight (as when clay squeezes in hole).							320		320.0 - 330.0' Some brecciation, minor serpentine and magnetite.
330' Depth at 10:00 a.m., on 04/17/92.							330		330.0 - 340.0' Banding more noticeable.
							340		340.0 - 355.0' Increase in percent pink feldspar. Scattered oxidized fractures, some filled with clay, some banding and lineation.
350' Depth at 10:50 a.m., on 04/17/92. 350 - 360' Driller reports very tight.							350		350.0 - 355.0' Brecciated (?), healed, with clay and gouge (?).
							360		355.0 - 375.0' Reddish brown color of cuttings due to scattered magnetite veins. Scattered mica, actinolite-tremolite veinlets. Scattered iron-stained fractures.
370' End day shift on 04/17/92 and begin night shift on 04/17/92.							370		
							380		375.0 - 420.0' Light greenish gray, brecciated with scattered minor veinlets of hematite/magnetite/serpentine; and veins of actinolite/tremolite in a clayey gouge. Scattered iron-stained fractures.
							390		

IRVING DEAN AFFELDT
Nº 1108
CERTIFIED ENGINEERING GEOLOGIST

DATE 06/92
JOB NO. G125-19
DWG NO. EM19013/5
DRAWN J HATALA
CHK'D R HARRIS
APP'D D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
MW-13
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO
5 of 6

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
	12 1/4" Tri Cone						390		**275.0 - 420.0' QUARTZITE:** Gray, fine-grained, scattered veinlets of magnetite. Some fracture filling with gypsum. Few brecciated pieces with quartz, feldspar and mica. Locally banding and lineation in the quartzite. Barely weathered, very hard, very strong. Chlorite, epidote, calcite fill.
							400		375.0 - 420.0' Light greenish gray.
							410		
420.0' Completed drilling on night shift on 04/17/92.							420		
									Bottom of Borehole Total Depth 420.0 feet Elevation 531.48 feet
							430		
							440		
							450		
							460		
							470		

IRVING DEAN AFFELDT
Nº 1108
CERTIFIED ENGINEERING GEOLOGIST

DATE 06/92
JOB NO. G125-19
DWG NO. EM19013/6
DRAWN J HATALA
CHK'D R HARRIS
APP'D D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
MW-13
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

6 of 6

APPENDIX A

LITHOLOGIC DESCRIPTION

Eagle Mountain Piezometer No. 1

0 - 15ft	ARTIFICIAL FILL
15 - 25ft	QUARTZITE
25 - 45ft	QUARTZITE AND QUARTZ MONZONITE
45 - 65ft	QUARTZITE
65 - 80ft	QUARTZ MONZONITE
80 - 196ft	QUARTZITE
196 - 200ft	QUARTZ MONZONITE WITH SOME QUARTZITE
200 - 205ft	QUARTZITE WITH SOME QUARTZ MONZONITE
205 - 270ft	QUARTZ MONZONITE

APPENDIX A

LITHOLOGIC DESCRIPTION

Eagle Mountain Piezometer No. 11

0- 10ft POORLY GRADED SAND (SP) : Trace coarse, angular to subrounded gravel; 10% fine, angular to subrounded gravel; 25% coarse, angular to subrounded sand; 60% medium, angular to subrounded sand; 5% fine, subangular to subrounded sand; brown, dry, maximum size = 25mm

10 - 20ft POORLY GRADED SAND WITH GRAVEL (SP) : 20% coarse, angular to subangular gravel; 15% fine, angular to subangular gravel; 30% coarse, angular to subrounded sand; 35% medium, angular to subrounded sand; trace fine sand; brown, dry, maximum size = 30mm

20 - 75ft POORLY GRADED SAND WITH GRAVEL (SP) : 5% coarse, angular to subangular gravel; 10% fine, angular to subangular gravel; 40% coarse, angular to subangular sand; 45% medium, angular to subangular sand; trace fine, subangular to subrounded sand; brown, dry, maximum size = 35mm

75 - 135ft POORLY GRADED GRAVEL WITH SAND (GP) : 25% coarse, angular to subrounded gravel; 35% fine, angular to subrounded gravel; 20% coarse, angular to subrounded sand; 20% medium, angular to subrounded sand; trace fine sand; brown, dry, maximum size = 43mm

135 - 205ft POORLY GRADED SAND WITH GRAVEL (SP) : 10% coarse, angular to subrounded gravel; 15% fine, angular to subrounded gravel; 30% coarse, angular to subrounded sand; 40% medium, angular to subrounded sand; 5% fine, subangular to subrounded sand; brown, moist (due to injection of water during drilling), maximum size = 37mm

205 - 210ft POORLY GRADED GRAVEL (GP) : 80% coarse, subangular to subrounded gravel; 20% fine, subangular to subrounded gravel; trace coarse, subangular to subrounded sand; trace medium, subangular to subrounded sand; trace fine, subangular to subrounded sand; trace fines; no dilatancy, medium toughness, medium plasticity, medium dry strength; brown, moist (due to injection of water during drilling), maximum size = 40mm

210- 255ft POORLY GRADED SAND (SP) : Trace coarse, subangular to subrounded gravel; trace fine, subangular to subrounded gravel; 15% coarse, subangular to subrounded sand; 85% medium, subangular to subrounded sand; trace fine, subangular to subrounded sand; brown, dry, maximum size = 39mm

LITHOLOGIC DESCRIPTION - Piezometer No. 11 (cont.)

255- 270ft SANDY LEAN CLAY (CL) : Trace fine, angular to subrounded gravel; trace coarse, angular to subrounded sand; 10% medium, angular to subrounded sand; 20% fine, subangular to subrounded sand; 70% fines; no dilatancy, medium toughness, medium plasticity, medium dry strength; brown, moist (due to injection of water during drilling)

270- 310ft CLAYEY SAND (SC) : Trace fine, angular to subrounded gravel; 5% coarse, angular to subrounded sand; 30% medium, angular to subrounded sand; 35% fine, subangular to subrounded sand; 30% fines; no dilatancy, medium toughness, medium plasticity, medium dry strength; brown, moist (due to injection of water during drilling)

310- 345ft SANDY LEAN CLAY (CL) : Trace fine, angular to subrounded gravel; trace coarse, angular to subrounded sand; 10% medium, subangular to subrounded sand; 30% fine, subangular to subrounded sand; 60% fines; no dilatancy, medium toughness, medium plasticity, medium dry strength; brown, moist (due to injection of water during drilling)

345- 365ft CLAYEY SAND (SC) : Trace fine, angular to subangular gravel; 10% coarse, angular to subangular sand; 40% medium, angular to subrounded sand; 30% fine, subangular to subrounded sand; 20% fines no dilatancy, medium toughness, medium plasticity, medium dry strength; brown, moist (due to injection of water during drilling)

365- 485ft POORLY GRADED SAND (SP) : 5% fine, angular to subrounded gravel; 40% coarse, angular to subrounded sand; 55% medium, angular to subrounded sand; trace fine, subangular to subrounded sand; trace fines; brown, dry

APPENDIX A

LITHOLOGIC DESCRIPTION

Eagle Mountain Piezometer No. 12

0- 10ft	POORLY GRADED SAND (SP) : 10% coarse, angular to subrounded gravel; 10% fine, angular to subrounded gravel; 45% coarse, angular to subrounded sand; 35% medium, angular to subrounded sand; trace fine sand; brown, dry, maximum size = 38mm
10 - 15ft	POORLY GRADED GRAVEL WITH SAND (GP) : 25% coarse, angular to subrounded gravel; 35% fine, angular to subrounded gravel; 25% coarse, angular to subrounded sand; 15% medium, angular to subrounded sand; trace fine sand; brown, dry, maximum size = 40mm
15 - 30ft	POORLY GRADED SAND WITH GRAVEL (SP) : 5% coarse, angular to subrounded gravel; 20% fine, angular to subrounded gravel; 40% coarse, angular to subrounded sand; 35% medium, angular to subrounded sand; trace fine sand; brown, dry, maximum size = 22mm
30 - 60ft	POORLY GRADED GRAVEL WITH SAND (GP) : 30% coarse, angular to subrounded gravel; 35% fine, angular to subrounded gravel; 25% coarse, subangular to subrounded sand; 10% medium, subangular to subrounded sand; trace fine sand; brown, dry, maximum size = 31mm
60 - 115ft	POORLY GRADED SAND WITH GRAVEL (SP) : 10% coarse, angular to subangular gravel; 20% fine, angular to subrounded gravel; 40% coarse, angular to subrounded sand; 30% medium, subangular to subrounded sand; trace fine sand; brown, dry, maximum size = 30mm
115 - 130ft	ELASTIC SILT (ML) : 10% fine, subangular to subrounded sand; 90% fines; slow dilatancy, medium toughness, low plasticity, low dry strength; brown, dry
130- 155ft	POORLY GRADED SAND (SP) : Trace coarse, subangular to subrounded gravel; 10% fine, angular to subrounded gravel; 35% coarse, angular to subrounded sand; 50% medium, subangular to subrounded sand; 5% fine, subangular to subrounded sand; brown, dry, maximum size = 32mm
155- 370ft	POORLY GRADED SAND (SP) : Trace fine, subangular to subrounded gravel; trace coarse, subangular to subrounded sand; 60% medium, subangular to subrounded sand; 40% fine, subangular to subrounded sand; brown, dry
370- 500ft	POORLY GRADED SAND (SP) : Trace fine, subangular to subrounded gravel; 20% coarse, subangular to subrounded sand; 70% medium, subangular to subrounded sand; 10% fine, subangular to rounded sand; trace to 5% fines; slow dilatancy, medium toughness, medium plasticity, low dry strength; brown, dry

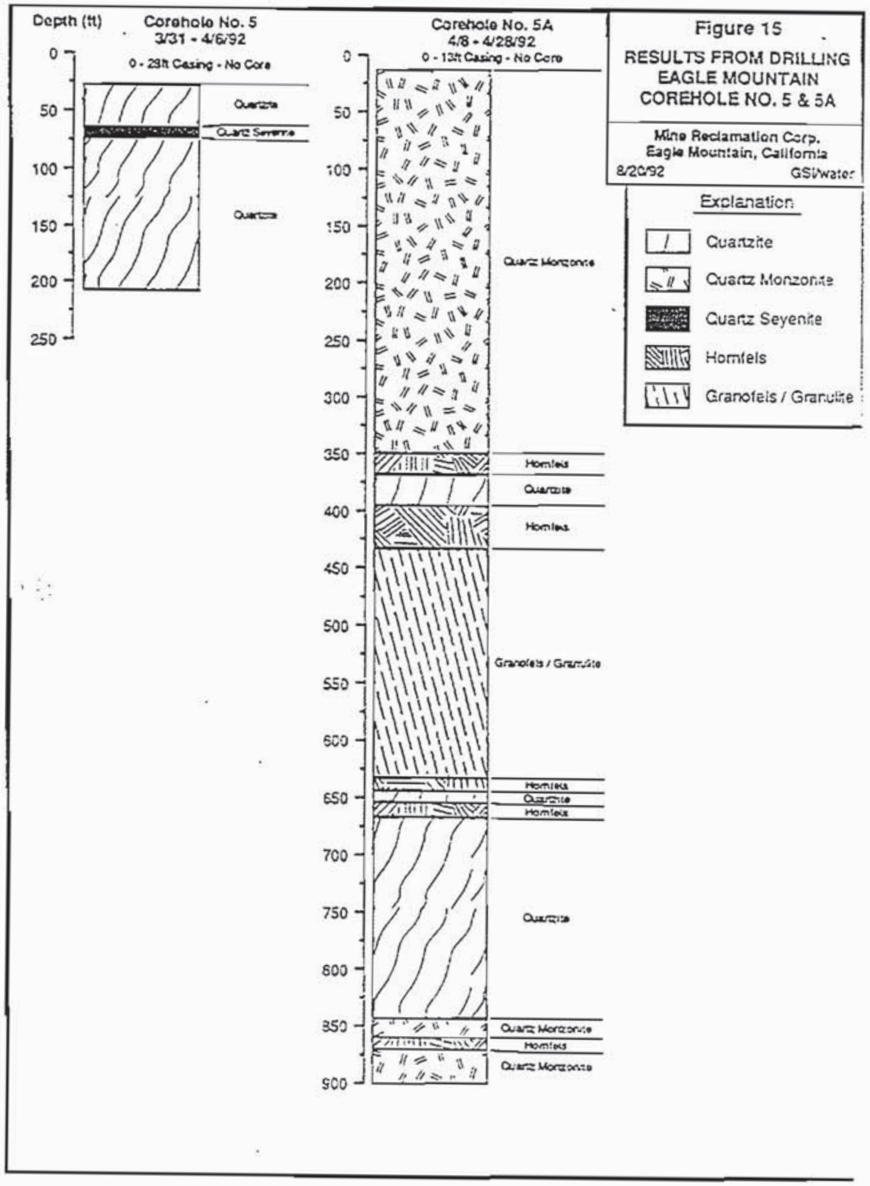
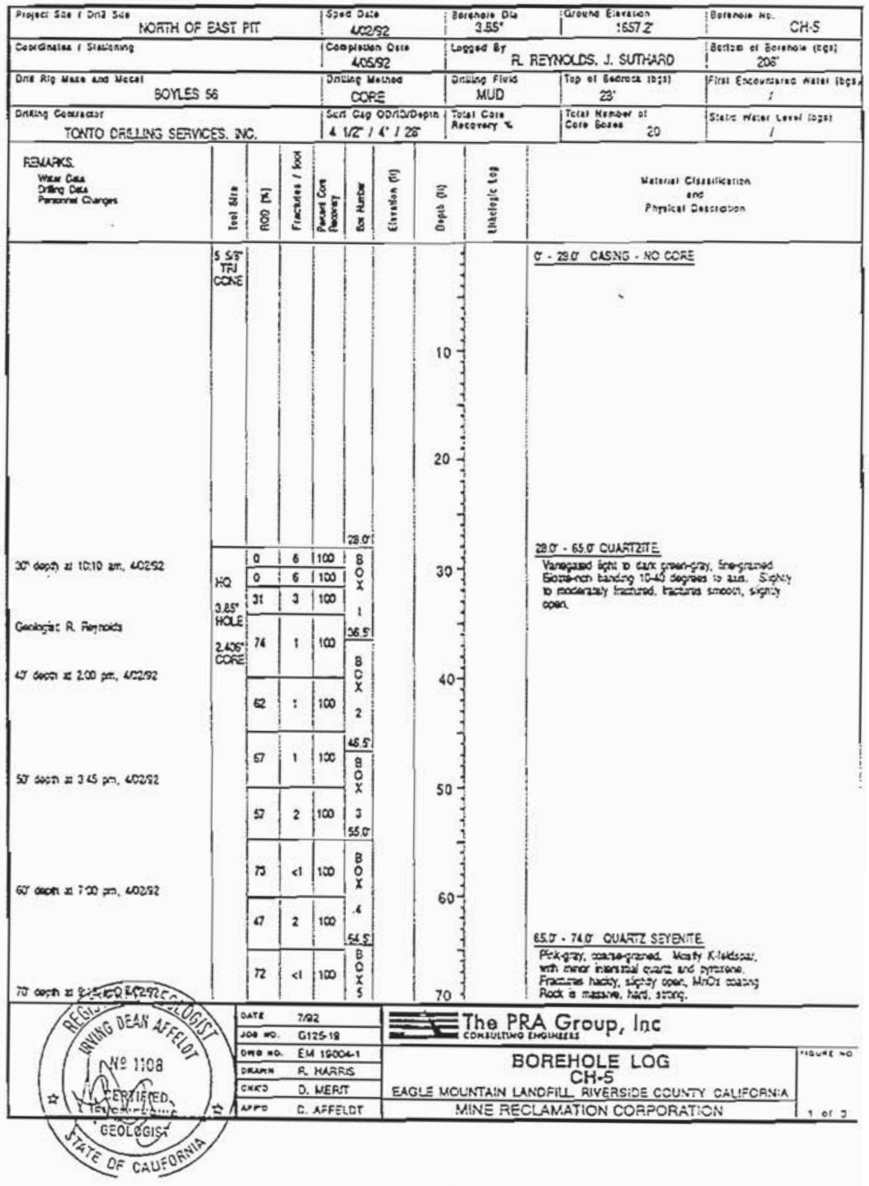


Figure 15

RESULTS FROM DRILLING EAGLE MOUNTAIN COREHOLE NO. 5 & 5A

Mine Reclamation Corp.
Eagle Mountain, California
8/20/92 GSi/water



Project Site / Drill Site: NORTH OF EAST PIT
Sped Date: 4/02/92
Borehole Dia: 3.55"
Ground Elevation: 1657.2'
Borehole No.: CH-5
Coordinates / Stationing:
Completion Date: 4/05/92
Logged By: R. REYNOLDS, J. SUTHARD
Bottom of Borehole (bgs): 208'
Drill Rig Make and Model: BOYLES 56
Drilling Method: CORE
Drilling Fluid: MUD
Top of Bedrock (bgs): 23'
First Encountered Water (bgs): /
Drilling Contractor: TONTO DRILLING SERVICES, INC.
Surf Csg OD/ID/Depth: 4 1/2" / 4" / 28'
Total Core Recovery %:
Total Number of Core Boxes: 20
Static Water Level (bgs): /

REMARKS.
Water Data
Drilling Data
Personnel Changes

30' depth at 10:10 am, 4/02/92
Geologist: R. Reynolds
40' depth at 2:00 pm, 4/02/92
50' depth at 3:45 pm, 4/02/92
60' depth at 7:00 pm, 4/02/92
70' depth at [illegible]

Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number
5 5/8" TRI CONE				
				28.0'
HQ	0	6	100	BOX 1
	0	6	100	
3.85" HOLE	31	3	100	
2.406" CORE	74	1	100	36.5' BOX 2
	62	1	100	
	67	1	100	46.5' BOX 3
	57	2	100	55.0'
	73	<1	100	BOX 4
	47	2	100	64.5'
	72	<1	100	BOX 5

Elevation (ft)
Depth (ft): 10, 20, 30, 40, 50, 60, 70
Lithologic Log

Material Classification and Physical Description

0' - 29.0' CASING - NO CORE

28.0' - 65.0' QUARTZITE.
Variegated light to dark green-gray, fine-grained. Biotite-rich banding 10-40 degrees to axis. Slightly to moderately fractured, fractures smooth, slightly open.

65.0' - 74.0' QUARTZ SEYENITE.
Pink-gray, coarse-grained. Mostly K-feldspar, with minor interstitial quartz and pyroxene. Fractures hackly, slightly open, MnOx coating. Rock is massive, hard, strong.

IRVING DEAN AFFELDT
No 1108

DATE	7/92
JOB NO.	G125-18
DWG NO.	EM 19004-1
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-5
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO
1 of 3

REMARKS
Water Data
Drilling Data
Personnel Changes

70' depth at 9:15 pm, 4/02/92
80' depth at 10:35 pm, 4/02/92
Geologist: J. Suthard
90' depth at 3:13 am, 4/03/92
100' depth at 6:12 am, 4/03/92
Geologist: R. Reynolds
Drilling down for repair
110' depth at 9:30 pm, 4/03/92
120' depth at 10:25 pm, 4/03/92
130' depth at 2:00 am, 4/04/92
Problems retrieving core barrel all night
Geologist: R. Reynolds
140' depth at 2:00 pm, 4/04/92
150' depth at 3:45

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log
HQ 3.85" HOLE 2.406" CORE	20	4	100	5 73.0'		70	
	32	3	100	BOX 6			
	27	6	100	82.0'		80	
	45	2	100	BOX 7 90.3'			
	48	2	100	BOX		90	
	25	4	100	8 100.0'			
	45	1	100	BOX		100	
	60	1	100	9			
	25	2	100	108.5'			
	42	2	100	BOX		110	
	48	2	100	10 118.0'			
	52	2	100	BOX 11		120	
	30	4	100	127.0'			
	0	>5	20	BOX		130	
	23	6	100	12 139.0'			
	98	<1	100	BOX		140	
	67	1	100	13 148.0' 14		150	

Material Classification and Physical Description

55.0' - 74.0' QUARTZ SYENITE:
Pink-gray, coarse-grained. Mostly K-feldspar, with minor interstitial quartz and pyroxene. Fractures blocky, slightly open, MnOx coating. Rock is massive, hard, strong.

74.0' - 208.0' QUARTZITE
Light to dark green, fine-grained, weak biotite banding. Hard, strong, slightly to moderately fractured. Fractures mostly 40-50 and 70-90 degrees to axis, smooth, minor calcite fill

100' - 107' dikelets of syenite to 1" common

115' - 120' minor syenite dikelets

130' - 135' fault zone, brecciated

IRVING DEAN AFFELOT
Nº 1108

DATE	7/92
JOB NO.	G125-19
DWG NO.	EM 19004-2
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELOT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-5
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

2 of 3

REMARKS
Water Data
Drilling Data
Personnel Changes

150' depth at 3:45 pm, 4/04/92
160' depth at 5:15 pm, 4/04/92
170' depth at 11:00 pm, 4/04/92
Geologist: J. Suthard
180' depth at 12:55 am, 4/05/92
190' depth at 9:25 am, 4/05/92
200' depth at 12:30 pm, 4/05/92
Deviation survey = <2 degrees
Geologist: R. Reynolds
208' stopped drilling due to severe vibration and loss of circulation, 1:40 pm, 4/04/92

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log
HQ 3.85" HOLE 2.406" CORE	40	5	100	BOX		150	
	32	2	100	14 157.0'			
	37	2	100	BOX		160	
	68	1	100	15 166.5'			
	64	<1	100	BOX			
	20	4	100	16 175.0'		170	
	76	<1	100	BOX		180	
	82	<1	100	17 185.0'			
	92	1	100	BOX		190	
	60	3	100	18 193.5'			
	44	3	95	BOX			
	16	>5	100	19 202.0'		200	
	7	5	95	BOX 20		210	
						220	
						230	

Material Classification and Physical Description

74.0' - 208.0' QUARTZITE
Light to dark green, fine-grained, weak biotite banding. Hard, strong, slightly to moderately fractured. Fractures mostly 40-50 and 70-90 degrees to axis, smooth, minor calcite fill

150.0' - 160.0' minor syenite dikelets

197.0' - 208.0' hydrothermal alteration bleaching

TOTAL DEPTH 208.0 FEET

IRVING DEAN AFFELOT
Nº 1108

DATE	7/92
JOB NO	G125-19
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BOREHOLE LOG
CH-5
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO
3 of 3

Project Site / Drill Site: NORTH OF EAST PIT
Spud Date: 04/08/92
Borehole Dia: 3.85"
Ground Elevation: 1657.20'
Borehole No: CH-5A
Coordinates / Stationing:
Completion Date: 04/28/92
Logged By: R. REYNOLDS, J. SUTHARD
Bottom of Borehole (bgs): 900'
Drill Rig Make and Model: BOYLES 56
Drilling Method: CORE
Drilling Fluid: MUD
Top of Bedrock (bgs): 14'
First Encountered: 335'
Drilling Contractor: TONTO DRILLING SERVICES, INC.
Surf Csg OD/ID/Depth: 4 1/2" / 4" / 13'
Total Core Recovery %
Total Number of Core Boxes: 53
Static Water Level (bgs)

REMARKS: Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
	5 5/8" Tri Cone						10		0' - 13.0' CASING NO CORE -
	HQ 3.85" Hole 2.406" Core	75	<1	100	BOX 1				13.0' - 349.5' QUARTZ MONZONITE. Porphyritic, pink gray, medium to coarse grained K-feldspar phenocrysts to 3 cm, abundant biotite Mostly hard, strong; slightly to highly fractured fractures variable
20' depth at 2:20 a.m., on 04/09/92.		38	3	100	1 22.0'				
		77	1	100	BOX		20		15.0' - 25.5' fractures 10 and 20 degrees to axis, slightly open minor calcite fill.
30.0' depth at 3:11 a.m., on 04/09/92.		23	3	92	2 31.5'				26.5' - 60.5' fractures 30, 60, and 90 degrees to axis, slightly open, very minor calcite
		80	1	100	BOX		30		
40.0' depth at 4:17 a.m., on 04/09/92.		72	1	100	3 40.5'				
		73	1	100	BOX		40		
50.0' depth at 5:24 a.m., on 04/09/92.		68	3	88	4 51.0'				
		12	4	100	BOX		50		
60.0' depth at 6:44 a.m., on 04/09/92.		55	<1	100	5 61.5'				
		0	>5	48	BOX		60		60.5' - 73.2' fractures horizontal, clay coating
70.0' depth at 10:02 a.m., on 04/09/92.		0	>5	25	6		70		

IRVING DEAN AFFELDT
№ 1108

DATE	06/92
JOB NO.	G125-19
DWG NO.	EM19005/1
DRAWN	N TOOR
CHK'D	R HARRIS
APP'D	D AFFELDT

The PRA Group, Inc
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BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
	HQ 3.85" Hole 2.406" Core	10	>5	42	BOX 6		70		13.0' - 349.5' QUARTZ MONZONITE. Porphyritic, pink gray, medium to coarse grained. K-feldspar phenocrysts to 3 cm, abundant biotite Mostly hard, strong; slightly to highly fractured. fractures variable.
		82	<1	100	76.5'				73.2' - 140.0' few fractures, 60 - 70 degrees to axis, weak chlorite coating.
80.0' depth at 11:35 a.m., on 04/09/92.		72	5	100	BOX		80		
		92	<1	80	7 85.0'				
90.0' depth at 1:25 p.m., on 04/09/92.		88	<1	100	BOX 8		90		
		74	<1	80	95.5'				
100.0' depth at 5:15 p.m., on 04/09/92.		71	1	100	BOX		100		
		100	0	97	9 105.0'				
110.0' depth at 6:45 p.m., on 04/09/92.		72	1	100	BOX 10		110		
		.65	<1	100	115.0'				
		87	<1	100	BOX				
120.0' depth at 6:40 p.m., on 04/09/92.		68	1	100	11 124.0'		120		
		80	<1	100	BOX				
130.0' depth at 10:30 p.m., on 04/09/92.		87	<1	100	12 132.5'		130		
		85	<1	100	BOX 13 141.0'				
140.0' depth at 12:25 a.m., on 04/10/92.		57	2	100	BOX		140		140.0' - 155.0' slightly fractured, 10, 60, and 80 degrees to axis, calcite coatings.
150.0' depth on 04/10/92		52	2	100	14 150.0'		150		

IRVING DEAN AFFELDT
№ 1108

DATE	07/92
JOB NO.	G125-19
DWG NO.	EM19005/2
DRAWN	N TOOR
CHK'D	R HARRIS
APP'D	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
	HQ 3.85" Hole 2.406" Core	85	1	100			150		**13.0' - 349.5' QUARTZ MONZONITE** Porphyritic, pink gray, medium to coarse grained. K-feldspar phenocrysts to 3 cm, abundant biotite. Mostly hard, strong; slightly to highly fractured, fractures variable.
		0	—	0	BOX 15				
160.0' depth at 3:30 p.m., on 04/10/92		20	4	55	154.5'		160		160.0' - 170.0' highly fractured, MnOx-stained sandy fracture filling, fractures 10 degrees to axis.
		73	<1	100	BOX				
170.0' depth at 4:50 p.m., on 04/10/92		27	1	90	16 174.0'		170		170.0' - 194.5' moderately to highly fractured, fractures 70 - 90 degrees to axis, calcite fil.
		33	2	75	BOX				
180.0' depth at 8:30 p.m., on 04/10/92		83	5	75	17		180		
		35	3	100	185.0'				
		31	3	85	BOX				
190.0' depth at 9:40 p.m., on 04/10/92		9	3	75	18 195.5'		190		
		47	2	90	BOX				194.5' - 234.5' fractures 10-45, 60, and 80 degrees to axis, minor calcite, rare gypsum fil
200.0' depth at 1:00 a.m., on 04/11/92		28	5	92	19 204.5'		200		
		22	4	95	BOX				
210.0' depth at 4:10 a.m., on 04/11/92		27	>5	92	20 212.5'		210		
		0	4	68	BOX				
220.0' depth at 6:50 a.m., on 04/11/92		22	4	100	21 223.0'		220		
230.0' de on 04/11/92		20	5	100	BOX 22		230		

IRVING DEAN AFFELDT
№ 1108

DATE	07/92	**The PRA Group, Inc** CONSULTING ENGINEERS	
JOB NO.	G125-19		
DWG NO.	EM19005/3	**BOREHOLE LOG** **CH-5A** EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA	
DRAWN	N TOOR		
CHK'D	R HARRIS		
APP'D	D AFFELDT	MINE RECLAMATION CORPORATION	3 of 12

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
					231.5'		230		
	HQ 3.55" Hole 2.406" Core	41	3	100	BOX				**13.0' - 349.5' QUARTZ MONZONITE** Porphyritic, pink gray, medium to coarse grained. K-feldspar phenocrysts to 3 cm, abundant biotite. Mostly hard, strong; slightly to highly fractured, fractures variable.
		10	4	100	23				
240.0' depth at 12:30 p.m., on 04/11/92		0	4	100	240.0'		240		234.5' - 243.0' fractures 10 - 40 degrees to axis; clay, calcite coating; weak slickensides at 238'.
		0	10	60	BOX 24				243.0' - 250.0' fractures 40 and 70-90 degrees to axis, slightly open, no fill
250.0' depth at 1:50 p.m., on 04/11/92		0	10	50	251.0'		250		
		30	2	100	BOX				
		0	-	0					
		57	3	100	25				
260.0' depth at 11:40 p.m., on 04/11/92		0	>5	100	260.5'		260		250.0' - 300.5' fractures 10-30 and 70-90 degrees to axis, irregular, clay and calcite fill
		17	3	100	BOX 26				
270.0' depth at 4:00 a.m., on 04/12/92		9	3	48			270		
		11	>5	62	274.0'				
		0	>5	80	BOX				
280.0' depth at 8:20 a.m., on 04/12/92		11	3	100	27 283.0'		280		
		56	2	100	BOX				
290.0' depth at 10:20 a.m., on 04/12/92		30	3	100	28 293.0'		290		
		37	3	100	BOX				
300.0' depth at 1:35 p.m., on 04/12/92		38	2	100	29 301.5'		300		300.5' - 309.5' fractures 10-20 and 40-70 degrees to axis, calcite fill
		38	2	100	BOX				
		52	1	100	30				
310.0' dep on 04/12/92							310		

IRVING DEAN AFFELDT
№ 1108

DATE	07/92	**The PRA Group, Inc** CONSULTING ENGINEERS	
JOB NO.	G125-19		
DWG NO.	EM19005/4	**BOREHOLE LOG** **CH-5A** EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA	FIGURE NO
DRAWN	N TOOR		
CHK'D	R HARRIS		
APP'D	D AFFELDT	MINE RECLAMATION CORPORATION	4 of 12

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log
	HQ 3.85" Hole 2.406" Core	43	2	100	310.5' BOX		310	
		30	2	100	31 319.5'			
320.0' depth at 5:50 p.m., on 04/12/92		48	2	100	BOX		320	
		21	2	75	32 329.0'			
330.0' depth at 9:50 p.m., on 04/12/92		8	>5	75	BOX		330	
		0	>5	80				
		22	4	60	33 339.5'			
340.0' depth at 12:20 a.m., on 04/13/92		70	2	100	BOX		340	
		52	2	100	34 349.5'			
350.0' depth at 4:00 a.m., on 04/13/92		23	4	100	BOX 35 357.5'		350	
		13	>10	95	BOX			
360.0' depth at 2:00 p.m., on 04/13/92		0	>10	75			360	
		0	>10	80	36 368.0'			
370.0' depth at 3:30 a.m., on 04/14/92		53	<1	100	BOX		370	
		95	<1	100	37 377.5'			
380.0' depth at 6:10 a.m., on 04/14/92		91	<1	100	BOX		380	
		88	<1	100	38 386.5'			
390.0' depth at 9:30 a.m., on 04/14/92					BOX 39		390	

Material Classification
and
Physical Description

13.0' - 349.5' QUARTZ MONZONITE

Porphyritic, pink gray, medium to coarse grained K-feldspar phenocrysts to 3 cm, abundant biotite. Mostly hard, strong; slightly to highly fractured, orientation variable.

309.5' - 324.5' fractures 40 and 70 degrees to axis, semi-smooth to hackly, slightly open.

324.5' - 368.0' fractures 10, 40, and 70 degrees to axis, smooth to hackly, minor calcite fil.

349.5' - 368.0' HORNFELS.

Medium gray, fine grained, equigranular. Alternating bands of biotite-amphibole-magnetite and quartz-feldspar. Hard, strong.

368.0' - 395.0' QUARTZITE.

White to medium gray, zones and dots of K-feldspar and epidote-diopside. Fractures 15-40 and 60-90 degrees to axis, calcite fil. Very hard, strong.

IRVING DEAN AFFELDT
Nº 1108

DATE	07/92
JOB NO.	G125-19
DWG NO.	EM19005/5
DRAWN	N TOOR
CHKD	R HARRIS
APPD	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

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REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log
	HQ 3.85" Hole 2.405" Core	27	3	100	39		390	
		[illegible]	2	100	395.0'			
		37	2	100	BOX			
400.0' depth at 12:01 p.m., on 04/14/92		13	>10	80	40 404.5'		400	
		30	2	100	BOX			
410.0' depth at 12:10 a.m., on 04/15/92		20	5	100	41 413.0'		410	
		33	4	100	BOX			
		82	2	96	42 421.0'			
420.0' depth at 4:20 a.m., on 04/15/92		50	3	92	BOX		420	
430.0' depth at 7:52 a.m., on 04/15/92		0	>5	75	43 431.0'		430	
		0	5	100	BOX			
		23	75	100	44 439.5'			
440.0' depth at 1:10 p.m., on 04/15/92		35	3	100	BOX		440	
		0	>10	100	45 447.5'			
		37	>10	100	BOX			
450.0' depth at 4:40 p.m., on 04/15/92		50	1	100			450	
		8	2	65	46 457.0'			
460.0' depth at 1:22 a.m., on 04/16/92		0	>5	75	BOX		460	
		37	3	90	47 466.0'			
470.0' depth at [illegible] on 04/16/92		21	3	85	BOX 48		470	

Material Classification
and
Physical Description

368.0' - 395.0' QUARTZITE

White to medium gray, zones and dots of K-feldspar and epidote-diopside. Fractures 15-40 and 60-90 degrees to axis, calcite fil. Very hard, strong.

395.0' - 434.0' HORNFELS

Gray to green gray, fine grained, bands of biotite and feldspar. Fractures variable orientation, semi-smooth, slightly open, minor calcite fil.

434.0' - 632.5' GRANOFELS / GRANULITE

Medium gray, medium to coarse grained, equigranular Appears to be a plastic mixture of quartz monzonite and recrystallized metasediments. Hard, medium strong Common quartz-feldspar dikes to 6"

434.0' - 470.0' fractures variable, slightly open semi-smooth, minor calcite fil.

IRVING DEAN AFFELDT
Nº 1108

DATE	07/92
JOB NO.	G125-19
DWG NO.	EM19005/6
DRAWN	N TOOR
CHKD	R HARRIS
APPD	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO.
5 of 12

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
	HQ 3.85" Hole 2.406" Core	21	3	100	BOX		470		434.0' - 632.5' GRANOFELS / GRANULITE Medium gray, medium to coarse grained, equigranular. Appears to be a plastic mixture of quartz monzonite and recrystallized metasediments. Hard, medium strong. Common quartz-feldspar clasts to 6". 470' - 530' fractures variable orientation, semi-smooth to hacky, slightly open, minor calcite fill.
		28	>10	100	48 475.5'				
		50	<1	100	BOX				
480.0' depth at 12:50 p.m., on 04/16/92.		100	0	100	49		480		
		0	4	100	484.5'				
Broken clutch housing on drill rig		22	>10	60	BOX				
490.0' depth at 12:30 a.m., on 04/17/92.		25	3	100	50		490		
		8	3	100	493.5' BOX				
500.0' depth at 3:50 a.m., on 04/17/92.		32	3	100	51 502.5'		500		
		0	3	100	BOX				
510.0' depth at 9:40 a.m., on 04/17/92.		35	2	100	52 511.0'		510		
		18	6	100	BOX 53				
520.0' depth at 6:30 p.m., on 04/17/92.		39	1	100	519.5'		520		
		57	<1	100	BOX				
		8	>10	60	54 529.0'				
530.0' depth at 10:30 p.m., on 04/17/92.		0	>10	80	BOX		530		530.0' - 560.0' fracture pattern random, fractures slightly open, semi-smooth, with minor clay, FeOx, and calcite fill.
		0	>5	35	55				
540.0' depth at 12:55 a.m., on 04/18/92.		22	>5	70	539.5' BOX		540		
		0	>5	40					
		0	4	90	56				
550.0' depth [illegible] on [illegible]		17	>5	100	549.0'		550		

IRVING DEAN AFFELDT
No 1108

DATE	07/92
JOB NO.	G125-19
DWG NO.	EM19005/7
DRAWN	N TOOR
CHK'D	R HARRIS
APP'D	D AFFELDT

The PRA Group, Inc
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BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

7 of 12

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log	Material Classification and Physical Description
	HQ 3.85" Hole 2.406" Core	12	>5	90	BOX		550		434.0' - 632.5' GRANOFELS / GRANULITE Medium gray, medium to coarse grained, equigranular. Appears to be a plastic mixture of quartz monzonite and recrystallized metasediments. Hard, medium strong. Common quartz-feldspar clasts to 6". 530.0' - 560.0' fracture pattern random, fractures slightly open, semi-smooth, with minor clay, FeOx, and calcite fill.
		0	>5	100	57				
		0	>5	100	557.0' BOX				
560.0' depth at 9:45 a.m., on 04/18/92.		100	4	100			560		
		26	2	100	58 565.5'				
570.0' depth at 9:30 p.m., on 04/18/92.		15	2	54	BOX		570		
Rig down for clutch adjustment		6	4	100	59 575.5'				
580.0' depth at 1:22 p.m., on 04/19/92.		7	4	83	BOX		580		560.0' - 605.0' fractures 10, 40, and 70 degrees to axis, calcite fill to 1/8"
Rig down for clutch repair		7	>5	78	60 585.0'				
		17	>5	62	BOX				
590.0' depth at 4:46 a.m., on 04/22/92.		0	>5	45	61		590		
		0	>5	100	597.5'				
600.0' depth at 9:30 a.m., on 04/22/92.		0	>10	100	BOX		600		
606' drilling stopped to run packer tests on HQ hole; reduced to NQ hole, resumed 5:47 a.m., 4/25/92	HQ	0	>10	100	62 605.0'				605.0' - 636.5' fractures 10-20 and 40-70 degrees to axis, semi-smooth to hacky, slightly open, clay and calcite fill.
	NQ 2.98" Hole 1.775" Core	0	—	37	BOX				
		0	5	100					
610.0' depth at 11:30 a.m., on 04/25/92.		0	6	100	63		610		
		11	6	95	616.5'				
620.0' depth at 12:55 p.m., on 04/25/92.		33	6	100	BOX		620		
		13	4	100	64 525.5'				
630.0' depth at 2:10 p.m., on 04/25/92.		7	6	100	BOX 65		630		

IRVING DEAN AFFELDT
No 1108

DATE	07/92
JOB NO.	G125-19
DWG NO.	EM19005/8
DRAWN	N TOOR
CHK'D	R HARRIS
APP'D	D AFFELDT

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CONSULTING ENGINEERS

BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO
8 of 12

REMARKS
Water Data
Drilling Data
Personnel Changes

790.0' depth at 2:10 p.m. on 04/27/92.
800.0' depth at 5:00 p.m. on 04/27/92.
810.0' depth at 12:56 a.m. on 04/28/92.
820.0' depth at 2:39 a.m. on 04/28/92.
830.0' depth at 5:09 a.m. on 04/28/92.
840.0' depth at 6:35 a.m. on 04/28/92.
850.0' depth at 9:35 a.m. on 04/28/92.
860.0' depth at 11:20 a.m. on 04/28/92.
870.0' depth ... on 04/28/92

Depth (ft): 790, 800, 810, 820, 830, 840, 850, 860, 870

Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Lithologic Log
NQ 2.56" Hole 1.775" Core		>10	55	BOX 81		
	0	5	65			
	0	>10	55	794.0'		
	10	>10	100	BOX		
	7	>10	60	82 803.5'		
	0	>10	80	BOX		
	14	5	90			
	27	3	100	83 812.5'		
	30	>5	92	BOX		
	0	>5	50	84		
	0	5	96	824.5'		
	43	10	100	BOX		
	10	>10	100	85 833.0'		
	11	>10	75	BOX		
	13	4	100	86 843.0'		
	28	4	100	BOX		
	31	1	100	87 852.0'		
	48	5	100	BOX		
	7	>10	100	88 861.5'		
	13	>10	100	BOX		
	52	2	95	89		

Material Classification
and
Physical Description

667.0' - 843.2' QUARTZITE.
Medium to dark gray, fine to medium grained, weakly bedded. Common quartz monzonite dikelets. Mostly hard, strong, highly fractured. Fractures variable orientation, slightly open, weak clay and calcite coating

827.0' - 833.0' abundant quartz monzonite, strongly altered to clay, with slickensides 10 degrees to axis

843.2' - 864.0' QUARTZ MONZONITE.
Strongly clay-altered and bleached, abundant biotite (>20%). Moderately hard, moderately strong, highly fractured. Clay and calcite fracture filling.

664.0' - 870.0' HORNFELS
Medium to dark gray, fine grained, equigranular. Biotite 30-40%, weakly foliated. Fractures 10-70 degrees to axis, irregular, weak clay FF, weak FeOx stain

REGISTERED GEOLOGIST IRVING DEAN AFFELDT No. 1108 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

DATE	07/92
JOB NO.	G125-19
DWG NO.	EM19005/11
DRAWN	K HOCHSTATTER
CHK'D	R HARRIS
APP'D	D AFFELDT

The PRA Group, Inc
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BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

11 of 12

REMARKS
Water Data
Drilling Data
Personnel Changes

870.0' depth at 12:55 p.m. on 04/28/92.
880.0' depth at 2:30 p.m. on 04/28/92.
890.0' depth at 4:05 p.m. on 04/28/92.
900.0' total depth at 5:50 p.m. on 04/28/92.

Depth (ft): 870, 880, 890, 900

Tool Size	RQD (%)	Fractures / foot	Percent Core Recovery	Box Number	Elevation (ft)	Lithologic Log
NQ 2.98" Hole 1.775" Core	52	2	95	870.0'		
	42	2	100	BOX		
	32	6	100	90 880.0'		
	7	>10	100	BOX		
	58	4	100	91 888.5'		
	22	>10	100	BOX 92 897.0'		
	0	>10	100	BOX 93 900.0'		

Material Classification
and
Physical Description

870.0' - 900.0' QUARTZ MONZONITE
Intensely clay-altered, weakly to strongly bleached. Abundant hornfels xenoliths. Moderately hard, moderately strong, highly fractured to brecciated. Fractures variable, clay and calcite FF.

880.0' - 883.0' fault breccia: quartzite and quartz monzonite clasts in matrix of calcite-cemented clay

885.0' - 890.0' fault breccia, strong calcite cement

895.0' - 900.0' fault breccia, clay-rich matrix

TOTAL DEPTH 900'

REGISTERED GEOLOGIST IRVING DEAN AFFELDT No. 1108 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

DATE	07/92
JOB NO.	G125-19
DWG NO.	EM19005/12
DRAWN	K HOCHSTATTER
CHK'D	R HARRIS
APP'D	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO.
12 of 12

REMARKS
Water Data
Drilling Data
Personnel Changes

530.0' depth at 2:10 p.m., on 04/25/92.
640.0' depth at 3:30 p.m., on 04/25/92.
550.0' depth at 4:57 p.m., on 04/25/92.
660.0' depth at 6:20 p.m., on 04/25/92.
670.0' depth at 8:55 p.m., on 04/25/92.
680.0' depth at 11:30 p.m., on 04/25/92.
690.0' depth at 6:30 a.m. on 04/26/92.
700.0' depth at 12:01 p.m., on 04/26/92.
710.0' depth at 3:15 p.m., on 4/25/92

Tool Size: NQ 2.98" Hole 1.775" Core

RQD (%)	Fractures / foot	Percent Core Recovery	Box Number
7	6	100	BOX 65 633.0'
0	5	100	BOX
0	6	100	66
0	6	100	642.0'
13	6	80	BOX 67 651.0'
33	4	100	BOX
0	6	100	68 660.0'
15	>5	100	BOX
0	>10	80	69
25	>10	100	669.5'
0	>10	80	BOX
13	6	100	70 678.0'
0	>10	100	
0	5	60	
0	—	10	BOX
40	1	67	71
0	>5	100	692.0'
13	4	100	BOX
28	4	100	72 700.5'
25	>5	100	BOX
24	>2	95	73
13	5	100	710.0'

Depth (ft): 630, 640, 650, 660, 670, 680, 690, 700, 710

Material Classification and Physical Description

434.0' - 632.5' GRANOFELS / GRANULITE

Medium gray, medium to coarse grained, equigranular. Appears to be a plastic mixture of quartz monzonite and recrystallized metasediments. Hard, medium strong.

632.5' - 644.0' HORNFELS.

Light to medium gray, fine grained, equigranular. Biotite 20%, weakly foliated, clusters of quartz-feldspar. Hard, strong, highly fractured. Fractures 20, 40, and 70 degrees to axis, slightly open, minor calcite.

644.0' - 653.5' QUARTZITE:

Pinkish gray, fine to medium gray, weakly foliated. Abundant feldspar, minor biotite. Hard, strong, highly fractured. Fractures 40 and 70 degrees to axis, slightly open, weak clay and minor calcite fill.

653.5' - 667.0' HORNFELS.

Pinkish gray, fine grained, foliated. Strongly intermixed with pink quartz monzonite. Hard, strong, highly fractured. Fractures 20 and 50-70 degrees to axis, slightly open hackly, weak clay and calcite coating.

667.0' - 843.2' QUARTZITE:

Medium to dark gray, fine to medium grained, weakly bedded. Common quartz monzonite dikelets. Mostly hard, strong, highly fractured. Fractures variable orientation, slightly open, weak clay and calcite coating

IRVING DEAN AFFELDT
№ 1108

DATE	07/92
JOB NO.	G125-19
DWG NO.	EM19005/9
DRAWN	K HOCHSTATTER
CHK'D	R HARRIS
APP'D	D AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY CALIFORNIA
MINE RECLAMATION CORPORATION

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REMARKS
Water Data
Drilling Data
Personnel Changes

710.0' depth at 3:15 p.m. on 04/26/92.
720.0' depth at 5:05 p.m. on 04/26/92.
730.0' depth at 10:30 p.m. on 04/26/92.
740.0' depth at 1:05 a.m. on 04/27/92.
750.0' depth at 3:00 a.m. on 04/27/92.
760.0' depth at 5:40 a.m. on 04/27/92.
770.0' depth at 7:30 a.m. on 04/27/92.
730.0' depth at 12:05 p.m. on 04/27/92.
790.0' [illegible] on 04/27/92

Tool Size: NQ 2.98" Hole 1.775" Core

RQD (%)	Fractures / foot	Percent Core Recovery	Box Number
13	5	100	
0	>10	100	BOX
67	1	55	
0	1	85	74
13	>10	65	726.0'
0	>10	50	BOX
17	>5	100	75
0	5	80	735.5'
28	5	84	BOX 76
27	5	92	745.5'
0	6	66	BOX
13	6	60	77 756.0'
23	5	94	BOX
8	5	90	78 765.0'
33	3	100	BOX
15	4	90	79 774.5'
0	>10	100	BOX
0	>10	100	60 783.5'
0	>10	100	BOX 81
0	>10	30	
0	>10	95	790.0'

Depth (ft): 710, 720, 730, 740, 750, 760, 770, 780, 790

Material Classification and Physical Description

667.0' - 843.2' QUARTZITE.

Medium to dark gray, fine to medium grained, weakly bedded. Common quartz monzonite dikelets. Mostly hard, strong, highly fractured. Fractures variable orientation, slightly open, weak clay and calcite coating

718.0' - 719.0' fault gouge, light gray clay with fragments of quartzite.

766.0' - 773.0' quartz monzonite sill

IRVING DEAN AFFELDT
№ 1108

DATE	07/92
JOB NO.	G125-19
DWG NO.	EM190C5/10
DRAWN	K HOCHSTATTER
CHK'D	R HARRIS
APP'D	D AFFELDT

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BOREHOLE LOG
CH-5A
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO.
10 of 12

Project Site / Drill Site: CENTRAL PIT
Spud Date: 02/13/92
Borehole Dia: 3.85 INCHES
Ground Elevation: 2307.76 FEET
Borehole No: CH-10
Coordinates / Stationing:
Completion Date: 02/25/92
Logged By: R. HARRIS, R. USREY, J. SUTHARD, D. VOLTURNO
Bottom of Borehole (bgs): 1383 feet
Drill Rig Make and Model: BOYLES 56-6
Drilling Method: CORE
Drilling Fluid: MUD
Top of Bedrock (bgs): SURFACE
First Encountered Water (bgs): 1309 feet
Drilling Contractor: TONTO DRILLING SERVICES, INC.
Surf Csg OD/ID/Depth: 6" / 5.5" / 17'
Total Core Recovery %: >95%
Total Number of Core Boxes: 161
Static Water Level (bgs):

REMARKS:
Water Data
Drilling Data
Personnel Changes

FOREMAN: WAYNE BEAUPRE
DRILL CREW A: (7am-7pm)
Driller: Shawn Nuttal
Helpers: Eric Owens
John Cross

DRILL CREW B: (7pm-7am)
Driller: Jeff Riley
Helpers: Bill Karten
Brent Williams
Geologist: D. Volturno

Casing set at 7.0 feet
Began coring at 4:30 pm
on 02/13/92

Geologist: R Harris

Stopped drilling at 17' -
problems retrieving core.
Replaced casing to 17'

23.5' depth at 11:40 pm, 2/13/92

Driller noted that hole made
minor amount of water

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log
5.25" TRI CONE	\	\	\				
HQ 3.850" HOLE 2.406" CORE	\	>10	40	BOX		10	
	\	>10	90	1			
	\	\	\	18.0' BOX		20	
	90	\	98	2			
	90	\	100	27.5' BOX 3		30	
	47	\	74	34.0' BOX			
	82	>10	80	4		40	
	39	4	65	44.5' BOX			
	0	5	80				
	0	>10	\			50	
	19	>10	65	5			
	19	>10	75	56.0' BOX			
	13	4	84	6		60	
	46	3	86	65.0' BOX			
	40	3	96	7		70	

Material Classification and Physical Description

0.0 - 7.0' SET CASING
No sample taken

7.0' - 15.4' QUARTZITE
Light gray, fine-grained, banded weathered

15.4' - 59.0' IRON ORE
Dark brown, highly fractured very hard. Minor mica.

23.5' Ore with irregular inclusions of light colored mineral (not calcite)

59.0' - 66.3' IRON ORE BRECCIA
Light rust colored fragments (30%) in ore matrix (70%). Fragments up to 2" Fractures dipping 30-60 degrees

66.3' - 67.8' DIORITE DIKE
Medium green, medium coarse-grained, with orthoclase phenocrysts. Fractures with slickensides Contact highly altered to chlorite

Irving Dean Affelot

DATE: 3/92
JOB NO.: G125-19
DWG NO.: EM 19006-1
DRAWN: R. HARRIS
CHK'D: D. MERIT
APP'D: D. AFFELOT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-10

EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO.
1 of 18

REMARKS
Water Data
Drilling Data
Personnel Changes

Geologist: D. Volturno

120' depth at 4:55 pm, 2/14/92

130' depth at 5:55 pm, 2/14/92

140' depth at 6:43 pm, 2/14/92

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log
HQ 3.850" HOLE 2.406" CORE	40	3	96	BOX 7		70	
	47	2	84	74.0' BOX			
	85	<1	100	8 83.0'		80	
	82	2	100	BOX			
	17	3	100	9 92.5'		90	
	50	4	100	BOX			
	0	>10	100	10		100	
	25	5	100	102.0'			
	50	3	100	BOX 11			
	47	4	100	110.5' BOX		110	
	13	6	100	12			
	46	3	100	120.0' BOX		120	
	69	3	100	13			
	54	4	100	129.2' BOX		130	
	25	4	100	14 137.8'			
	37	5	100	BOX 15		140	
	48	3	95	145.8' BOX 16		150	

Material Classification and Physical Description

69.5' - 73.5' ORE BRECCIA:
Light rust colored fragments in ore, with weathered chunks of limonite-stained diorite 76.0' to 76.5' highly fractured, with clay gouge

73.5' - 92.5' DIORITE:
Gray, fine-grained matrix. Hard, strong, healed fractures

felsic zone with healed fractures

92.5' - 119.5' PORPHYRY DIKE
Green, aphanitic. Fine-grained plagioclase phenocrysts, 2 - 5%, altering to chlorite. Limonite stain in fractures. Hard Most fractures dipping 30 - 50 degrees.

highly altered zone - dark green epidote and chlorite

brecciated, traces of calcite in veins

119.5' - 129.2' ORE BRECCIA:
Tan to light green angular fragments. 40-50% fragments 1-6mm in black ore matrix Fractures dip 20-60 degrees. Very hard, very strong. Apertures tight, some limonite staining

129.2' - 133.0' SKARN ZONE
Increasing green alteration. Fractures with soft to medium hard fill.

133.0' - 138.5' DIORITE PORPHYRY DIKE.
Gray, with feldspar phenocryst (60%). Fractures dip steeply. Healed fractures with ore filling

138.5' - 140.2' SKARN ZONE
Green alteration, soft to medium hard

140.2' - 155.0' ORE BRECCIA
Tan to light gray angular fragments 40-50% fragments 1-6mm in black ore matrix Magnetite/ hematite matrix, with swirled green alteration bands. Fractures tight, dipping 20-60 degrees Slightly hard, moderately strong

Irving Dean Affelot
No 1108

DATE: 3/92
JOB NO.: G125-19
DWG NO.: EM 19006-2
DRAWN: R HARRIS
CHK'D: D MERIT
APP'D: D AFFELOT

The PRA Group, Inc
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BOREHOLE LOG
CH-10

EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

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REMARKS
Water Data
Drilling Data
Personnel Changes

155' depth at 10:00 pm, 2/14/92

Geologist: J. Suthard
170' depth at 11:30 pm, 2/14/92

180' depth at 1:00 am, 2/15/92

190' depth at 2:07 am, 2/15/92

200' depth at 4:16 am, 2/15/92

210' depth at 5:18 am, 2/15/92

220' depth at 6:27 am, 2/15/92

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number
HQ 3.850" HOLE 2.406" CORE	32	5	100	BOX 16 154.2'
	18	8	100	BOX
	42	6	100	17 162.7'
	12	<3	100	BOX 18 171.0'
	63	1	90	BOX
	77	2	100	19 180.0'
	85	2	100	BOX
	63	2	100	20 185.2'
	96	<1	100	BOX
	85	1	100	21 197.5'
	82	1	100	BOX 22
	66	1	100	208.0' BOX
	58	3	100	23 214.5'
	71	1	100	BOX
	83	<1	100	24 222.8'
	37	5	100	BOX 25

Elevation (ft)

Depth (ft): 150, 160, 170, 180, 190, 200, 210, 220, 230

Lithologic Log

Material Classification and Physical Description

140.2' - 155.0' IRON ORE BRECCIA:
Tan to light green, angular fragments. 40-50 % fragments 1- 6 cm in black ore matrix. Fragments dip 20 -60 degrees. Slightly hard, mod strong.

155.0' - 157.0' IRON ORE:
Rust black. Highly fractured, nearly vertical dip limonite stained SL, not well-healed.

157.0' - 164.5' QUARTZITE
Light green, very fine-grained. Steeply dipping banding. Highly fractured.

164.5' - 173.0' SCHISTOSE META-ARKOSE
Light green with bands of black, pink, green. Bands dip 60 degrees. Fractures mostly parallel bands. Moderately hard, moderately strong

173.0' - 176.0' IRON ORE
Rusty black, highly fractured. Magnetite rich

176.0' - 178.0' ORE BRECCIA:
Fragments of meta-arkose in magnetite ore

178.0' - 185.5' IRON ORE.
Magnetite-rich. Light to dark green alteration zones, steeply dipping veins of calcite, abundant calcite.

185.5' - 187.0' QUARTZITE.
Greenish white, very fine-grained
Very hard, very strong.

187.0' - 229.8' IRON ORE:
Magnetite-rich, mixed with white calc-silicates or quartzite to 190.8'.

190.8' - 214.5' ore with veins of white calc-silicate, 20-30 degrees from vertical. Magnetite with pyrite, serpentine, minor chlorite. Moderately hard, moderately strong. Very fractured, brecciated, numerous healed fractures.

229.8' - 237.0' QUARTZITE:

IRVING DEAN AFFELDT
№ 1108

DATE	3/92
JOB NO.	G125-10
DWG NO.	EM 19006-3
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO.
3 of 12

REMARKS
Water Data
Drilling Data
Personnel Changes

Geologist: D. Volturno
230' depth at 8:00 am, 2/15/92
Problems with mud cake.
Geologist: R Harris.

240' depth at 8:00 pm, 2/15/92

250' depth at 8:00 pm, 2/15/92

260' depth at 9:30 pm, 2/15/92

Geologist: J. Suthard

300' depth at 5:47 am, 2/16/92
Deviation survey = 0.75 degrees

Geologist: D. Volturno

Tool Size	RQD	Fractures per foot	Percent Core Recovery	Box Number
HQ 3.850" HOLE 2.406" CORE	0	6	100	25 227.5'
	16	2	100	BOX
	0	8	100	
	0	8	100	26 241.0'
	0	>10	56	BOX
	25	1	80	27 250.0'
	14	2	92	BOX
	65	1	88	28 259.0'
	28	3	100	BOX
	22	3	92	29 267.0'
	32	2	98	BOX 30
	24	3	98	275.8' BOX
	0	5	81	31 283.3'
	30	2	82	BOX
	42	2	100	32 292.5'
	46	2	98	BOX
	100	<1	100	33 301.5'
	92	<1	100	BOX 34
	100	<1	100	310.6'

Elevation (ft)

Depth (ft): 230, 240, 250, 260, 270, 280, 290, 300, 310

Lithologic Log

Material Classification and Physical Description

229' - 237.0' QUARTZITE
Light gray, fine-grained. Very hard, very strong, fresh. Highly fractured, fractures dipping 30 - 90 degrees, tight, with hematite-limonite stain.

237.0' - 245.5' QUARTZ MONZONITE DIKE
Light pink-brown, fine-grained. Moderately hard moderately strong

245.5' - 275.5' IRON ORE
Magnetite rich, rusty black, slightly vuggy
Moderately hard, slightly weathered.
Scattered zones and veins of skarn minerals

247.2' - 247.5' Green alteration zone (skarn, calc-silicate minerals)

258.0 - 275.8 Skarn dark green to yellow -green, some steeply dipping banding

nearly vertical veins of calcite

266.0' - 267.0' magnetite vein, slightly vuggy

275.8' - 294.0' QUARTZ MONZONITE DIKE.
Fine-grained, pink-brown. Highly fractured fractures slightly open, with limonite-hematite stain. Very hard, very strong, fresh

282.0' increasing alteration, veins of ore

291.0' - 294.0' Gouge light to dark green crumbly

294.0' - 319.7' IRON ORE
Black, fresh, hard, very strong. Abundant fresh pyrite. Minor fractures Hard veins to 1/2" of tremolite and calcite.

IRVING DEAN AFFELDT
№ 1108

DATE	3/92
JOB NO.	G125-19
DWG NO.	EM 19006-4
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

The PRA Group, Inc
CONSULTING ENGINEERS

BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

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REMARKS
Water Data
Drilling Data
Personnel Changes

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery
HQ	100	<1	100
3.86" HOLE	93	<1	100
2.406" CORE	33	4	100
	0	\	100
	0	6	100
	0	10	100
	0	7	100
	67	3	100
	33	2	100
	0	6	100
	33	3	100
	44	2	100
	0	4	100
	33	5	100
	50	3	100
	33	8	100
	25	10	100
	\	\	\
	18	4	100
	8	5	100
	11	4	100
	0	8	100
	0	9	100

Box Number: BOX 35, 318.7' · BOX 36, 325.0' · BOX 37, 334.1' · BOX 38, 343.5' · BOX 39, 351.4' · BOX 40, 360.5' · BOX 41, 367.5' · BOX 42, 375.0' · BOX 43, 382.2' · BOX 44

Elevation (ft) · Depth (ft): 310, 320, 330, 340, 350, 360, 370, 380, 390 · Lithologic Log

Geologist R. Harris

Geologist J. Suhard
Electrical generator failure, 9:03 pm, 2/16/92. Resumed drilling 11:40 pm, 2/16/92

Geologist D. Volturno

390' depth [illegible] 2/16/92

Material Classification and Physical Description

294.0' - 319.7' IRON ORE
Black, fresh, hard, very strong. Abundant pyrite. Minor fracturing, hard veins of calcite and tremolite to > 1/2".

319.7' - 341.0' QUARTZ MONZONITE
Pink-brown, fine grained, highly fractured. Fractures variable dip, mostly steep, minor limonite stain. Veins and fractures chloritized. Very hard, very strong

341.0' - 389.5' SCHISTOSE META-ARKOSE
Banded pink-brown, dark green, light green, yellow-green. Moderately fractured, veins healed; fractures tend to follow bedding. Slightly weathered, decreasing with depth.

365.5' increasing chlorite-epidote alteration, increasing fracture density, fractures open, 30-40 degrees to axis

382' - 385' highly fractured, highly altered, limonite stain in fractures

389.5' - 395.0' QUARTZITE

Nº 1108

DATE	3/92
JOB NO.	G125-19
DWG NO.	EM 19006-5
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

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CONSULTING ENGINEERS

BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE
5 of

REMARKS
Water Data
Drilling Data
Personnel Changes

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery
HQ	49	5	100
3.85" HOLE 2.406 CORE	47	4	100
	53	1	100
	60	1	100
	60	1	100
	50	<1	100
	80	<1	100
	87	<1	100
	47	1	100
	63	3	100
	58	2	100
	43	4	100
	60	4	100
	38	4	100
	32	4	100
	100	0	100
	100	0	100
	63	1	100

Box Number: 390.4' · BOX 45, 400.0' · BOX 46, 408.6' · BOX 47, 417.5' · BOX 48, 425.5' · BOX 49, 434.7' · BOX 50, 443.2' · BOX 51, 452.0' · BOX 52, 460.5' · BOX 53, 468.5' · 54

Elevation (ft) · Depth (ft): 390, 400, 410, 420, 430, 440, 450, 460, 470 · Lithologic Log

400' depth at 1:00 pm on 2/17/92
Deviation survey = 0.75 degrees

410' depth at 1:00 pm on 2/17/92

420' depth at 1:48 pm on 2/17/92

430' depth at 2:41 pm on 2/17/92

440' depth at 3:55 pm on 2/17/92

Geologist R. Harris

450' depth at 5:00 pm on 2/17/92

460' depth at 5:55 pm on 2/17/92

470' dep[illegible] 2/18/92

Material Classification and Physical Description

389' - 395.0' QUARTZITE
Rust yellow to red hematite stain, moderately weathered, moderately hard, moderately fractured, fractures variable orientation. Zones of pyroxene-chlorite-epidote alteration

395.0' - 402.5' SKARN:
Fine grained, mottled with K-feldspar-epidote-calcite-quartz-pyroxene. Hard, strong

402.5' - 428.0' IRON ORE:
Abundant fresh pyrite zones up to 2". Moderately fractured; fractures tight, dipping up to 60 degrees. Hard, strong, slightly weathered limonite stained.

412.8' - 415.7' moderately weathered zone, abundant limonite stain. Vugs of remnant pyrite filled with quartz.

423.7' - 425.0' slightly fractured with limonite-hematite stain. Slightly weathered

428.0' - 436.2' QUARTZ MONZONITE
Pink-brown, coarse-grained. Abundant K-feldspar alteration and pyrite in healed fractures. Fractured, minor limonite stain, shallow dip.

436.2' - 452.0' IRON ORE
Abundant pyrite. Very hard, very strong, fresh. Numerous vertical fractures with pyrite filling

452.0' - 457.6' ANDESITE DIKE:
Greenish gray, fine-grained. Moderately altered, hard strong to 456.4, becoming brecciated, softer, more altered.

457.6' - 610.0' QUARTZITE
Light gray, fine-grained. Very hard, very strong. Many re-healed fractures with limonite up to 5 mm dipping 0 - 10 degrees. Fractures tight, with pyrite, dipping 30 - 45 degrees. Irregular veins to 10 mm

Nº 1108

DATE	3/92
JOB NO.	G125-19
DWG NO.	EM 19006-6
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

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CONSULTING ENGINEERS

BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

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REMARKS
Water Data -
Drilling Data
Personnel Changes

480' depth at 4:13 am, 2/18/92

RQD and fractures per foot averaged for box 56 (7 core runs).

490' depth at 9:10 am, 2/18/92

RQD and fractures per foot averaged for box 57 (6 core runs).

500' depth at 1:42 pm, 2/18/92

Deviation survey = 1.5 degrees

510' depth at 4:40 pm, 2/18/92

520' depth at 7:35 pm, 2/18/92

530' depth at 12:00 am, 2/19/92

540' depth at 2:36 am, 2/19/92

550' depth at 6:00 am, 2/19/92

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)
HQ	63	1	100	BOX		470
3.850" HOLE	13	4	80	54 477.0'		
2.406" CORE	75	2	100	BOX		480
	44	3	100	55		
	13	4	100	484.5'		
	(60)	(1)	100	BOX 56 497.5'		490
	(69)	(1)	100	BOX 57 500.0'		500
	63	<1	100	BOX		
	100	<1	100	58		
	100	0	100	508.5'		
	100	0	100			510
	100	0	100	BOX		
	81	1	100	59		
	42	4	100	517.8'		
	37	4	100	BOX		520
	60	3	100			
	42	1	100	60 527.0'		
	94	1	100	BOX		530
	70	0	100	61 536.0'		
	88	<1	100	BOX		540
	83	1	100	62 545.0'		
	100	<1	100	BOX		
	86	<1	100	63		550

Lithologic Log

Material Classification and Physical Description

457.5' - 610.0' QUARTZITE

Light gray, fine-grained. Very hard, very strong. Many re-healed fractures, with limonite, up to 5 mm, dipping 0 - 10 degrees. Fractures with pyrite, tight, dip 20 -45 degrees. Irregular quartz veins to 10 mm.

483.0' - 484.5' gray streaked, with green epidote or diopside, and pyrite. Limonite-filled fractures.

500.0' - 547.0' light green, with zones of banding dipping about 60 degrees. Fractures nearly vertical. Slightly less hard and strong.

banding steepens with depth.

547.0' - 550.0' Gray, banding nearly absent. Very hard, very strong. Dark green alteration zones.

IRVING DEAN AFFELDT
No 1108

DATE	3/92
JOB NO.	G125-19
DWG NO.	EM 19006-7
DRAWN	R HARRIS
CHK'D	D. MERIT
APP'D	D AFFELDT

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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO
7 of 15

REMARKS
Water Data
Drilling Data
Personnel Changes

Geologist: D. Votumo

560' depth at 9:30 am, 2/19/92

570' depth at 10:55 am, 2/19/92

580' depth at 2:15 pm, 2/19/92

590' depth at 3:25 pm, 2/19/92

Geologist: J. Suhard

598' depth at 4:00 pm, 2/19/92
Deviation survey = 0.75 degrees

610' depth at 6:10 pm, 2/19/92

620' depth at 6:06 pm 2/19/92

630' depth at [illegible] pm, 2/19/92

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)
HQ	69	1	100	BOX 63 554.0'		550
3.850" HOLE	67	1	100	BOX		
2.406" CORE	58	2	100	64		560
	53	2	100	562.0'		
	53	2	100	BOX 65		
	58	2	100	571.8'		570
	40	3	100	BOX 66		
	40	4	100	580.5'		580
	80	<1	100	BOX 67		
	49	3	98	589.0' BOX		590
	52	3	100	68 597.7'		
	63	2	100	BOX 69		600
	52	2	100	606.0'		
	67	3	100	BOX 70		610
	37	1	100	615.0' BOX		
	38	1	100	71 624.0'		620
	56	2	100	BOX 72		
						630

Lithologic Log

Material Classification and Physical Description

457.5' - 610.0' QUARTZITE

Light gray, fine-grained. Very hard, very strong. Many re-healed fractures with limonite stain, up to 5 mm, dipping 0 - 10 degrees. Tight fractures with pyrite, dip 20 - 45 degrees. Irregular quartz veins to 10 mm.

575.0' - 578.5' abundant tight healed fractures with calcite. Orientation varies.

578.7' ore vein, one inch, 90 degrees to core axis.

583.6' - 610.0' scattered quartz monzonite dikes, 2- 8 inches, 30 -45 degrees to axis. Green alteration in quartzite.

610.0' - 668.0' ANDESITE DIKE

Dark gray with epidote-chlorite-pyroxene-pyrite alteration. Aphanitic groundmass with feldspar phenocrysts to 1/4". Moderately fractured, hard, strong, slightly weathered. Fractures tight, with quartz, epidote, minor calcite, serpentine, limonite

IRVING DEAN AFFELDT
No 1108

DATE	4/92
JOB NO.	G125-19
DWG NO.	EM 19006-8
DRAWN	R HARRIS
CHK'D	D. MERIT
APP'D	D AFFELDT

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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

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REMARKS
Water Data
Drilling Data
Personnel Changes

- 640' depth at 10:45 pm, 2/19/92
- Geologist: R. Usrey
- 650' depth at 2:09 am, 2/20/92
- 660' depth at 4:55 am, 2/20/92
- 670' depth at 5:40 am, 2/20/92
- 680' depth at 7:15 am, 2/20/92
- Geologist: D. Volturno
- 690' depth at 8:00 am, 2/20/92
- 700' depth at 9:20 am, 2/20/92
  Deviation survey = 1 degree
- 710' depth at [illegible], 2/20/92

Tool Size: HQ
3.650" HOLE
2.406" CORE

ROD (%)	Fractures per foot	Percent Core Recovery
50	1	100
50	2	100
67	2	100
33	2	100
52	2	100
67	2	100
55	2	100
74	1	100
0	3	100
0	5	100
15	3	100
22	4	100
18	2	100
30	2	100
8	4	100
13	3	100
33	5	100
27	2	100
0	>10	20
0	4	100
17	6	100
57	1	100
22	4	100

Box Number: BOX 72 633.0'; BOX 73 641.5'; BOX 74 645.5'; BOX 75 658.0'; BOX 76 667.0'; BOX 77 675.0'; BOX 78 683.5'; BOX 79 691.5'; BOX 80 702.0'; BOX 81

Elevation (ft)

Depth (ft): 630, 640, 650, 560, 670, 680, 590, 700, 710

Lithologic Log

Material Classification and Physical Description

610.0' - 666.0' ANDESITE DIKE
Light gray, fine-grained. Very hard, very strong. Many re-healed fractures with limonite stain, up to 5 mm, dipping 0 - 10 degrees. Tight fractures with pyrite, dipping 20 - 45 degrees. Irregular quartz veins to 10 mm.

634.0' - 645.0' minor limonite stain, calcite in veins. Slightly weathered.

655.0' - 662.8' highly fractured. Apertures slightly open, limonite stain, calcite, dipping 0 - 30 degrees

662.8' - 666.0' shear zone with slicks, serpentine, talc [illegible] in fractures.

666.0' - 691.4' SKARN
Dark green alteration in andesite (?), with iron ore and calcite veins. Moderately hard, moderately strong, moderately weathered

691.4' - 806.0' QUARTZITE
Dark gray, very fine-grained. Hard, strong, fresh to slightly weathered. Moderately fractured, apertures slightly open, dipping mostly 0 - 30 degrees, minor limonite stain, minor calcite.

No. 1108

DATE	4/92
JOB NO.	G125-19
DWG NO.	EM 19006-9
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

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BORING LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO.
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REMARKS
Water Data
Drilling Data
Personnel Changes

- 710' depth at 2:10 am, 2/20/92
- 720' depth at 3:45 pm, 2/20/92
- Geologist: J. Suthard
- 730' depth at 4:45 pm, 2/20/92
- 740' depth at 5:47 pm, 2/20/92
- 750' depth at 6:50 pm, 2/20/92
- 760' depth at 8:25 pm, 2/20/92
- 770' depth at 9:46 pm, 2/20/92
- Geologist: R. Usrey
- 780' depth at 11:25 pm, 2/20/92
- 790' depth at 12:15 am, 2/21/92

Tool Size: HQ
3.25" HOLE
2.406" CORE

ROD (%)	Fractures per foot	Percent Core Recovery
25	4	100
20	4	100
67	2	100
75	2	100
69	2	100
73	1	100
32	2	100
52	1	100
60	2	100
58	2	100
31	1	100
0	>10	100
0	>10	100
0	>10	100
25	>10	100
23	4	100
17	3	100
28	2	100

Box Number: 81 712.0'; BOX 82 720.2'; BOX 83 729.0'; BOX 84 738.0'; BOX 85 746.5'; BOX 86 754.5'; BOX 87 762.5'; BOX 88 772.5'; BOX 89 781.5'; BOX 90 790.0'

Elevation (ft)

Depth (ft): 710, 720, 730, 740, 750, 760, 770, 780, 790

Lithologic Log

Material Classification and Physical Description

691.4' - 806.0' QUARTZITE
Dark gray, very fine grained. Hard, strong, fresh to slightly weathered. Moderately fractured, apertures slightly open, dipping mostly 0 - 30 degrees, minor limonite stain, minor calcite.

759.0' - 779.0' fault zone: brecciated, minor bleaching, minor gouge, moderately altered

No. 1108

DATE	4/92
JOB NO	G125-18
DWG NO.	EM 19006-10
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

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REMARKS
Water Data
Drilling Data
Personnel Changes

790' – 870'

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number
HQ	28	2	100	BOX 91
3.850" HOLE	89	<1	100	
2.406" CORE	60	1	100	798.0'
	47	1	100	BOX 92
	43	2	100	807.0'
	48	1	100	BOX 93 815.0'
	60	1	100	BOX 94
	18	2	100	824.0'
	33	2	100	BOX 95
	50	2	100	832.3'
	50	2	100	BOX 96
	40	2	100	842.0'
	60	1	100	BOX 97 850.0'
	27	3	100	BOX 98
	40	2	100	858.7'
	40	2	100	BOX 99
	27	>10	100	868.0' BOX

Remarks:
800' depth at 4:01 am, 2/21/92
Deviation survey = 1 degree
810' depth at 5:14 am, 2/21/92
820' depth at 6:29 am, 2/21/92
830' depth at 7:38 am, 2/21/92
Geologist: D. Volturno
840' depth at 8:38 am, 2/21/92
850' depth at 9:45 am, 2/21/92
860' depth at 10:58 am, 2/21/92
870' depth at ~~11:40 am~~, 2/21/92

Material Classification and Physical Description

591.4' - 806.0' QUARTZITE
Dark gray, very fine-grained. Hard, strong, fresh to slightly weathered. Moderately fractured, apertures slightly open, dipping mostly 0 - 30 degrees, minor limonite stain, minor calcite.

806.0' - 892.0' META-ARKOSE
Light gray, generally quartz-rich, minor dolomitic zones. Moderately hard to hard, moderately strong to strong, moderately weathered. Moderately fractured with dark green alteration along fractures. Apertures tight, veins 20 - 30 degrees.

839.0' - 846.5' brecciated zones, highly altered. Healed fractures with massive pink-brown quartz veins, minor calcite veins.

863.6' - 869.0' breccia zone with gouge slickensides, hematite stain.

REGISTERED GEOLOGIST
IRVING DEAN AFFELDT
No 1108
CERTIFIED ENGINEERING GEOLOGIST

DATE	4/92
JOB NO.	G125-19
DWG NO.	EM 19006-11
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE NO
11 of 18

REMARKS
Water Data
Drilling Data
Personnel Changes

870' – 950'

Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number
HQ	53	<1	100	BOX 100
3.85" HOLE	1	1	100	876.5'
2.406" CORE	57	2	100	
	11	5	100	BOX 101
	72	1	100	
	35	1	100	885.0' BOX 102
	27	3	100	893.0'
	68	1	100	BOX 103
	19	2	100	902.5'
	100	<1	100	BOX 104
	23	2	100	910.0'
	70	1	100	BOX 105
	57	2	100	918.7'
	42	1	100	BOX 106 927.0'
	85	1	100	BOX 107
	83	1	100	935.5'
	100	<1	100	BOX 108
	60	1	100	944.0'
	27	3	100	BOX 109

Remarks:
870' depth at 11:40 am, 2/21/92
880' depth at 1:48 pm, 2/21/92
Geologist: J. Sutard
890' depth at 6:27 pm, 2/21/92
900' depth at 10:00 pm, 2/21/92
Deviation survey = 1.0 degree
Geologist: R. Usrey
910' depth at 3:10 am, 2/22/92
920' depth at 4:15 am, 2/22/92
930' depth at 5:40 am, 2/22/92
940' depth at 7:50 am, 2/22/92
Geologist: D. Volturno
950' depth at 9:22 am, 2/22/92

Material Classification and Physical Description

806.0' - 892.0' META-ARKOSE
Light gray, generally quartz-rich, minor dolomitic zones. Hard, strong, moderately weathered. Moderately fractured, with dark green alteration along fractures. Apertures tight, veins dip 20-30 degrees.

892.0' - 904.5' QUARTZ MONZONITE
Light gray, coarse grained, K-feldspar phenocrysts. Epidote in fractures, disseminated epidote 1-2 %

892' - 893' green andesite dike

904.4' - 921.0' SKARN:
Dark green, fine grained, vertical flow texture. Pyroxene-rich, with epidote in veins. Hard, strong, slightly weathered. Moderately fractured with limonite, hematite stain, fractures dip 0-45 degrees.

921.0' - 924.0' QUARTZ MONZONITE.
Green-gray, medium grained. Epidote-filled veins 1-3 mm, pyroxene-rich zones. Hard, strong, slightly fractured.

924.0' - 950.0' QUARTZITE:
Light gray, fine grained, shattered appearance, with dark green alteration along shatter lines. Veins of pink-brown massive quartz to 1 cm. Very hard, very strong, unweathered, slightly fractured, with minor calcite fill.

937' - 946' scattered ore veins to 2 cm.

REGISTERED GEOLOGIST
IRVING DEAN AFFELDT
No 1108
ENGINEERING GEOLOGIST

DATE	4/92
JOB NO.	G125-19
DWG NO.	EM 19006-12
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

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REMARKS
Water Data
Drilling Data
Personnel Changes

960' depth at 10:35 am, 2/22/92

970' depth at 11:45 am, 2/22/92

980' depth at 1:55 pm, 2/22/92
Geologist J. Suthard

990' depth at 4:00 pm, 2/22/92

1000' depth at 5:32 pm, 2/22/92
Deviation survey = 1 degree

1010' depth at 9:35 pm, 2/22/92

1020' depth at 10:35 pm, 2/22/92
Geologist R. Laney

1030' depth [illegible] 2/23/92

Tool Size: HQ
3.85" HOLE
2.406" CORE

RQD (%)	Fractures per foot	Percent Core Recovery	Box Number
33	3	100	109 952.0'
60	1	100	BOX
56	2	100	110 961.0'
87	<1	100	BOX
47	1	100	111 970.0'
67	<1	100	BOX 112
17	2	100	978.2'
0	>10	100	BOX
0	5	100	
67	1	100	113 987.0'
0	3	85	
52	2	100	BOX 114
22	4	100	995.5'
50	3	100	BOX
75	3	100	115
42	2	100	1003.0' BOX
73	1	100	116 1011.0'
40	2	100	BOX
85	<1	100	117 1020.0'
87	<1	100	BOX 118
62	1	100	1028.5' BOX 119

Elevation (ft)

Lithologic Log

Depth (ft): 950, 960, 970, 980, 990, 1000, 1010, 1020, 1030

Material Classification
and
Physical Description

951.0' - 952.8' IRON ORE
Black, magnetite-rich, abundant massive pyrite-tremolite-sericite, minor limonite stain. Calcite abundant in fractures to 1 mm.

952.8' - 955.0' QUARTZ MONZONITE
Greenish, highly altered. Calcite abundant in horizontal fractures. Moderately to very fractured, hard, strong, slightly-weathered.

955.0' - 970.5' IRON ORE / SKARN
Dark green to black, highly altered. Abundant magnetite, pyrite, pink massive quartz zones. Slightly fractured with calcite veins to 1 mm. Mostly hard to very hard, strong to very strong unweathered.

970.5' - 977.1' ANDESITE DIKE
Dark gray, slightly porphyritic, aphanitic groundmass. Slightly to moderately fractured, epidote and calcite filling. Apertures slightly open, minor limonite stain. Hard, strong unweathered.

977.1' - 981.1' IRON ORE
Red, brown, black; hematite, minor magnetite. Highly weathered, soft, crumbly, vuggy

981.1' - 1027.5' SKARN
Green chlorite, epidote, tremolite, with ore veins (magnetite + pyrite) to 2 inches. Scattered quartzite zones. Moderately fractured, with calcite fill, limonite stain. Hard, strong, slightly weathered.

1027.5' - 1054.9' IRON ORE
Black, magnetite-rich. Moderately fractured, apertures slightly open, dip steep to vertical, with limonite stain. Hard, strong, very slightly weathered.

IRVING DEAN AFFELDT
No 1108

DATE	4/92
JOB NO.	G125-10
DWG NO.	EM 19006-13
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

The PRA Group, Inc
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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

FIGURE

13 of 1

REMARKS
Water Data
Drilling Data
Personnel Changes

1040' depth at 1:15 am, 2/23/92

1050' depth at 2:25 am, 2/23/92

1060' depth at 4:00 am, 2/23/92

Geologist: D. Voltumo

1070' depth at 5:50 am, 2/23/92

1080' depth at 8:47 am, 2/23/92

1090' depth at 2:37 pm, 2/23/92

1100' depth at 3:50 pm, 2/23/92
Geologist: J. Suthard
Deviation survey = 1.5 degrees

1110' depth [illegible] 2/23/92

Tool Size: HQ
3.65" HOLE
2.406" CORE

RQD (%)	Fractures per foot	Percent Core Recovery	Box Number
62	1	100	BOX
17	2	100	119 1036.8'
60	2	100	BOX
57	1	100	120 1045.0'
25	1	100	BOX
23	2	100	121 1054.0'
27	3	100	BOX 122
28	2	100	1063.0' BOX
0	>10	100	123 1070.5'
0	>10	100	BOX
17	>10	100	
29	3	100	124 1078.5'
17	5	100	BOX
53	2	100	
67	1	100	125
67	1	100	1086.5' BOX
67	1	100	126
53	2	100	1095.5' BOX
72	2	100	127 1103.0'
78	1	100	BOX 128

Elevation (ft)

Lithologic Log

Depth (ft): 1030, 1040, 1050, 1060, 1070, 1080, 1090, 1100, 1110

Material Classification
and
Physical Description

1027.5' - 1054.9' IRON ORE
Black, magnetite-rich. Moderately fractured, apertures slightly open, dip steep to vertical, with limonite stain. Hard, strong, very slightly weathered.

1045.9' - 1067.4' SKARN
Mixed skarn mineralization; iron ore zone. Moderately weathered.

1067.4' - 1081.3' ANDESITE DIKE
Green-gray, highly altered, abundant limonite stain. Mostly highly fractured to shattered. Slightly hard, slightly strong, highly weathered.

1081.3' - 1109.0' QUARTZITE
Pinkish tan, green, gray. Pervasive chlorite-epidote alteration. Calcite in veins 1-5 mm, minor limonite stain. Hard to very hard, very strong, slightly to moderately fractured, apertures slightly open.

1109.0' - 1112.0' ANDESITE DIKE

IRVING DEAN AFFELDT
No 1108

DATE	4/92
JOB NO.	G125-10
DWG NO.	EM 19006-14
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
MINE RECLAMATION CORPORATION

14 of 1

REMARKS
Water Data
Drilling Data
Personnel Changes

Tool Size: HQ
3.85" HOLE
2.406" CORE

1120' depth at 8:15 pm, 2/23/92
1130' depth at 10:00 pm, 2/23/92
Geologist: R. Usrey
1140' depth at 12:25 am, 2/24/92
1150' depth at 2:25 am, 2/24/92
Geologist: D. Voltumo
1160' depth at 4:55 am, 2/24/92
1170' depth at 8:01 am, 2/24/92
1180' depth at 9:40 am, 2/24/92
1190' depth at 11:12 am, 2/24/92

RQD (%)	Fractures per foot	Percent Core Recovery	Box Number
77	<1	100	BOX 128 1114.0'
0	5	65	BOX
32	3	100	129 1122.5'
42	3	100	BOX
40	3	100	130 1130.5'
47	2	100	BOX 131 1139.2'
65	1	100	BOX
52	3	100	132 1148.0'
72	2	100	BOX 133
57	2	100	1156.0'
62	2	100	BOX 134 1164.1'
70	2	100	
67	1	100	BOX 135
52	1	100	1173.2'
33	2	100	BOX 136
53	2	100	1181.2'
93	<1	100	BOX 137

Depth (ft): 1110, 1120, 1130, 1140, 1150, 1160, 1170, 1180, 1190

Material Classification and Physical Description

1109.0' - 1112.0' ANDESITE DIKE
Green, highly altered, highly deformed. Moderately to slightly hard, moderately to slightly strong

1112.0' - 1116.5' FAULT GOUGE
Green to yellow, minor limonite stain; slickensides.

1116.5' - 1164.8' QUARTZITE
Green/gray/tan. Slightly weathered, moderately fractured, fractures slightly healed, mostly 5-20 degrees from axis, with chlorite-talc fill, limonite stain

1164.8' - 1178.9' QUARTZ MONZONITE
Gray to pinkish green; inclusions of green altered quartzite. Hard to very hard, strong, slightly weathered. Moderate chlorite-epidote-pyrite alteration. Calcite veins, hairline to 1 cm.

1178.9' - 1195.0' QUARTZITE
Medium pink-gray. Highly fractured, healed with dark green chlorite-epidote-pyrite, hairline to 3 cm, 10-30 degrees from axis. Very hard, very strong, slightly weathered

REGISTERED GEOLOGIST
IRVING DEAN AFFELDT
№ 1108
ENGINEERING GEOLOGIST

DATE 4/92
JOB NO. G125-19
DWG NO. EM 19006-15
DRAWN R. HARRIS
CHK'D D. MERIT
APP'D D. AFFELDT

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FIGURE NO.
15 of 18

REMARKS
Water Data
Drilling Data
Personnel Changes

Tool Size: HQ
3.85" HOLE
2.406" CORE

1190' depth at 11:12 am, 2/24/92
1200' depth at 12:30 pm, 2/24/92
Deviation survey = <1.5 degrees
Geologist: J. Suthard
1210' depth at 4:40 pm, 2/24/92
1220' depth at 6:30 pm, 2/24/92
1230' depth at 9:55 pm, 2/24/92
Geologist: R. Usrey
1240' depth at 3:40 am, 2/25/92
Geologist: D. Voltumo
1250' depth at 9:50 am, 2/25/92
1260' depth at 12:05 pm, 2/25/92
1270' ~~depth at 2:00 am~~ 2/25/92

RQD (%)	Fractures per foot	Percent Core Recovery	Box Number
60	1	100	BOX
13	>10	100	138 1196.5'
25	3	100	BOX 139 1206.0'
0	2	100	
61	1	100	BOX
52	2	100	140 1212.7'
0	3	100	BOX
50	5	100	141
16	4	85	1222.2'
18	3	68	BOX
11	4	92	142 1231.0'
52	2	100	BOX 143
36	2	100	1239.0'
42	2	100	BOX
0	4	100	
33	3	100	144 1247.0'
44	2	100	BOX
14	>10	100	145 1256.0'
13	2	100	BOX
53	1	100	146 1262.5'
47	1	100	BOX
47	2	100	147

Depth (ft): 1190, 1200, 1210, 1220, 1230, 1240, 1250, 1260, 1270

Material Classification and Physical Description

1178.9' - 1195.0' QUARTZITE
Medium pink-gray. Highly fractured, mostly healed with dark green chlorite-epidote-pyrite, hairline to 3 cm, 10-30 degrees from axis. Very hard, very strong, slightly weathered.

1195.0' - 1198.5' SKARN:
Very dark green to black, highly altered; ore veins with pyrite. Moderately hard, moderately strong, moderately weathered, highly fractured, apertures moderately open.

1198.9' - 1203.5' ANDESITE.
Dark gray, porphyritic. Moderately to highly fractured. Minor epidote-calcite fill.

1203.5' - 1223.5' DIORITE
Medium gray to green, fine to medium grained. Green alteration (pyroxene-amphibole-feldspar-epidote-pyrite). Moderately fractured, tight to moderately open, veins of epidote-calcite, limonite stain. Hard, strong

1223.5' - 1236.0' ANDESITE.
Dark gray, aphanitic, slightly porphyritic. Moderately to highly fractured, apertures tight to slightly open with epidote-pyrite fill, limonite stain. Hard, strong, slightly weathered.

1236.0' - 1238.5' QUARTZ MONZONITE
Pink to brown, medium grained. Fractures mostly healed hairline to 3 mm, 10-30 degrees from axis, with calcite fill, limonite stain. Very hard, very strong, slightly weathered

1238.5' - 1252.0' QUARTZITE
Gray, tan, pink mottled zones. Older fractures healed, with black to green alteration zones. Younger fractures healed, with abundant calcite, apertures slightly to moderately open, mostly near-vertical. Hard, strong.

1252.0' - 1275.5' QUARTZ MONZONITE
Gray-brown, coarse-grained. Hard, strong. Moderately fractured, with calcite fill, slightly open. Scattered swirled masses of quartzite

REGISTERED GEOLOGIST
IRVING DEAN AFFELDT
№ 1108
ENGINEERING GEOLOGIST

DATE 3/92
JOB NO G125-19
DWG NO. EM 19006-16
DRAWN R. HARRIS
CHK'D C. MERIT
APP'D D AFFELDT

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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
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REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log
1270' depth at 2:00 pm, 2/25/92	HQ	47	2	100	147 [illegible]		1270	
	3.85" hole	63	2	100	BOX			
	2.406" core	74	1	100	148 [illegible]			
1280' depth at 4:06 pm, 2/25/92 Geologist: J. Suthard		50	3	60	BOX		1280	
		83	<1	100				
		40	2	100	149			
		50	2	100	[illegible] BOX			
1290' depth at 11:57 pm, 2/25/92 Geologist: R. Usrey		22	3	100			1290	
		57	3	100	150 [illegible]			
		57	2	100	BOX			
Geologist: D. Voltumo 1300' depth at 11:52 am, 2/26/92 Deviation survey = 1.5 degrees		58	1	100	151 [illegible]		1300	
		44	2	100	BOX			
1310' depth at 3:10 pm, 2/26/92 Geologist: J. Suthard		13	3	100	152 [illegible]		1310	
		25	3	100	BOX			
1320' depth at 5:15 pm, 2/26/92		63	<1	100	153 [illegible]		1320	
Broken drive chain - rig down until 12:42 am, 2/28/92		100	0	100	BOX			
		56	<1	100				
		100	<1	100	154			
Geologist: R. Usrey 1330' depth at 1:27 am, 2/27/92		100	<1	100	1329.6'		1330	
		35	2	100	BOX			
		0	>10	100	155 1337.5'			
1340' depth at 4:00 am, 2/28/92		0	>10	60	BOX		1340	
		47	5	100	156			
Geologist: D. Voltumo 1350' depth at [illegible] am, 2/28/92		17	5	100	1347.1' 157		1350	

Material Classification and Physical Description

1252.0' - 1276.5' QUARTZ MONZONITE.
Gray-brown, coarse-grained. Hard, strong. Moderately fractured, with calcite ff, apertures slightly open. Scattered swirled masses of quartzite

1276.5' - 1285.5' LIMESTONE.
Gray-green, with abundant calcite veins and hairline fractures with black (ore?) ff. Hard, strong, moderately fractured, apertures slightly open. Increasing silicification with depth.

1285.5' - 1289.0' QUARTZ MONZONITE
Brown and gray, mixed with minor green-altered quartzite. Hard, strong, slightly weathered, moderately fractured, with epidote-calcite ff, limonite stain

1289.0' - 1296.9' QUARTZITE.
Dark gray, with 3-5 mm ore veins. Hard, strong. Moderately fractured, apertures slightly open, with calcite-chlorite-epidote ff

1296.9' - 1330.0' SKARN
Gray, black, green, orange, with mixed zones of quartzite and ore. Up to 25% ore, with abundant pyrite. Hard, strong, slightly weathered. Moderately fractured, apertures moderately open, calcite in veins

1298' - 1327' dissolution of calcite veins

1330' - 1389' QUARTZITE
Light green to medium dark gray, fine-grained to vitreous. Very hard, very strong, unweathered. Moderately fractured; fractures healed to slightly open. Calcite-epidote veins, hairline to 5 mm, 0-30 degrees to axis

IRVING DEAN AFFELDT
No 1108

DATE	4/92
JOB NO.	G125-19
DWG NO.	EM 19006-17
DRAWN	R. HARRIS
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APP'D	D. AFFELDT

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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
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FIGURE NO
17 of 18

REMARKS Water Data Drilling Data Personnel Changes	Tool Size	RQD (%)	Fractures per foot	Percent Core Recovery	Box Number	Elevation (ft)	Depth (ft)	Lithologic Log
1350' depth at 10:05 am, 2/28/92	HQ	11	>10	100	BOX 157		1350	
	3.580" HOLE	19	5	100	1356.2'			
1360' depth at 12:30 pm, 2/28/92	2.406" CORE	23	5	100	BOX		1360	
		30	1	100	158 1363.5'			
		13	5	100	BOX 159			
1370' depth at 2:17 pm, 2/28/92		17	3	100	1372.0'		1370	
		79	1	100	BOX 160			
Geologist: J. Suthard 1380' depth at 5:10 pm, 2/28/92		81	<1	100	1380.5'		1380	
		72	<1	100	BOX			
		87	<1	100	161 1389.0'			
Total depth 1389' at 7:30 pm, 2/28/92							1390	
							1400	
							1410	
							1420	
							1430	

Material Classification and Physical Description

1330.0' - 1389.0' QUARTZITE.
Light green to medium dark gray, fine-grained to vitreous. Very hard, very strong, unweathered. Moderately fractured; fractures healed to slightly open. Calcite-epidote veins, hairline to 5 mm, 0-30 degrees from axis.

TOTAL DEPTH 1389 FEET

IRVING DEAN AFFELDT
No 1108

DATE	4/92
JOB NO.	G125-19
DWG NO.	EM 19006-18
DRAWN	R. HARRIS
CHK'D	D. MERIT
APP'D	D. AFFELDT

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BOREHOLE LOG
CH-10
EAGLE MOUNTAIN LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
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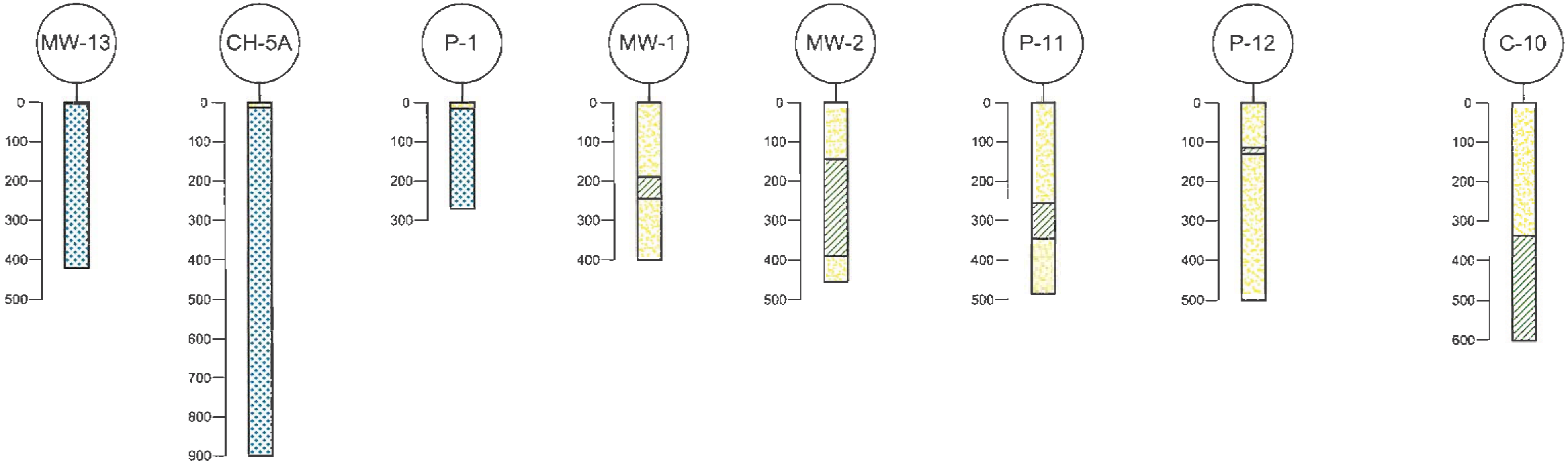
MW-13
CH-5A
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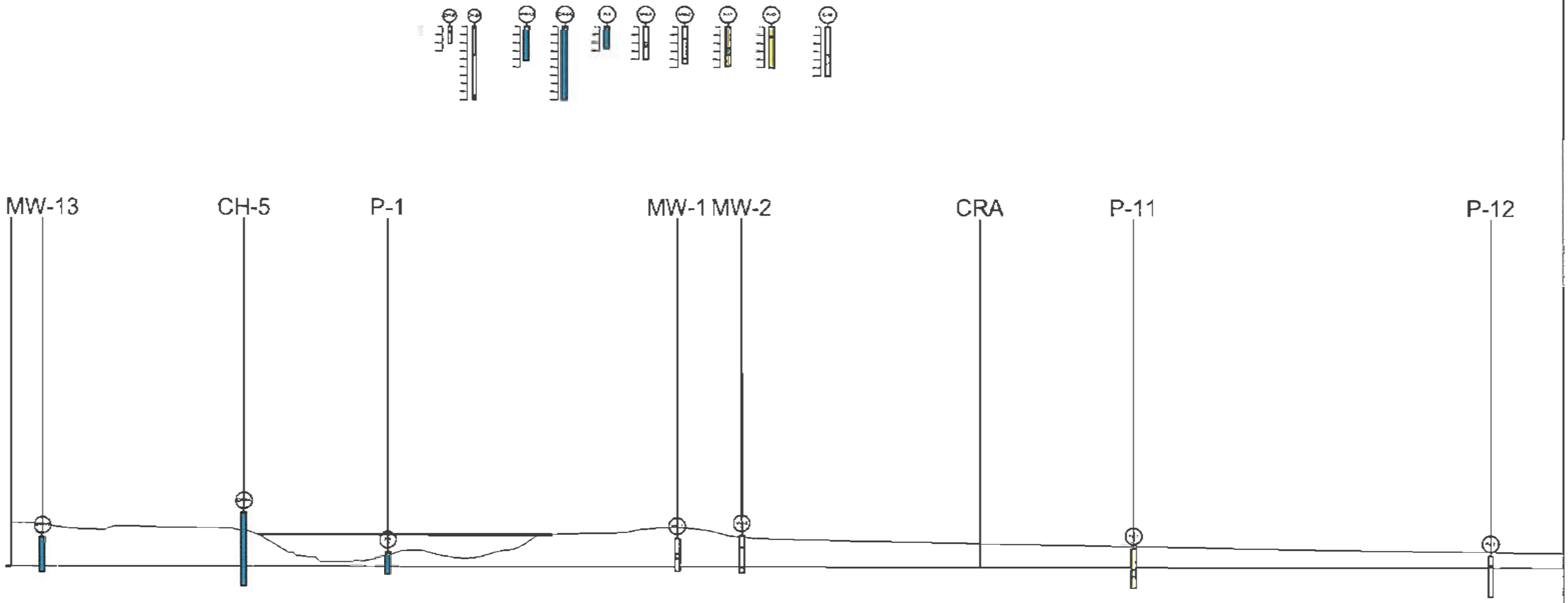
MW-13
CH-5
P-1
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MW-2
CRA
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P-12

Table E.1 Summary of Soil Laboratory Testing

Sample Information			In-situ Water Content, %	In-situ Dry Unit Weight, pcf	Atterberg Limits		Sieve/Hydrometer			USCS Group Symbol	Hydraulic Conductivity
Boring	Sample No	Depth (ft)			LL	PI	-#4 (%)	-#200 (%)	(< 5μm) (%)		(cm/s)
C-1	3	17	1.7	112.4		-	91	8.3	-	SP-SM	
	7	58	1.1	111.4		-	97.3	9.3	-	SP-SM	
	12	101	2.8	111.6	NP	NP	98.3	14.6	8	SM	
	13	110	-	-	-	-	99.8	11.7	6	SP-SM	
	14	120-125*	-	-	-	-	81.6	8.7	3	(SP-SM)g	
	15	141	-	-	-	-	99.4	25.4	19	SM-SC	
	16	160	-	-	-	-	92.5	16.5	10	SM-SC	
	17	177	-	-	-	-	65.4	13.1	-	(SM)g	
	18	199	-	-	-	-	99.7	27.9	16	SC	
	19	201	5.3	109.9	31	9	96.1	18.8	11	SC	
	21	210-220*	-	-	NP	NP	-	-	-		
	24	240-250*	-	-	-	-	97.9	23.3	13	SM-SC	
	26	262	7.7	104.8	24	4	-	-	-	SC-SM	
	27	263-272*	-	-	-	-	96.7	19	8	SM	
	28	265-275*	-	-	-	-	77.9	14.9	7	(SM)g	
	29	280-295*	-	-	-	-	98.3	16.4	-	SM	
	32	322	5.6	126.1	-	-	98.7	26.1	13	SM	
	34-2	380	-	-	21	3	-	-	-	SM	
	37	400-420*	-	-	40	26	-	-	-	CL	
	38	420-426*	-	-	-	-	99.9	8.1	-		
	42-2	460	15.3	113.8	23	3	-	-	-	SC-SM	
	42-3	460	-	-	22	6	-	-	-	SC-SM	
C-5	1	n/a	-	-	-	-	97.6	19	15	SC-SM	
	2	n/a	-	-	-	-	92.4	14.4	11		
	4-2	20	2.6	124.2	-	-	74.6	13.3	7	(SM)g	
	8	n/a	-	-	-	-	99.7	16	13	SM	
	9	59	-	-	-	-	58.6	2.8	-	(SW)g	
	10-3	62	2.9	112.4	-	-	98.9	22	16	SC-SM	2.70E-07
	11	n/a	-	-	-	-	83.6	14.5	9	(SM)g	
	12-3	81	2	113.7	-	-	45	9.8	-	(GP-GM)s	
	13	101	-	-	-	-	98.5	4.8	-	SP-SM	
	14	121	-	-	-	-	52.7	6.7	-	(GP-GM)s	
	16	142	23.5	93.2	58	35	100	91.2	70	CH	9.20E-10
	18	n/a	-	-	-	-	100	96.2	53	ML/CL	
	23	206	15.3	109.8	36	10	100	75.6	47	(ML)s	
	25	241	-	-	-	-	99.7	42.3	18	SM	
	28	276	-	-	-	-	100	33.4	-	SM	
	29	280	-	-	-	-	100	8.2	7.4	SP-SM	
	30	300	-	-	-	-	100	41.5	18	SM-SC	
	MC-1	344**	31.4	92	100	58		98.7	-	CH	
C-9	3	17	0.4	102.4			90.4	9.2	-	SW-SM	
	6	35-45*	-	-	-	-	98.6	16.6	-	SM	
	11	59-77*	-	-	49	32	-	-	-	CL	
	13	82	23.6	90.5	41	24	100	68.6	30	s(CL)	
	15	87-94*	-	-	-	-	86.8	12.7	6	SM	
	17	95-105*	-	-	-	-	87.1	10.2	4	SP-SM	
	MC-1	145	5.9	107.9			94.6	23	-	SM	3.50E-05
C-10	1	0-15.5*	-	-	-	-	93.5	7.9	5	SP-SM	
	2	16	3.9	115.6			93.2	7.8	-	SP-SM	
	3	17-30	-	-	-	-	97.5	10.8	7	SP-SM	
	4	30-63*	-	-	-	-	97.1	5.8	-	SP-SM	
	5	63-93*	-	-	-	-	91.2	3.7	3	SP	
	9	95	-	-	-	-	98.4	12.4	8	SP-SM	
	10	100	2.1	115.8			91.3	9.5	-	SP-SM	
	12	104-121*	-	-	-	-	98	16.2	11	SM	
	13	122-139*	-	-	-	-	78.4	7	5	(SP-SM)g	
	14	175-191*	-	-	-	-	99.6	8.4	7	SP-SM	
	17	191-198*	-	-	-	-	73.4	8	6	(SP-SM)g	
	18	198	2.8	100.5			66.9	5.6	-	(SP-SM)g	
	20	207-240*	-	-	-	-	94.5	15.7	8	SM	
	21	240-260*	-	-	-	-	93.7	12.1	6	SP-SM	
	22	260-280*	-	-	-	-	99	10.5	-	SP-SM	
	29	359	0.4	110.3	47	24	100	63.6	53	(CL)s	
	34	428-442*	-	-	61	31	100	91.3	50	CH	
	35	442-453*	-	-	59	32	100	48.3	35	CH	
	37	469-470*	-	-	59	37	99.6	86.7	70	CH	
	39	500-520	-	-	51	29	98.2	80.4	59	(CH)s	

*grab sample

**Shelby Tube sample

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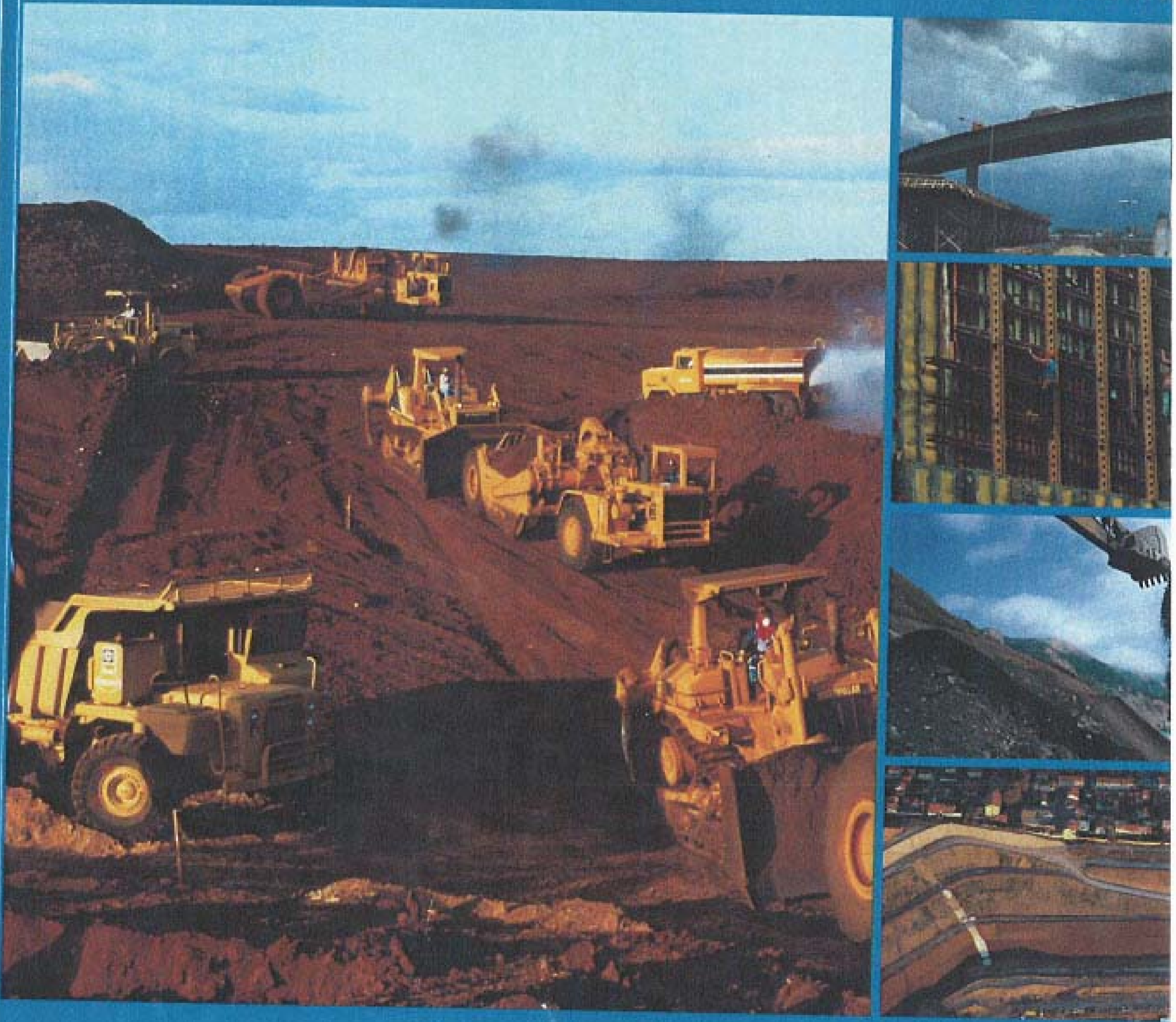

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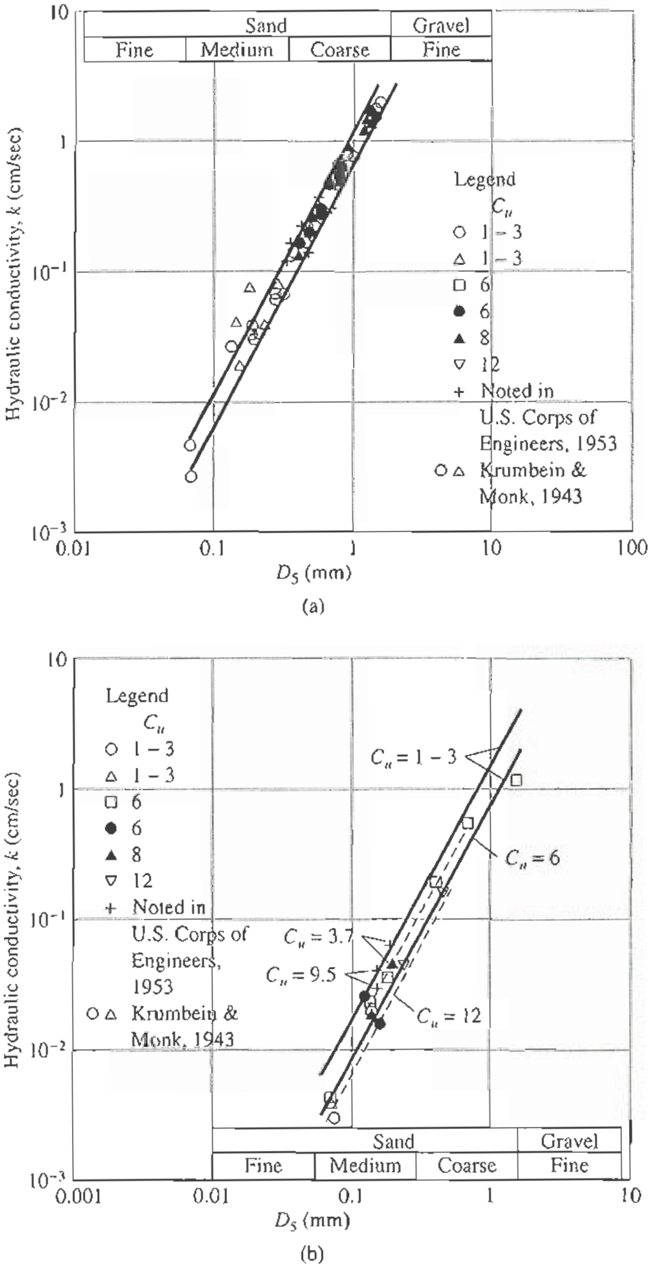

Figure 6.8
Results of permeability tests on which Eq. (6.27) is based: (a) results for C_u = 1–3; (b) results for $C_u > 3$ (after Kenney, Lau, and Ofoegbu, 1984)

where D_5 = diameter (mm) through which 5% of soil passes. Figures 6.8a and 6.8b show the results on which Eq. (6.27) is based.

On the basis of laboratory experiments, the U.S. Department of Navy (1971) provided an empirical correlation between k (ft/min) and D_{10} (mm) for granular soils with the uniformity coefficient varying between 2 and 12 and $D_{10}/D_5 < 1.4$. This correlation is shown in Figure 6.9.

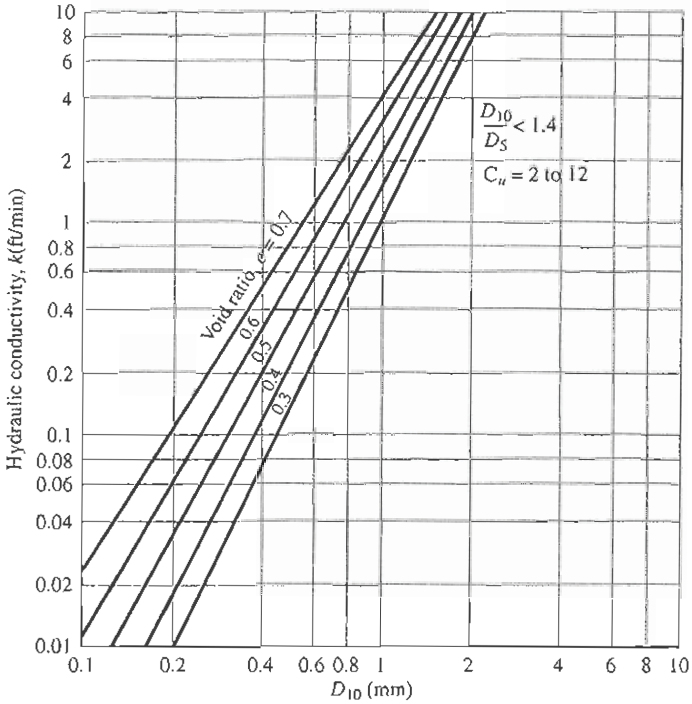

Figure 6.9 Permeability of granular soils (after U.S. Department of Navy, 1971)

According to their experimental observations, Samarasinghe, Huang, and Drnevich (1982) suggested that the hydraulic conductivity of normally consolidated clays (see Chapter 10 for definition) can be given by

$$k = C_3 \left(\frac{e^n}{1 + e} \right) \tag{6.28}$$

where C_3 and n are constants to be determined experimentally. This equation can be rewritten as

$$\log[k(1 + e)] = \log C_3 + n \log e \tag{6.29}$$

Hence, for any given clayey soil, if the variation of k with the void ratio is known, a log-log graph can be plotted with $k(1 + e)$ against e to determine the values of C_3 and n.

Some other empirical relationships for estimating the hydraulic conductivity in sand and clayey soils are given in Table 6.3. One should keep in mind, however, that any empirical relationship of this type is for estimation only, because the magnitude of k is a highly variable parameter and depends on several factors.

Tavenas et al. (1983) also gave a correlation between the void ratio and the hydraulic conductivity of clayey soil. This correlation is shown in Figure 6.10. An important point to note, however, is that in Figure 6.10, *PI*, the plasticity index, and *CF*, the clay-size fraction in the soil, are in *fraction* (decimal) form.

Table 6.3 Empirical Relationships for Estimating Hydraulic Conductivity

Type of Soil	Source	Relationship[a]	Comments
Sand	Amer and Awad (1974)	$k = C_2 D_{10}^{2.32} C_u^{0.6} \frac{e^3}{1 + e}$	
	Shahabi, Das, Tarquin (1984)	$k = 1.2 C_2^{0.735} D_{10}^{0.89} \frac{e^3}{1 + e}$	Medium to fine sand
Clay	Mesri and Olson (1971)	$\log k = A' \log e + B'$	
	Taylor (1948)	$\log k = \log k_0 - \frac{e_0 - e}{C_k}$ $C_k \approx 0.5 e_0$	For $e < 2.5$,

[a] D_{10} = effective size
C_u = uniformity coefficient
C_2 = a constant
k_0 = *in situ* hydraulic conductivity at void ratio e_0
k = hydraulic conductivity at void ratio e
C_k = permeability change index

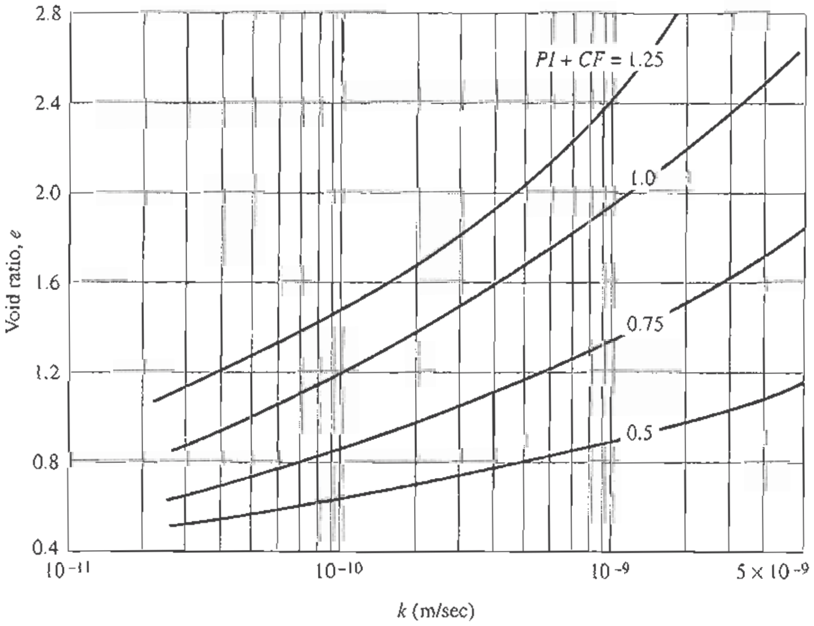

Figure 6.10 Variation of void ratio with hydraulic conductivity of clayey soils (based on Tavenas et al., 1983)

Eagle Mountain Pumped Storage Project Seepage Recovery Assessment

Prepared by: Richard Shatz [C.E.G. 1514], David Fairman, Donghai Wang, Ph.D., P.E.,

GEI Consultants, Inc.

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Introduction

Eagle Crest Energy Company (ECEC) is in the licensing stages of a two reservoir hydroelectric project known as the Eagle Mountain Pumped Storage Project (Project). The Colorado River Aqueduct (CRA) passes within about one mile east of the Lower Reservoir, and is located between the reservoir and the proposed location of the groundwater supply wells, near Desert Center, that will be used to draw water for the initial fill and annual makeup water for the reservoirs. The potential effects of Project operations on groundwater elevations beneath the CRA are of particular interest, since significant changes in the subsurface saturated conditions could result in land subsidence and impact the integrity and function of the CRA.

Two particular groundwater-related issues associated with the Project are: 1) the potential effects of groundwater extraction in the Desert Center area as water supply for the initial filling and replacement of annual losses from evaporation and seepage; and 2) the potential effects of seepage from the reservoirs. The first issue is addressed in a separate memorandum titled *Groundwater Supply Pumping Effects*, dated April 20, 2009. This memorandum describes the approach and results to address the second issue, the potential impacts of seepage from the reservoirs on groundwater levels.

Approach

This technical memorandum provides an assessment of the groundwater impacts due to seepage, and seepage recovery schemes to address the Lower and Upper reservoirs separately. Different approaches are required to address the Lower and Upper reservoirs since subsurface conditions are dramatically different. The Lower Reservoir is partially situated on unconsolidated alluvium and is evaluated using a groundwater flow model to develop a seepage recovery system design. The Upper Reservoir sits atop fractured bedrock, and a seepage recovery system is defined by performing a review of known faults that intersect the reservoir footprint.

For the Lower Reservoir, the model set-up, analysis results, and proposed seepage recovery design are discussed. For the Upper Reservoir, this memo includes a description of the geology beneath the reservoir and the proposed seepage recovery system. A groundwater model was not developed for the Upper Reservoir as application of the model would require data that does not currently exist.

Lower Reservoir Seepage Assessment

Portions of the Lower Reservoir overlie saturated alluvium, while the remainder sits atop fractured bedrock. A groundwater model was developed to assess the effects of seepage from the reservoir on local groundwater conditions for the portion overlying saturated alluvium. Because of the close proximity of the bedrock to the saturated alluvium it was assumed that the faults and fractures would be hydraulically connected to the alluvium.

Upon review of the geologic conditions at the Project site, it was decided that a numerical model built in MODFLOW would be the most cost-effective and beneficial approach to evaluating groundwater conditions in the vicinity of the CRA. The model was developed using MODFLOW-2000 (version 1.18.00, released on 8/23/2007).

Modeling Goals and Objectives

Upon filling of the Lower Reservoir, some seepage from the reservoir is expected. That seepage needs to be controlled to prevent adverse changes in water elevations beneath the CRA that could cause subsidence and hydrocompaction.

The model objectives are to:

- Create a model that can accurately simulate current groundwater conditions in the vicinity of the Lower Reservoir and the CRA based on the available data.
- Evaluate the impacts of seepage from the Lower Reservoir into the saturated alluvium.
- Simulate the effects of seepage recovery wells to capture the seepage lost from the Lower Reservoir.
- Prepare a plan for the seepage recovery array to adequately capture Lower Reservoir seepage, but not significantly raise or depress the groundwater elevations beneath the CRA.

This analysis defines an optimum number and spacing of the recovery wells, and presents hydrographs at hypothetical observation wells located adjacent to the CRA to document the effects of seepage/pumping on the CRA. The potential impacts of seepage from the Lower Reservoir and extraction from the seepage recovery wells were determined by comparing the baseline model results with those of the different scenarios.

Final design of the monitoring and recovery well system will be based upon a refined modeling effort during final engineering design based upon measured aquifer hydraulic characteristics. The model developed for this evaluation can be re-applied to support the final design phase.

Hydrogeology

Figure 1 shows the general project area. The regional hydrogeology and the basis for model development are based on:

- Descriptions of geologic conditions in the Lower Reservoir (CH2MHill, 1996).
- Water elevations obtained from monitoring wells constructed for the Eagle Mountain Landfill and Recycling Center Project.
- Subsurface logs from coring performed for the Eagle Mountain Mine.
- Well drillers' logs from Eagle Mountain Mine water supply wells.
- Cross-sections developed by ECEC, shown on Figures 2 and 3.

- Cross-sections developed by GeoPentech for a groundwater banking project in the area, shown on Figures 4 and 5.
- Geophysical survey (gravity survey) from GeoPentech shown on Figure 6.

The regional hydrogeology is characterized by fractured bedrock at the surface, with recent and older alluvium overlapping onto the sloping surface of the bedrock. The alluvium is part of the Chuckwalla Groundwater Basin. The alluvium in the upper portions of the Chuckwalla Groundwater Basin can be grouped into three units with similar sediments and hydraulic parameters. Figures 2 through 5 show the geologic layering of the alluvial sediments in the vicinity of the Lower Reservoir.

The first alluvial layer is about 300 feet thick and consists of sand and gravel with a few discontinuous layers of silt and clay. Approximately 150 feet of the alluvium is saturated. Exposures of the alluvium in the eastern face of the Lower Reservoir were described as a coarse fanglomerate (CH2MHill, 1996). Underlying the first layer are lake deposits consisting primarily of clay. The lakebed thickness varies and may be thinner near the margins of the basin and thicker towards the central portions of the basin based on geophysical surveys (gravity). However, no wells have fully penetrated the lakebeds to determine their actual thickness. One well (CW-1) penetrated over 900 feet of clayey lakebed deposits before being terminated. The lakebed deposits are potentially underlain by coarser sediments, based on geophysical surveys, but there are no wells to confirm the presence of this layer (GeoPentech, 2003). The sediments are likely to have a lower permeability than the first alluvial layer because of compaction and development of clay due to weathering.

The alluvial sediments were deposited on an irregular bedrock surface. Geophysical surveys suggest the bedrock surface is a large bowl opposite the reservoirs (GeoPentech, 2003). The southern edge of the bowl aligns with a narrow bedrock ridge that juts easterly into the basin. The upper coarse-grained sediments were deposited above the bowl rim, whereas the lakebed sediments are below the rim. This configuration would create confining conditions in the underlying coarse sediment and prevent outflow from these sediments. The northern edge of the bowl connects to the Pinto Groundwater Basin where inflow into the Chuckwalla Groundwater Basin occurs. A basalt flow and several faults are present, as shown on Figure 4, but their effects on groundwater levels are not defined.

The bedrock beneath the Lower Reservoir is broken by the inactive East Pit Fault. The East Pit Fault appears to offset the bedrock by about 300 feet, which creates a near vertical bedrock contact on the western side of the valley starting near the reservoirs and extending to the south. Figure 2 shows the difference in the bedrock surface. West of the fault the alluvium is thin and unsaturated. Portions of the CRA, south of hypothetical monitoring well OW03 (Figure 1), rests on this unsaturated alluvium. The East Pit fault consists of about a 30-foot zone of broken rock and is in hydraulic continuity with the alluvial deposits.

Groundwater level measurements near the reservoirs are available for a two-year period between 1992 and 1994, after the time when significant pumping for the Eagle Mountain Mine and jojoba agricultural activities occurred in the 1960’s through the1980s. The measurements occurred during a period when there were no quantifiable or significant stresses applied to the aquifer that could be used for calibration. There was some pumping in the Desert Center area for domestic uses and limited agricultural uses during this period.

Groundwater occurs in the sediments above the lakebeds at a depth of about 25 feet below the lowest point in theEast Pit, in the west bowl. The west bowl of the East Pit is the western portion of the East Pit, and is outside and to the west of, the portion of the East Pit proposed to be used for the project's lower reservoir. The groundwater surface generally is deeper, progressing easterly into the valley. The nature of the sediments infer – and groundwater levels show – that the aquifer is unconfined.

Only one groundwater level measurement is available for the lakebed deposits at groundwater monitoring well (C-10) located near the eastern edge of the model area. It showed the groundwater level was about 60 feet below the top of the clay surface and over 200 feet below the water surface in the overlying sediments as shown on Figure 4. There is great uncertainty regarding this single data point due to this significant difference.

No groundwater levels are available for the coarse-grained sediments underlying the lakebeds. If present, this aquifer would be confined.

The groundwater flow direction in the alluvium is relatively uniform while flow in the bedrock is variable. Figure 1 shows the groundwater flow directions. The flow direction in the saturated alluvium above the lakebeds is generally to the southeast (CH2MHill, 1996). Groundwater flow in the bedrock is towards the Eagle Creek Canyon, from both the northwest and southwest.

Hydraulic characteristics of the sediments overlying the lakebeds were estimated during the investigation for the landfill. The hydraulic conductivities were estimated to be between 0.02 and 7.1 feet per day as shown in Table 1. Descriptions of the fanglomerate from monitoring well construction describe the sediments as ranging from boulders to coarse sand, and therefore the estimated K appear to be too low. Typical K values for well-sorted sand and gravel are from 3 to 180 feet/day (Fetter, 1988). Because the fanglomerate are part of older continental deposits and could be weathered and compacted, a conservative K of 25 feet per day and an S of 0.05 were used in the model.

Conceptual Model

The model area was defined to include both the Upper and Lower Reservoirs, but is centered on the Lower Reservoir and the closest portion of the CRA as shown in Figure 1. The area modeled is the alluvial aquifers, which will extend from the alluvium–bedrock contact at the Lower Reservoir to about 2 miles east of the CRA. As described above, the model is only set up to simulate groundwater conditions for the portion of the model area overlying saturated alluvium, with the portion of the model overlying bedrock, including the Upper Reservoir, designated as *inactive*. The following assumptions were made in development of the model:

1. A 3-layer model simulates the geologic conditions present in the vicinity of the reservoir. Layer 1 represents the saturated alluvium above the lakebeds, Layer 2 represents the lakebeds, and Layer 3 represents the underlying coarse-grained sediments.

2. The model is run under steady-state conditions because of the short period of available groundwater level measurements, and those data obtained during a period when there was little to no stress on the aquifer to calibrate the model.

3. The model boundaries are generally oriented to be parallel and perpendicular with the regional groundwater flow direction in the alluvial basin.

4. Layer 3, the confined aquifer, has no outflow, either naturally or by pumping wells. The aquifer is full and water is neither flowing into nor out of the aquifer. Therefore, assigning very small hydraulic conductivities is appropriate to both Layers 2 and 3,

essentially making the model a 1-layer model at this time. The deeper layers are built into the model for use during final engineering design.

5. The upgradient and downgradient boundaries are specified to keep the system in balance under current conditions so the seepage from the Lower Reservoir can be added after the model performance is verified.
6. Seepage from the reservoir instantaneously percolates through the unsaturated sediments and reaches the groundwater surface.
7. There are no other sources or outflows of water such as wells, streams, evaporation, or precipitation.

Model Development

The groundwater flow model was developed as follows.

Model Grid

The model cells are square, with a two-step nodal spacing. The node spacing in the central portion of the model area, which is in the vicinity of the Lower Reservoir and the closest stretch of CRA, is 200 feet by 200 feet. The node spacing expands to 400 feet by 400 feet for the extremities of the model area. Figure 7 shows the model grid.

Layers

The model was constructed with three layers to simulate the hydrogeologic conditions in the Upper Chuckwalla Groundwater Basin. Layer 1 is the saturated sands and gravels above the lakebeds. Layer 2 is the lakebed deposits. Layer 3 is the coarse sediments that may underlie the lakebeds.

The top of Layer 1 is the groundwater surface and was determined from the general gradient in the area and extrapolated as a uniform planar surface to best fit actual groundwater elevations, particularly in those areas close to the reservoir and aqueduct as shown on Figure 8. Given the limited measurements available, Layer 1 has been assigned a uniform thickness of 150 feet over the entire modeled area. This assumed thickness resulted in a reasonable fit to the few clay surface elevations shown on Figure 9. Layer 1 slopes to the southeast with edges partially controlled by the bedrock contact and partially by no flow and constant head boundaries as discussed in the Boundary Conditions section of this memo.

The lakebed deposits extent is poorly defined and may have a variable thickness as shown on Figures 4 and 5. Because of the limited data points available an average and uniform thickness of 400 feet was used to create Layer 2. Definition of Layer 3 is also limited, so an average and uniform thickness of 850 feet was used. Both Layer 2 and Layer 3 surfaces were assumed to be parallel to the top of Layer 1. Both layers were created to extend throughout the modeled area.

Seepage Infiltration

The average seepage from the Lower Reservoir assuming a 0.5 foot thick seepage blanket is constructed would have seepage losses of about 890 acre-feet per year (AFY), or about 550 gpm (GEI, *Seepage Analyses for Upper and Lower Reservoirs*, dated January 5, 2009). The maximum seepage would be about 1,600 AFY if only limited seepage control improvements were made. For the current analysis, the average seepage was distributed evenly over the eastern portion of the reservoir overlying alluvium, even though it is possible that some of the seepage could migrate through the bedrock via the crushed zone of the East Pit Fault.

Based on this interpretation of the subsurface conditions, it appears the fault intersects the alluvium near the Lower Reservoir. To simplify the modeling approach and provide a reasonable worst-case scenario, all seepage is assumed to be entering the system through the alluvial sediments.

Aquifer Parameters

Layer 1 was assigned a hydraulic conductivity (K) of 25 feet per day (ft/day) and a storativity (S) of 0.05. Layers 2 and 3 were assigned a K = 3 x 10^{-6} ft/day (1 x 10^{-9} centimeters per second) and S = 0.0001, which creates an essentially impermeable lower boundary for Layer 1. The aquifer characteristics of these deeper layers may be adjusted based upon measurements made to support final engineering design.

Initial and Boundary Conditions

The model is oriented such that the east and west boundaries are parallel to the direction of groundwater flow and therefore are no-flow boundaries. The upgradient and downgradient boundaries are general head boundaries assuming a total volumetric flow of 6,625 AFY (estimated outflow through the southern edge of the modeled area) through the system (790,120 ft^3/day), and an aquifer thickness of 150 feet. The flow was distributed across an up gradient length of 20,600 feet and across a down gradient length of 14,600 feet. The down gradient length is shorter due to the model area coinciding with a bedrock ridge that juts easterly into the valley.

The initial heads for Layer 1 were based on groundwater levels measured in monitoring wells constructed for the landfill. A uniform planar surface was developed that provided a best fit near the Lower Reservoir. Because Layers 2 and 3 have no hydraulic head measurements the heads were assumed to be at the top of Layer 2.

Modeling Runs

The overall approach to simulating the groundwater conditions in the vicinity of the Lower Reservoir and CRA was performed using the model runs outlined below. All runs are steady-state simulations.

> Run 1 – Simulate current groundwater conditions and compare results of model analysis with current groundwater elevations interpolated by observation wells to evaluate the model performance.
>
> Run 2 – Add seepage from the Lower Reservoir to Run 1 and observe changes in water elevations around the reservoir and at simulated observation wells along the CRA.
>
> Run 3 – Add seepage recovery wells to Run 2 and observe changes in water elevations around the reservoir and at simulated observation wells along the CRA.

Transient simulations were performed for both Runs 2 and 3 to develop hydrographs showing the projected changes in groundwater levels beneath the CRA and when steady state conditions are reached. This allows the timing of groundwater changes in response to seepage, and seepage mitigation, to be evaluated. Water balance results for each modeling run are also provided.

Run 1 - Model Performance

The model performance was evaluated by observing the model's ability to replicate the current groundwater conditions using the given aquifer parameters, boundary conditions, and initial conditions. General agreement was observed between the initial groundwater gradient and the steady-state elevations simulated by the model after Run 1. As shown on Figure 10, the up gradient and down gradient elevations were accurately estimated and the model reasonably matched the uniform initial gradient.

It was expected that the uniform gradient projected over the entire alluvial portion of the model would not be as accurately replicated near the encroaching bedrock contact along the southwestern portion of the model since the extrapolated gradient does not take into account the no-flow boundary effects. It would appear that the model better approximated the groundwater elevations in this area. Overall, the model appears to reasonably replicate the current groundwater conditions in the alluvial area.

Run 2 – Seepage

Run 2 was performed following verification of the model's ability to replicate the current groundwater conditions. The purpose of Run 2 was to assess the impacts of seeping 890 AFY from the Lower Reservoir on groundwater elevations and did not include seepage recovery wells. The estimated seepage is based on the analysis found in the Technical Memorandum on Seepage (Section 12.5). Run 2 is based on an assumed placement of a 5-feet thick liner consisting of grouting, seepage blanket, and RCC or soil cement treatment over alluvium.

As shown in Figure 11, Run 2 showed that a groundwater mound is created in the vicinity of the Lower Reservoir and a rise in groundwater elevations occur across the model. Groundwater levels rose about 8 feet beneath the reservoir, far less than the 25 feet of unsaturated alluvium. A series of hypothetical observation wells were placed along the CRA as monitoring points to evaluate groundwater elevation changes. As shown on Figures 12 through 14, groundwater elevations at the closest observation well, OW05, rose 1.88 feet in response to seepage from the Lower Reservoir. Down gradient observation well OW03.2 rose about 2.65 feet.

A transient analysis was performed to evaluate the change of groundwater elevations over time. Figure 12 showed that groundwater elevations at OW05 rose 1.64 feet (87 percent of elevation change at steady state) after three years in response to seepage from the Lower Reservoir, and reached 1.87 feet (99 percent) after 10 years.

Run 3 – Seepage Recovery and Alternatives Evaluation

Run 3 consisted of multiple runs varying the number, pumping rates, and preliminary locations of the seepage recovery wells. In all runs the seepage from the reservoirs was captured, using 5 to 7 wells, but the drawdown beneath the CRA varied from about 1 to 4 feet. Consideration was given to placement of the wells away from the reservoir to effectively capture the seepage. Model Run 2 showed that a saturated mound would not rise high enough to connect to the reservoir bottom. Therefore, the seepage will migrate mostly vertically through unsaturated alluvium before reaching the water surface. To allow the seeped water to reach the groundwater surface the recovery wells' array design consisted of six wells distributed about 1500 to 2000 feet from the eastern and southern edges of the Lower Reservoir at a spacing of about 1000 feet, each pumping 92 gpm. The locations of the wells are shown on Figure 15. Figure 16 shows the results of Run 3. Groundwater elevations in the vicinity of the CRA were maintained between 0 and 3 feet below the initial groundwater conditions. Pumping the seepage recovery wells would result in less than 6 feet of drawdown in these wells.

A transient analysis was performed to evaluate the change of groundwater elevations over time. Figures 12 through 14 show that the seepage recovery wells reduced the water elevations at OW05 to 1.86 feet (89 percent of elevation change at steady state) below the initial groundwater elevations after three years, and reached 2.08 feet (greater than 99 percent) after 10 years. The other observation wells reached steady state conditions in a similar time frame.

Water Balances

Figure 17 shows the mass balance for all three runs. The inflow and outflow values are within a fraction of a percent of each other, indicating that model parameters are being accounted for and the model is valid.

Landfill Compatibility

The water surface elevation in the Lower Reservoir will range from elevation 925 and 1,092 feet msl. The landfill is proposed to be constructed in four phases. Phases 1 through 3 will be constructed at elevations above the lower reservoir's maximum water surface elevation and therefore cannot be affected by the seepage from the lower reservoir. Phase 4 is located to the north of the lower reservoir and its foundation finish grade at its lowest point is about 1,040 feet msl (about 800 feet from the reservoir), below the maximum reservoir water surface. This portion of the landfill is being built at least in part over the older alluvium exposed in the eastern portion of the Lower Reservoir, however the area is currently covered by tailing piles so the exact extent of the alluvium is unknown.

The groundwater model covered this area and can approximate the change in the groundwater level beneath this portion of the landfill. Groundwater levels directly beneath the reservoir, if not controlled by seepage recovery wells, would be expected to rise a maximum of 8 feet. Existing monitoring well MW-1 is the closest monitoring well in the alluvium to Phase 4. The groundwater elevation in well MW-1 was 706 feet msl in 1992. The water surface elevation with uncontrolled recharge mounding, projects to be about 714 feet elevation, far below the landfill foundation. With seepage control wells, as shown on Figure 16, groundwater levels are expected to change by about one to four feet.

Upper Reservoir Seepage Assessment

The Upper Reservoir is entirely underlain by bedrock. The bedrock is fractured and seepage from the Upper Reservoir will likely be through these fractures. These groundwater conditions do not readily lend themselves to modeling. Therefore, a geologic assessment of the major faulting pattern was prepared to develop a preliminary seepage recovery well network to capture all of the seepage from the Upper Reservoir.

Hydrogeology

Bedrock geologic units present at the site can be generally classified as igneous or meta-sedimentary (including the iron ore) with little to no primary permeability. The meta-sediments have been folded into an anticline with the Upper Reservoir on the north limb. Subsequent to the folding and fracturing volcanic dikes intruded the rock in a northeast–southwest trend.

Fracturing and faulting of the rock created secondary permeability that can convey water from the reservoir. Geologic mapping of the Upper Reservoir was performed prior to the excavation of the pit by the Eagle Mountain Mine and shows the location of the major faults. Figure 18 shows the location of these major faults (digitized from Proctor, 1992). For purposes of this analysis, it was assumed that the fractures would be connected to these major faults. The faults near and beneath the Upper Reservoir (Fault "A") have a similar northwest-southeast trend to the East Pit Fault, which crosses through the Lower Reservoir. Although no dips are provided for faults in the Upper Reservoir it is believed they would be similar to the East Pit Fault, which is nearly vertical (dips about 80 degrees to the east).

Two borings were completed in the Upper Reservoir site vicinity (MW-10 and CH-10). Rock core obtained from boring CH-10 provides insights on the hydrogeologic character of the bedrock. The boring was drilled to a total depth of 1,389 feet. Water was first observed at a depth of 1,309 feet. Rock in the upper 350 feet of the boring was found to be moderately fractured, interbedded igneous and meta-sedimentary rock. Monitoring well MW-10 was drilled to a total depth of 1,214 feet. Water was first encountered at a depth of 506 feet. The water surface subsequently dropped and later stabilized at a depth of 1,018 feet. The observations suggest that water may be present in joints and fractures at various depths and that lower fractures are either dry or at lower heads.

The groundwater flow direction in the bedrock is regionally towards the southeast, in the direction of Eagle Creek Canyon as shown on Figure 1 (CH2MHill, 1996). It is possible there are either faults or fractures in the rock that are concealed beneath the thin alluvium in the canyon. Faults and fractures typically create weak zones where erosion can create canyons. The orientation of the canyon would suggest a fault or fracture could convey water to the east into the saturated alluvium where it could be captured by the Lower Reservoir seepage recovery wells.

The depth to groundwater in the bedrock beneath portions of the CRA is about 450 feet below ground surface, as shown on Figure 2. Groundwater levels in the bedrock would have to rise by about 180 feet before saturating the alluvium overlying bedrock.

Hydraulic Characteristics

Hydraulic characteristics of the bedrock joint and fractures were estimated during the investigation for the landfill. The hydraulic conductivities were estimated to be between 0.02 and 5.1 feet per day as shown in Table 1.

Few wells in the area obtain water from the fractured bedrock. The former Eagle Mountain school well (School Well) was drilled to a depth of about 750 feet before encountering adequate flow to support a small well. The well could be pumped at a rate of about 75 gpm.

Seepage

The Upper Reservoir may seep an average of 738 acre-feet of water annually or about 460 gallons per minute (GEI, *Seepage Analyses for Upper and Lower Reservoirs*, dated January 5, 2009). Raising and lowering of water levels in the reservoir during normal operations would allow some of the seepage, especially in the sidewalls, to drain back into the reservoir during low water level periods.

Seepage Recovery Wells

A preliminary seepage recovery network was designed assuming that the average well would be capable of pumping only 70 gallons per minute, similar to the School Well. About seven seepage recovery wells may be needed. Five of the seven seepage recovery wells were positioned around the Upper Reservoir outside of the landfill perimeter at currently known locations of faults that extend beneath the reservoir. Figure 18 shows the location of the proposed seepage recovery well system.

In addition to the seepage recovery well system near the Upper Reservoir, additional seepage recovery wells will be constructed along the axis of the Eagle Creek Canyon at the intersections of the faults that cross beneath the Upper Reservoir. These wells in conjunction with the wells near the Upper Reservoir will be used to maintain the water levels below the elevation of the liner for the proposed landfill operations in this area and to prevent a rise in groundwater levels in the bedrock beneath the CRA.

Conclusions

The results of the MODFLOW model for the Lower Reservoir indicate that groundwater levels in the vicinity of the CRA would increase by up to three feet by seepage from the Lower Reservoir if not controlled through seepage recovery wells. A preliminary seepage recovery well array design consists of six wells, each pumping 92 gpm, and resulted in capture of all of the seepage, with groundwater elevations only being reduced beneath the CRA by about three feet. The absolute elevations are reflected in Figure 13 with the elevation increasing from about 629 feet msl to about 632 feet msl without the network and decreasing from about 629 to 626 with the network. Although the seeped water could be allowed to flow unimpeded to offset drawdown related to water supply pumping, this does not allow for unanticipated conditions. Therefore, seepage recovery wells will be installed and equipped. Once the reservoirs are at full capacity and the actual operating conditions are observed, groundwater management alternatives will be employed to minimize groundwater level changes beneath the CRA.

The maximum seepage from the Lower Reservoir with limited seepage control improvements is estimated to be about 1,600 AFY, about double the average seepage that was analyzed in this assessment. Therefore, worst case projections would suggest the seepage, if not controlled by pumping, would raise groundwater levels by about 6 feet beneath the CRA. The seepage could be controlled by pumping wells.

Seepage from the Upper Reservoir will be along joints, fractures, and faults that cross beneath the reservoir. About seven seepage control wells will be needed to control the seepage losses, assuming they will each pump about 70 gpm. Since the faults are near-vertical angle drilling may be an effective method. Additional seepage recovery wells will be constructed along the axis of the Eagle Creek Canyon to provide secondary control to prevent groundwater levels from rising beneath this area of the proposed landfill.

Mitigation Measures

Mitigation SR-1:

Aquifer tests will be performed during final engineering design to confirm the seepage recovery well pumping rates and aquifer characteristics. The tests will be performed by constructing one of the seepage recovery wells and pumping the well while observing the drawdown in at least two seepage recovery or monitoring wells. If available, additional observation wells will be monitored. Upon completion of this testing the model will be re-run and the optimal locations of the remainder of the seepage recovery wells will be determined to effectively capture water from the Lower Reservoir and maintain groundwater level rises and drawdown at less than significant levels beneath the CRA.

Mitigation SR-2:

A testing program will also be employed for seepage recovery wells for the Upper Reservoir. However, the purpose of these tests is to assess the interconnectedness of the joints and fractures and the pumping extraction rate. Drawdown observations will be made in nearby observation wells to support final engineering design.

Mitigation SR-3:

A groundwater level monitoring network will be developed to confirm that seepage recovery well pumping is effective at managing groundwater levels beneath the CRA and in the Eagle Creek Canyon portion of the proposed landfill. The monitoring network will consist of both existing and new monitoring wells to assess changes in groundwater levels beneath the landfill and the CRA. In addition to the proposed monitoring wells, groundwater levels, water quality, and production will be recorded at the Project seepage recovery wells.

Mitigation SR-4:

Seepage from the upper reservoir will be maintained below the bottom elevation of the landfill liner. Seepage from the Lower Reservoir will be maintained to prevent significant rise in water levels beneath the CRA.

Alternative Mitigation Measure:

As shown in the analyses for the Project water supply well pumping assessment, the cumulative change in groundwater levels beneath the CRA (near OW03) over the 50-year life of the Project are projected to be drawn down by about 14 feet as a result of pumping for the proposed projects – pumped-storage project, landfill project, and solar projects – and other existing uses in the basin (GEI, 2009). The Project water supply pumping will result in about 6 feet of drawdown. Project pumping drawdown could be mitigated by managing seepage from the reservoirs, which, if left unimpeded, could raise groundwater levels by up to 3 feet. Implementation of this option would require confirmation of groundwater level rises and water quality of the resulting seepage.

Mitigation SR-5:

Groundwater monitoring will be performed on a quarterly basis for the first four years of Project pumping and thereafter may be extended to bi-annually or annually depending on the findings. Annual reports will be prepared and distributed to interested parties.

References

CH2M Hill, 1996. Eagle Mountain Landfill and Recycling Center Project, Produced for Riverside County and Bureau of Land Management.

GEI, January 5, 2009. Eagle Mountain Pumped Storage Project: Seepage Analyses for the Upper and Lower Reservoirs.

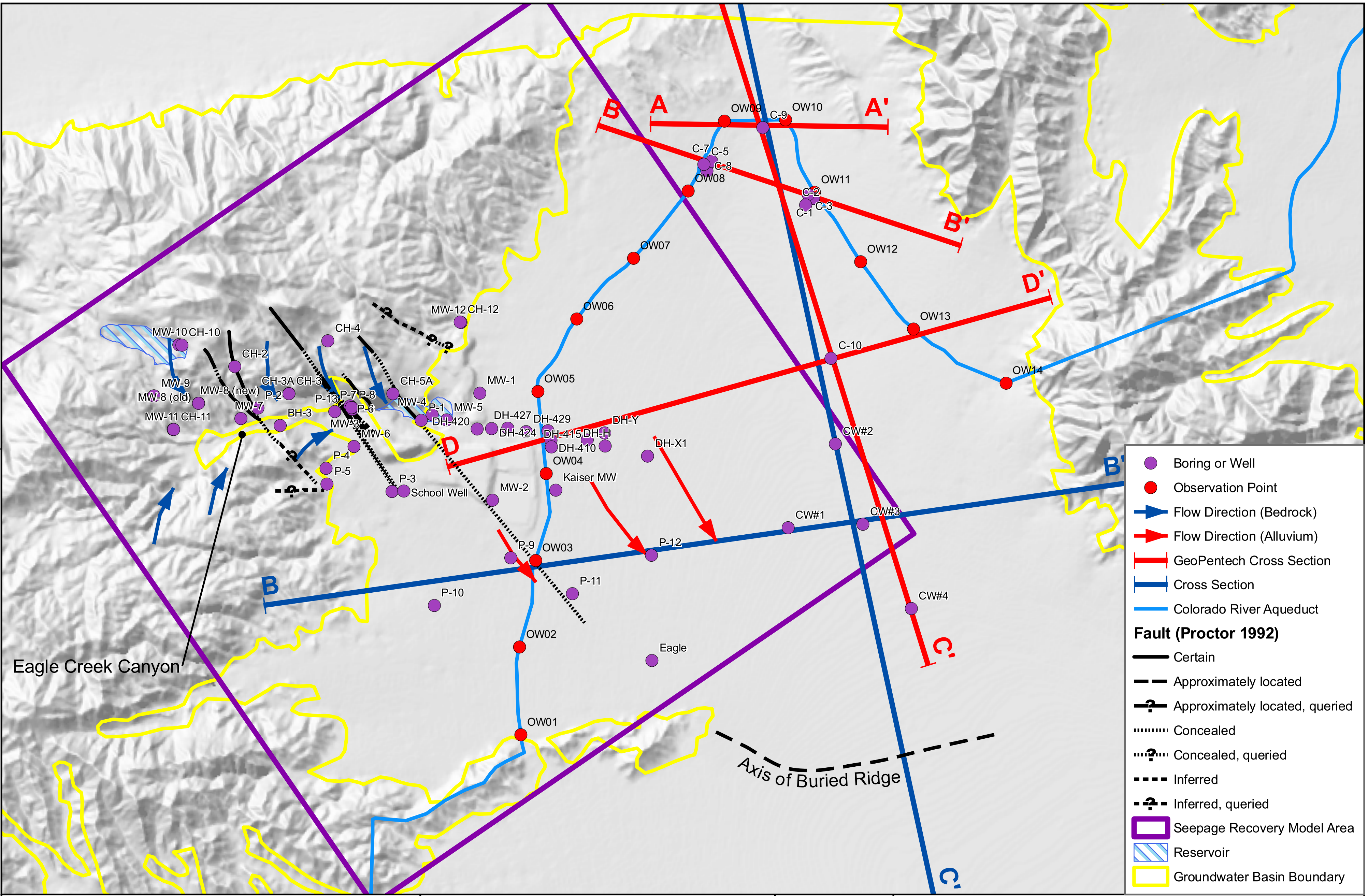
GEI, April 20, 2009. Groundwater Supply Pumping Effects.

GeoPentech, 2003. Upper Chuckwalla Groundwater Basin Storage, Draft Report (not for public release). Produced for Metropolitan Water District.

Greystone, 1994. Eagle Mountain Pumped Storage License Application. Produced for Eagle Crest Energy Company.

Proctor, Richard J., July 31, 1992. Largest Faults and General Geologic Units at Eagle Mtn. Landfill Site, Plate 1.

Figures



Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy Company

SEEPAGE RECOVERY MODEL AREA

MARCH 2009

FIGURE 1

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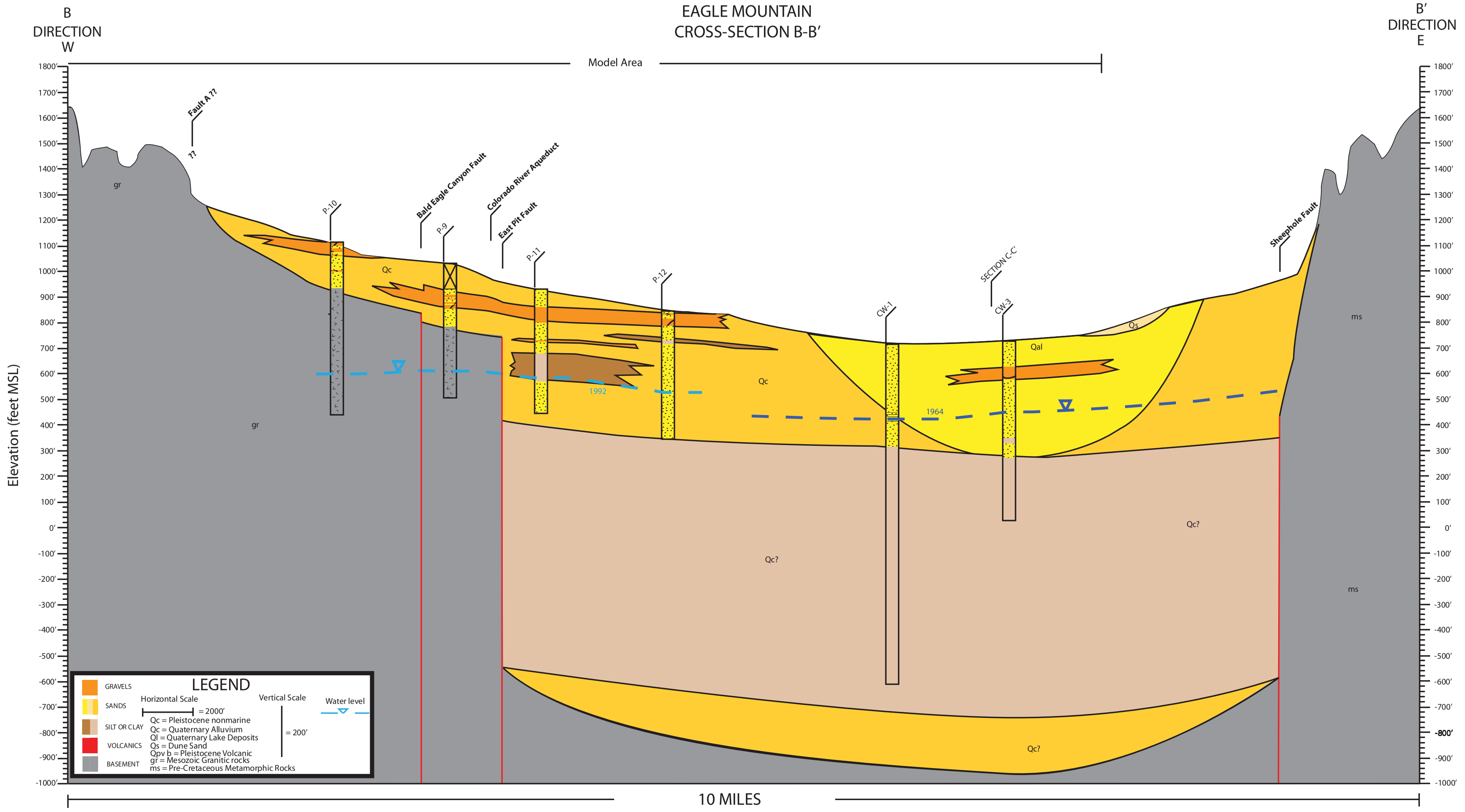


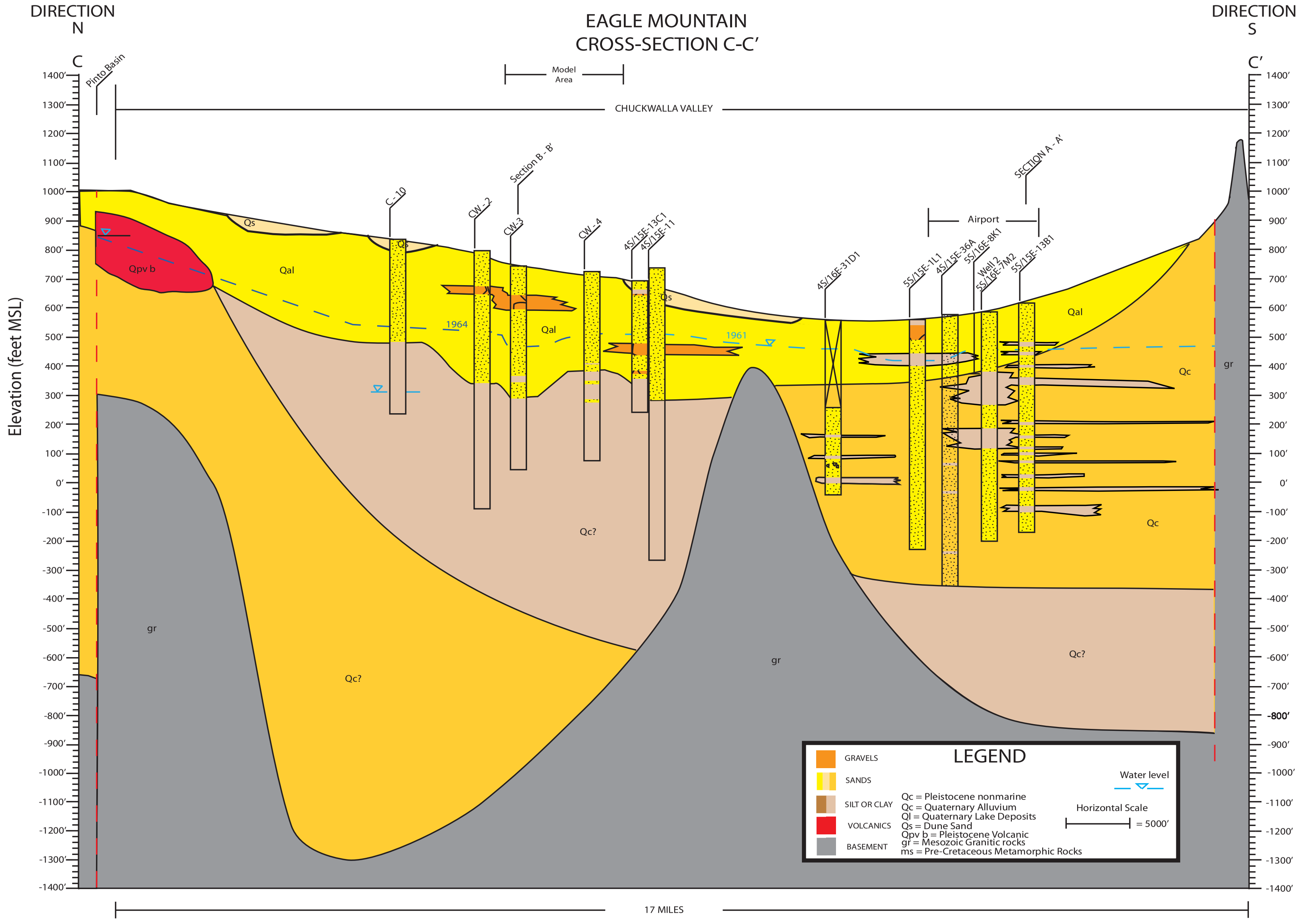
EAGLE MOUNTAIN PUMPED STORAGE
EAGLE MOUNTAIN, CA

EAGLE CREST ENERGY COMPANY

CROSS-SECTION B-B′

MARCH 2009

FIGURE 2



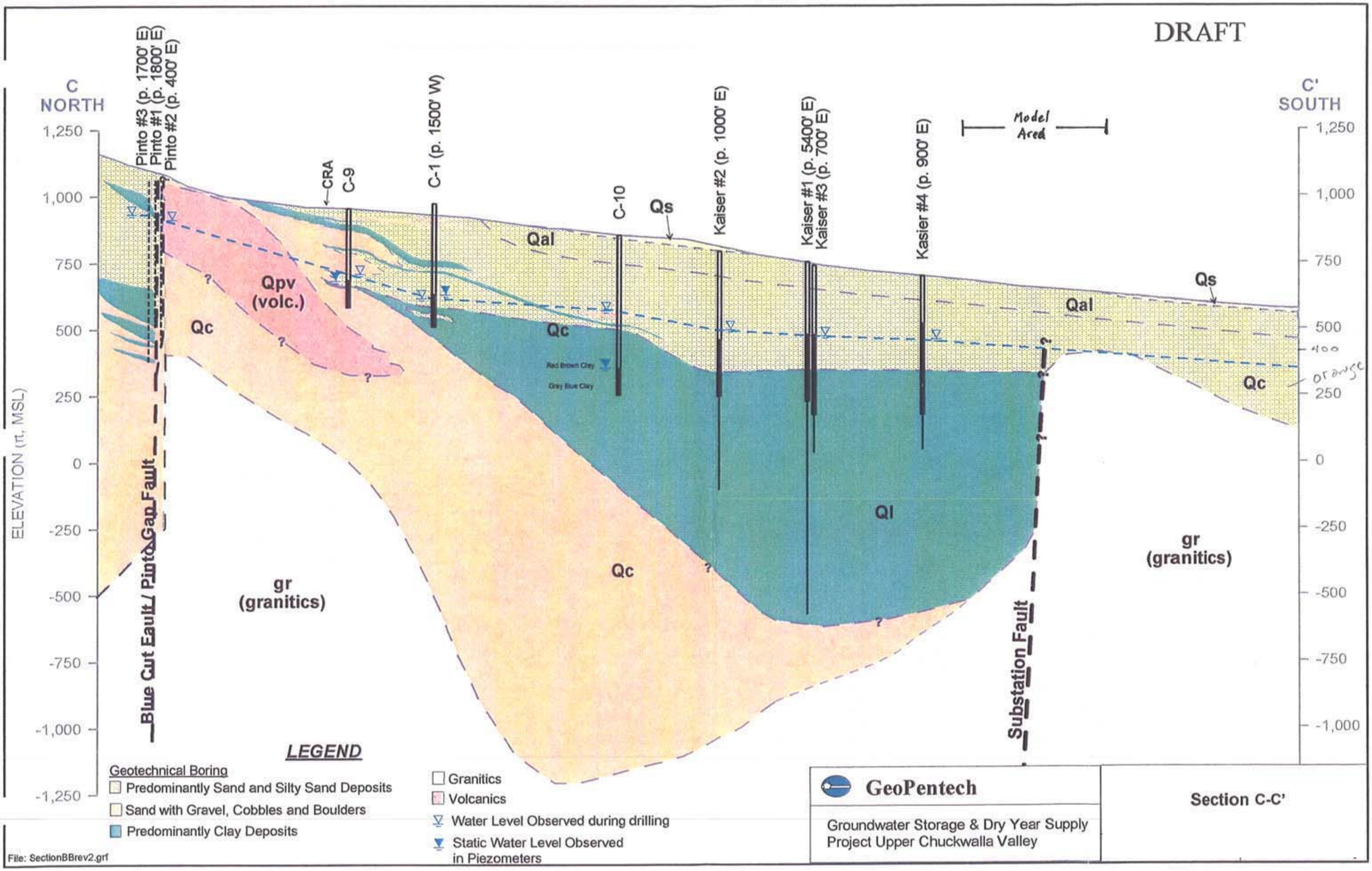
EAGLE MOUNTAIN PUMPED STORAGE
EAGLE MOUNTAIN, CALIFORNIA

EAGLE CREST ENERGY COMPANY

CROSS-SECTION C - C'

MARCH 2009

FIGURE 3



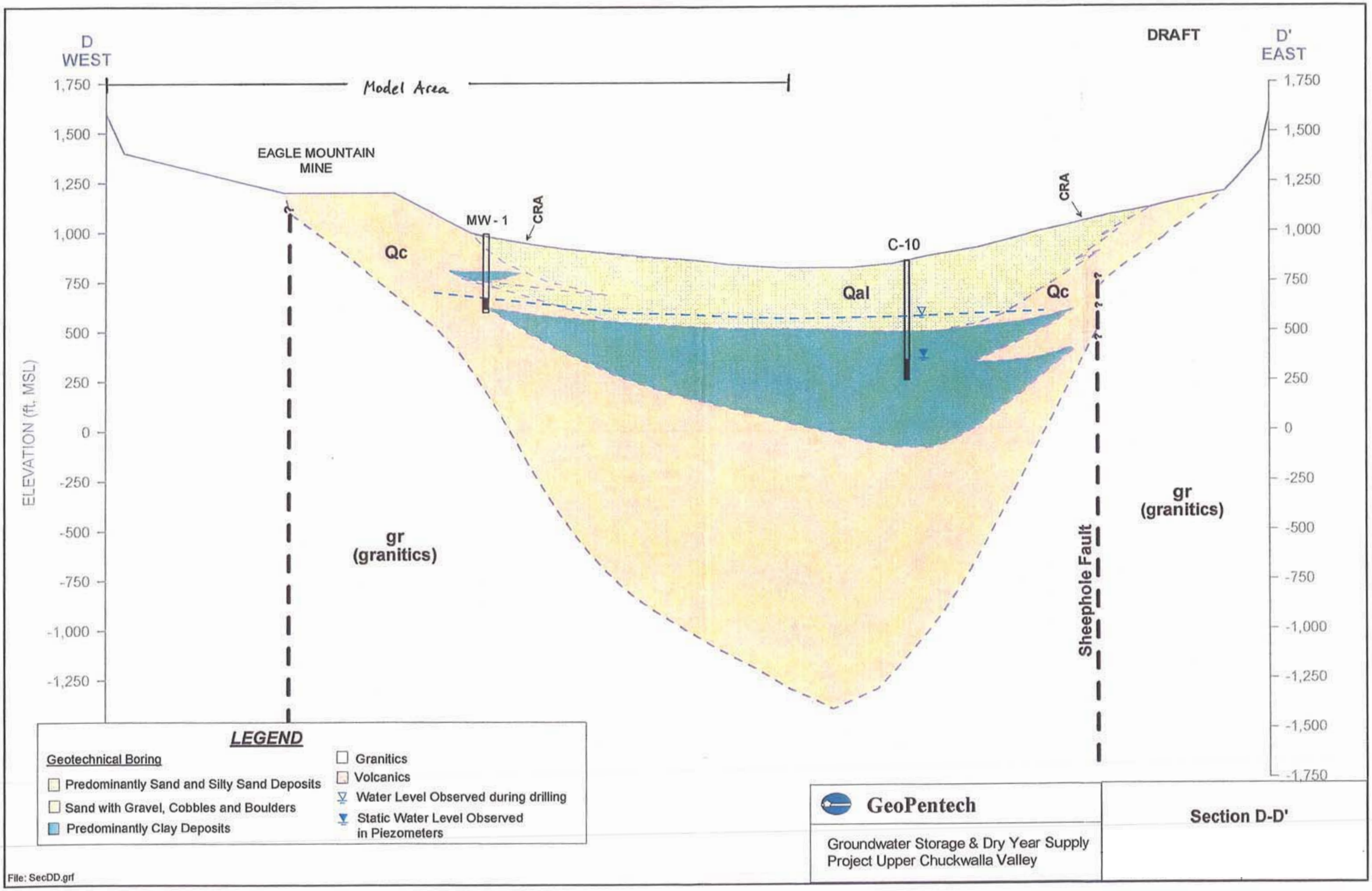
Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy Company

GEOPENTECH CROSS SECTION C-C'

MARCH 2009

FIGURE 4



Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy Company

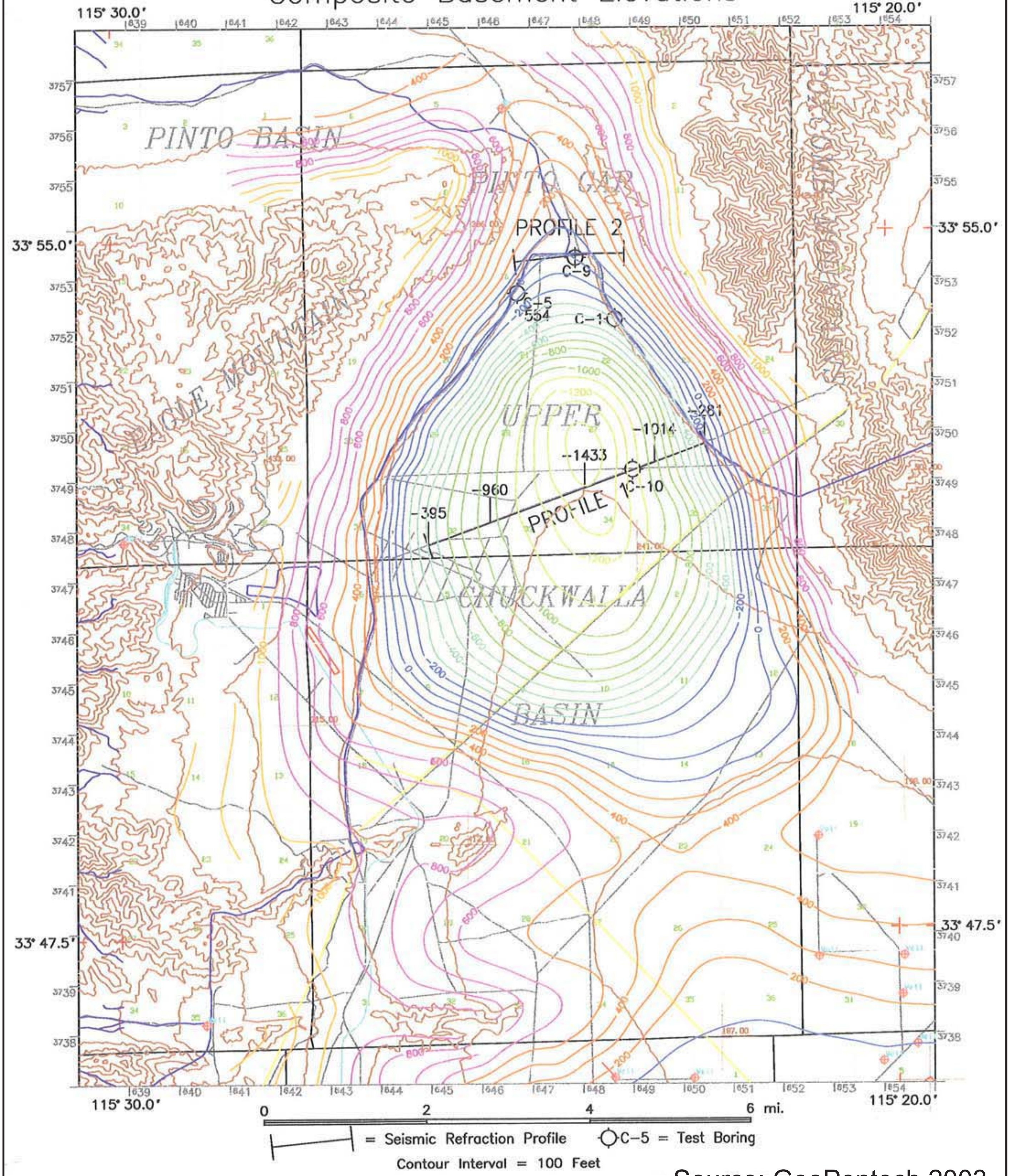
GEOPENTECH CROSS SECTION D-D'

MARCH 2009

FIGURE 5

31-Mar-2009 S:\GIS\Projects\Fig5_GeoPentechD.mxd

Composite Basement Elevations



Source: GeoPentech 2003.

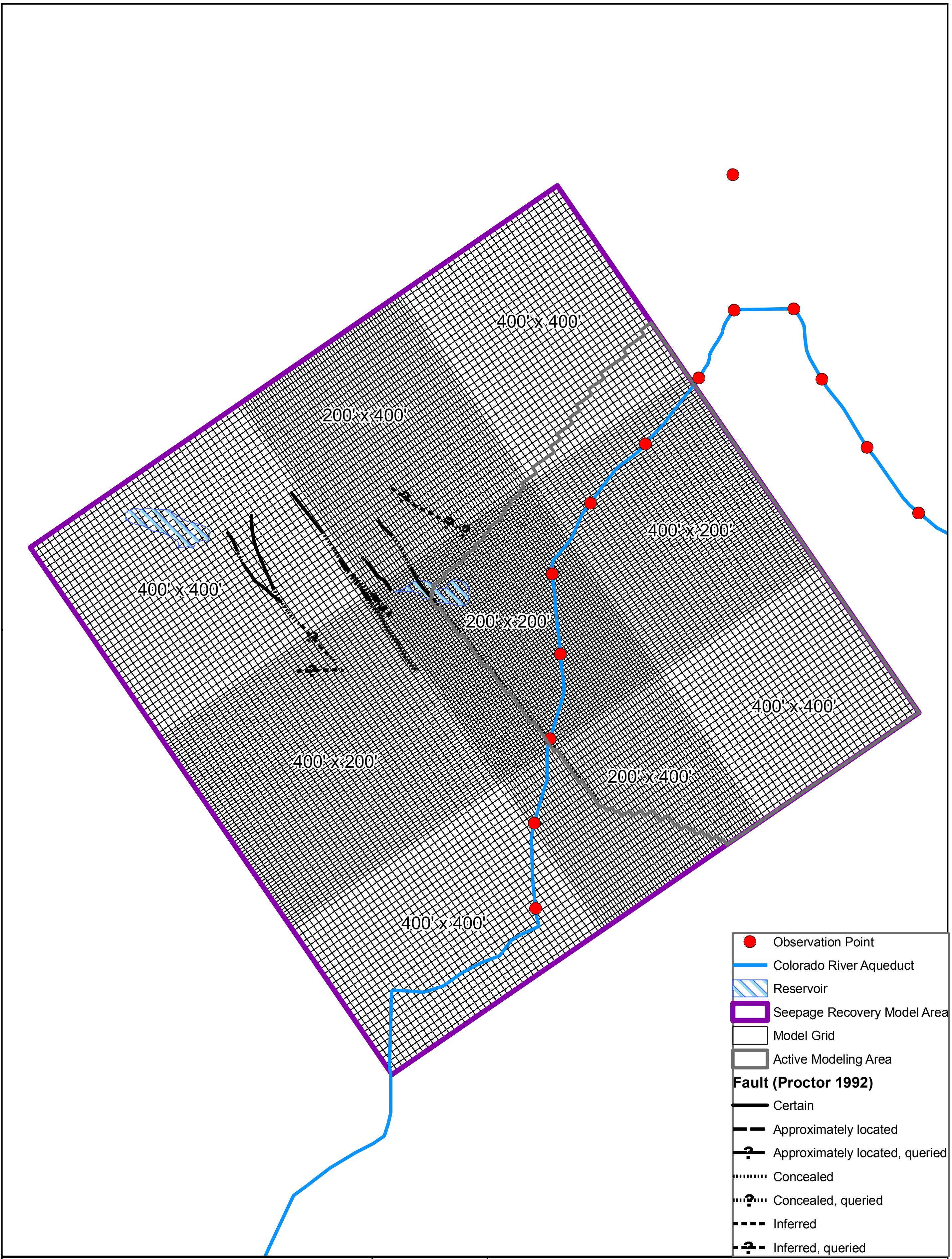
Pumped Storage Project
Eagle Mountain, California

BEDROCK ELEVATION MAP
BASED ON BOUGOUR ANOMALIES

Eagle Crest Energy Company

MARCH 2009

FIGURE 6



Pumped Storage Project
Eagle Mountain, California

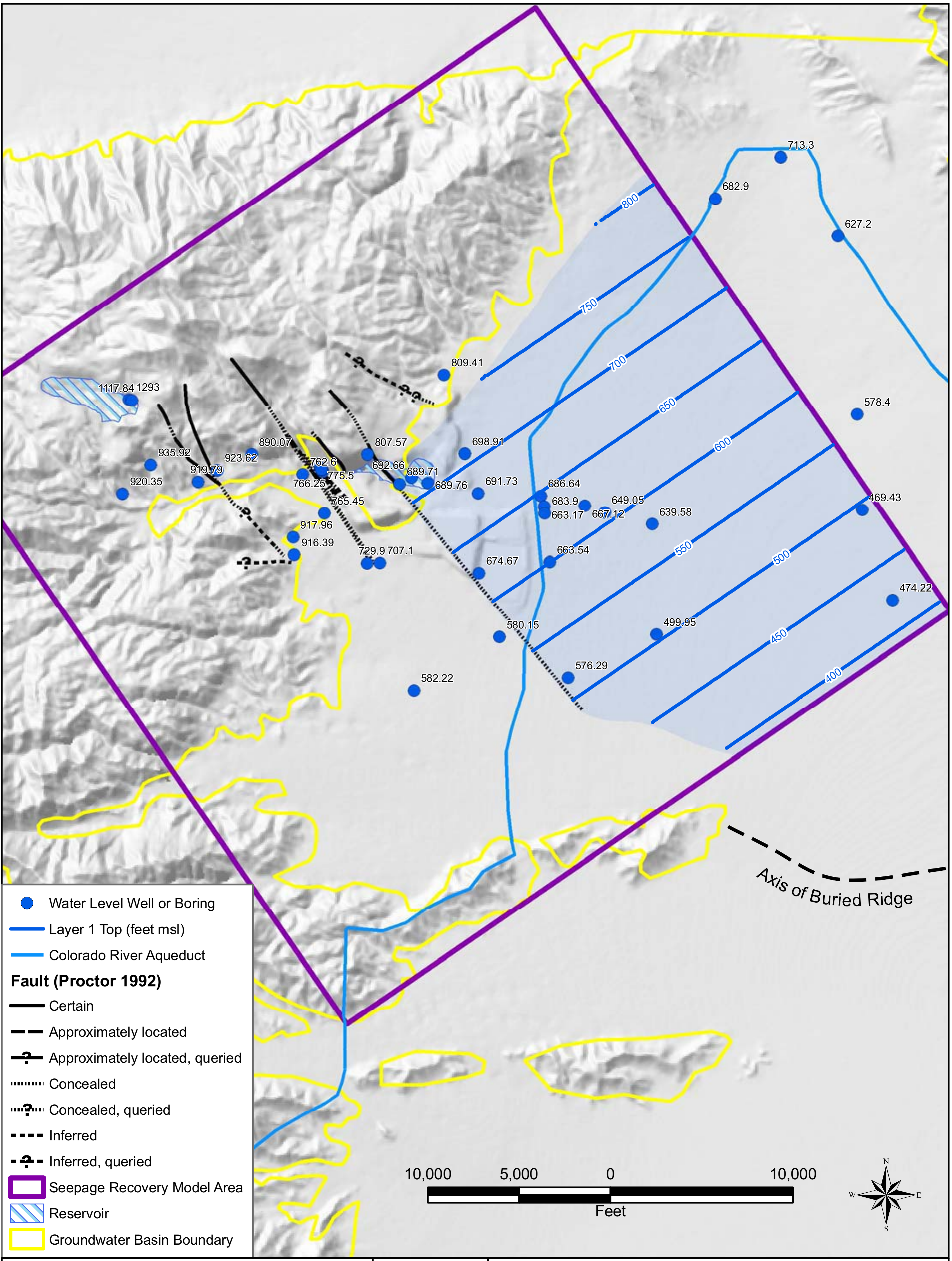
Eagle Crest Energy Company

MODEL GRID

MARCH 2009

FIGURE 7

30-Mar-2009 S:\GIS\Projects\083850_EagleMtn_gwmodeling\ModelGrid.mxd DLF



30-Mar-2009 S:\GIS\Projects\083850_EagleMtn_gwmodeling\Layer1_top.mxd DLF

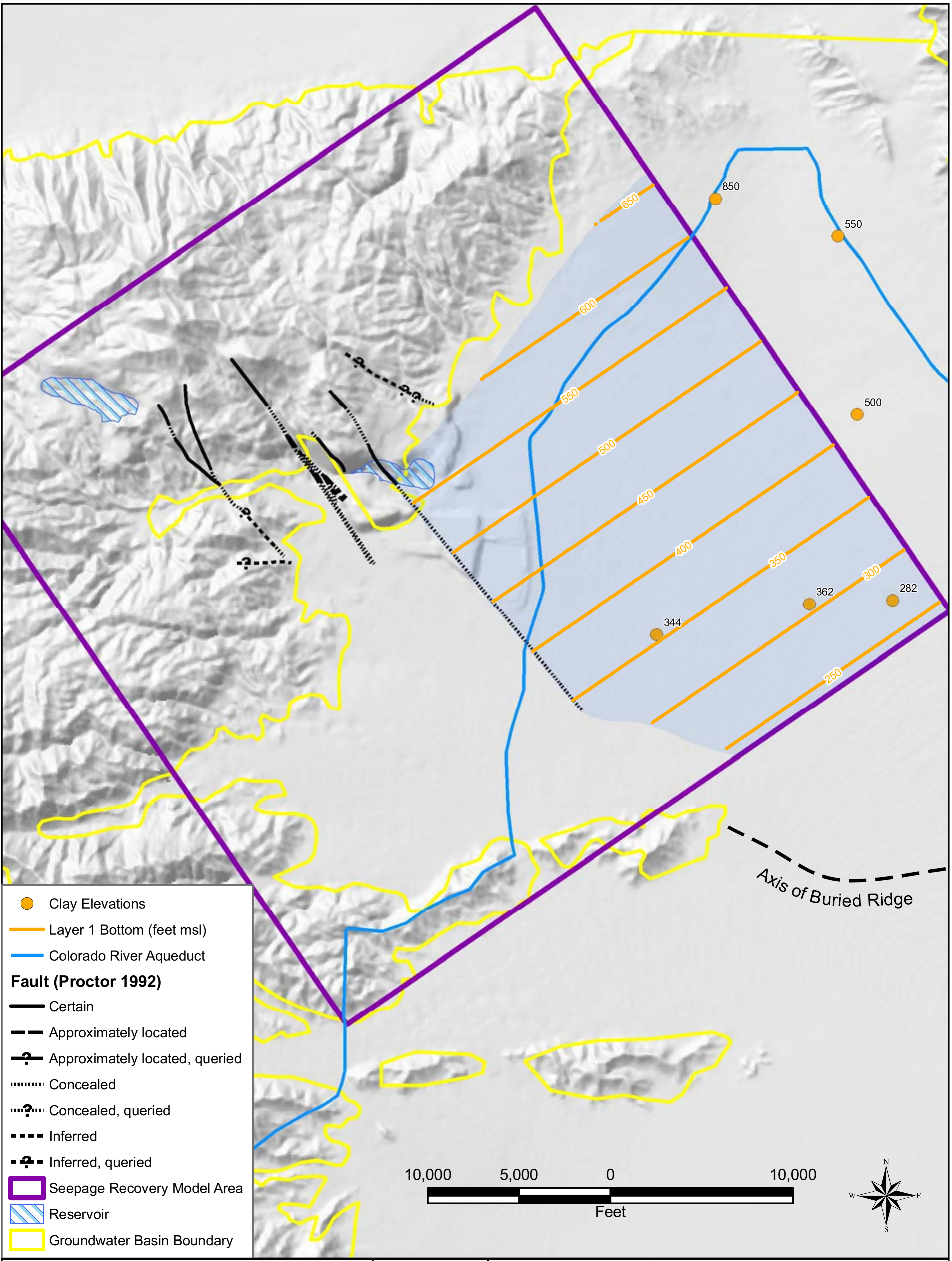
Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy Company

TOP OF LAYER 1

MARCH 2009

FIGURE 8



Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy Company

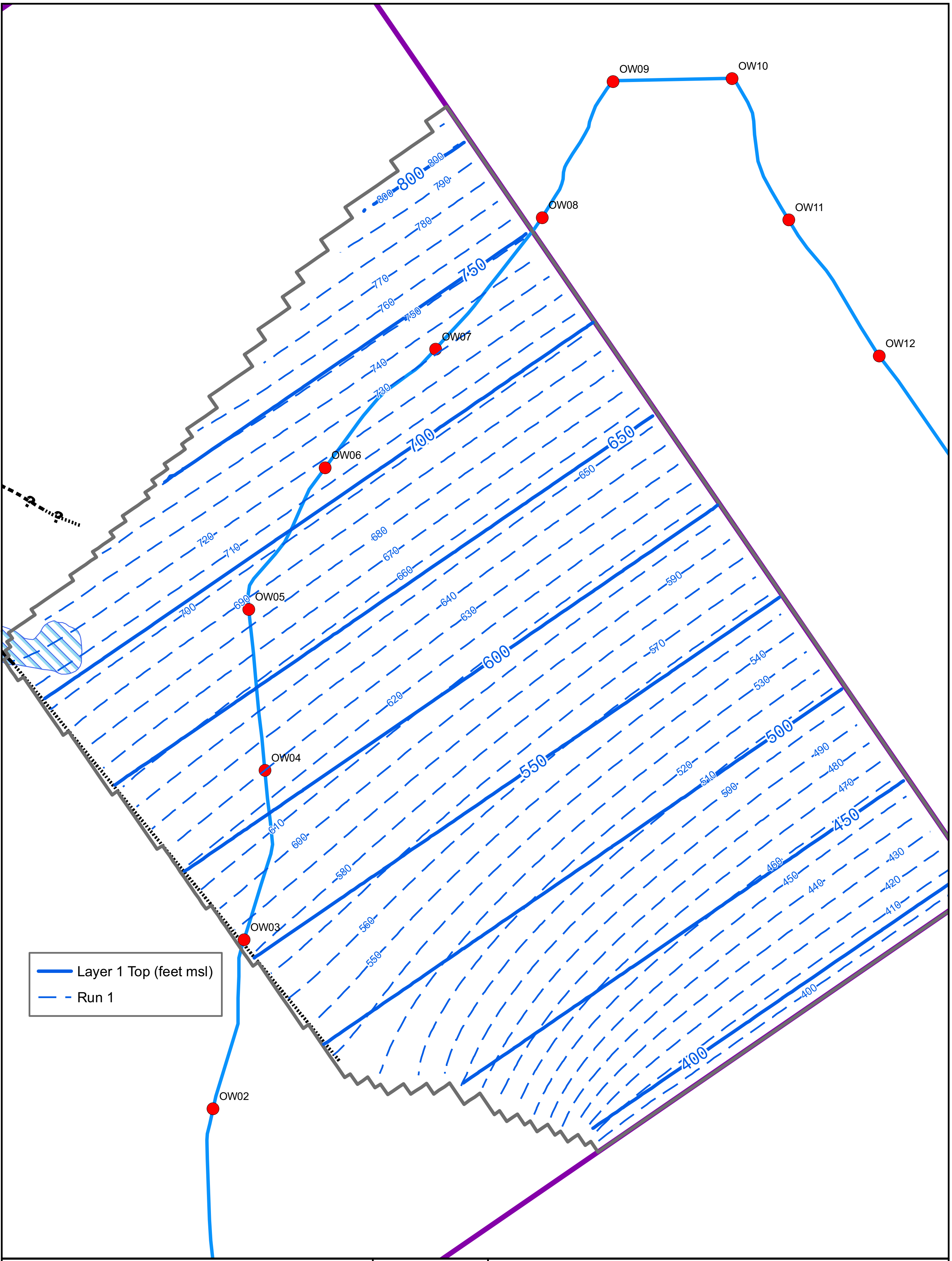
BOTTOM OF LAYER 1

MARCH 2009

FIGURE 9

S:\GIS\Projects\083850_EagleMtn_gwmodeling\Layer1_bottom.mxd DLF

30-Mar-2009



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30-Mar-2009

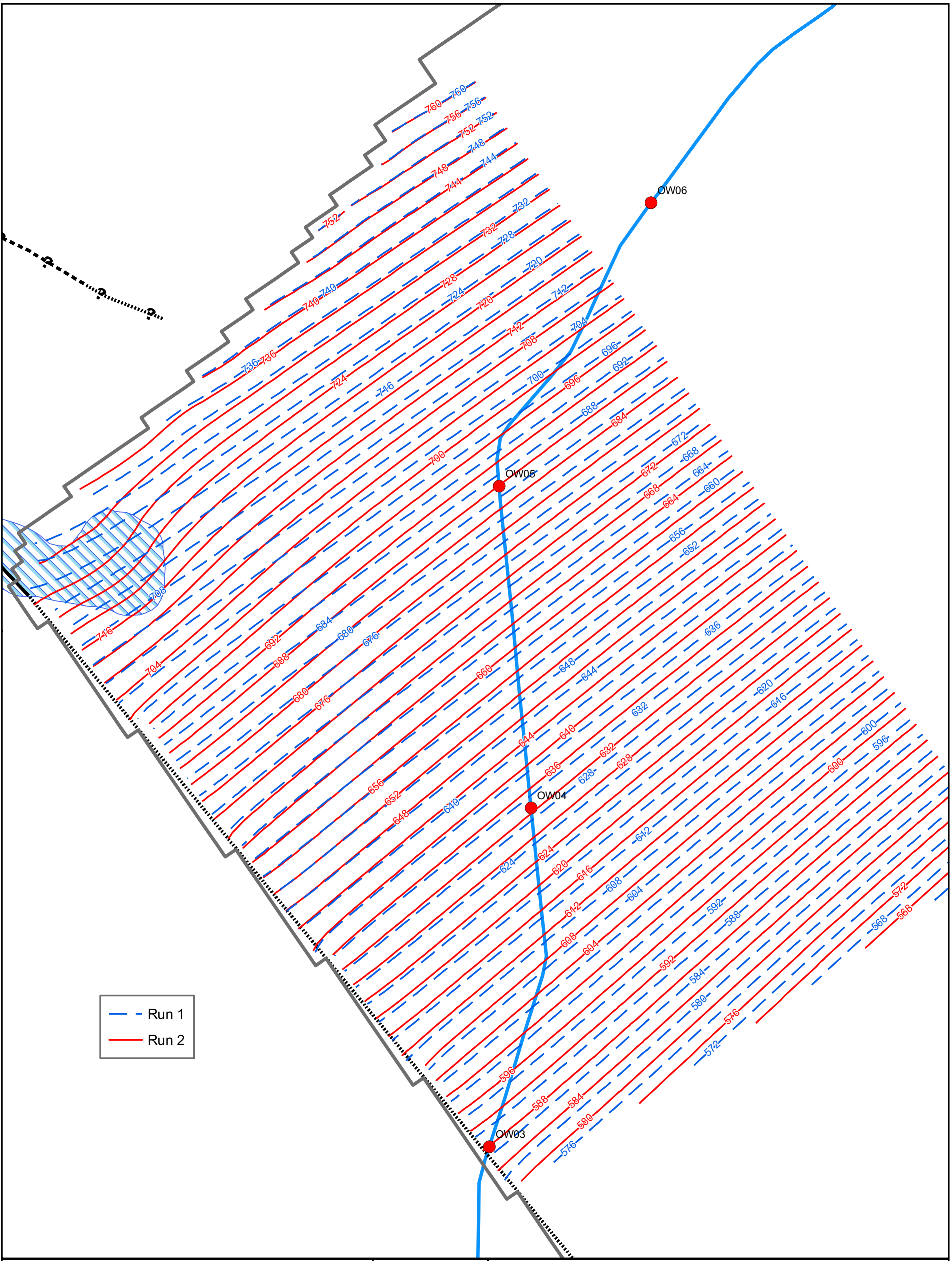
Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy Company

LAYER 1 INPUT AND MODEL RESULTS RUN 1

MARCH 2009

FIGURE10



S:\GIS\Projects\083850_EagleMtn_gwmodeling\ModelRun2.mxd DLF

30-Mar-2009

Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy Company

MODEL RESULTS RUNS 1 AND 2

MARCH 2009

FIGURE11

FIGURE 12
GROUNDWATER LEVEL CHANGE OVER TIME AT OW03.2

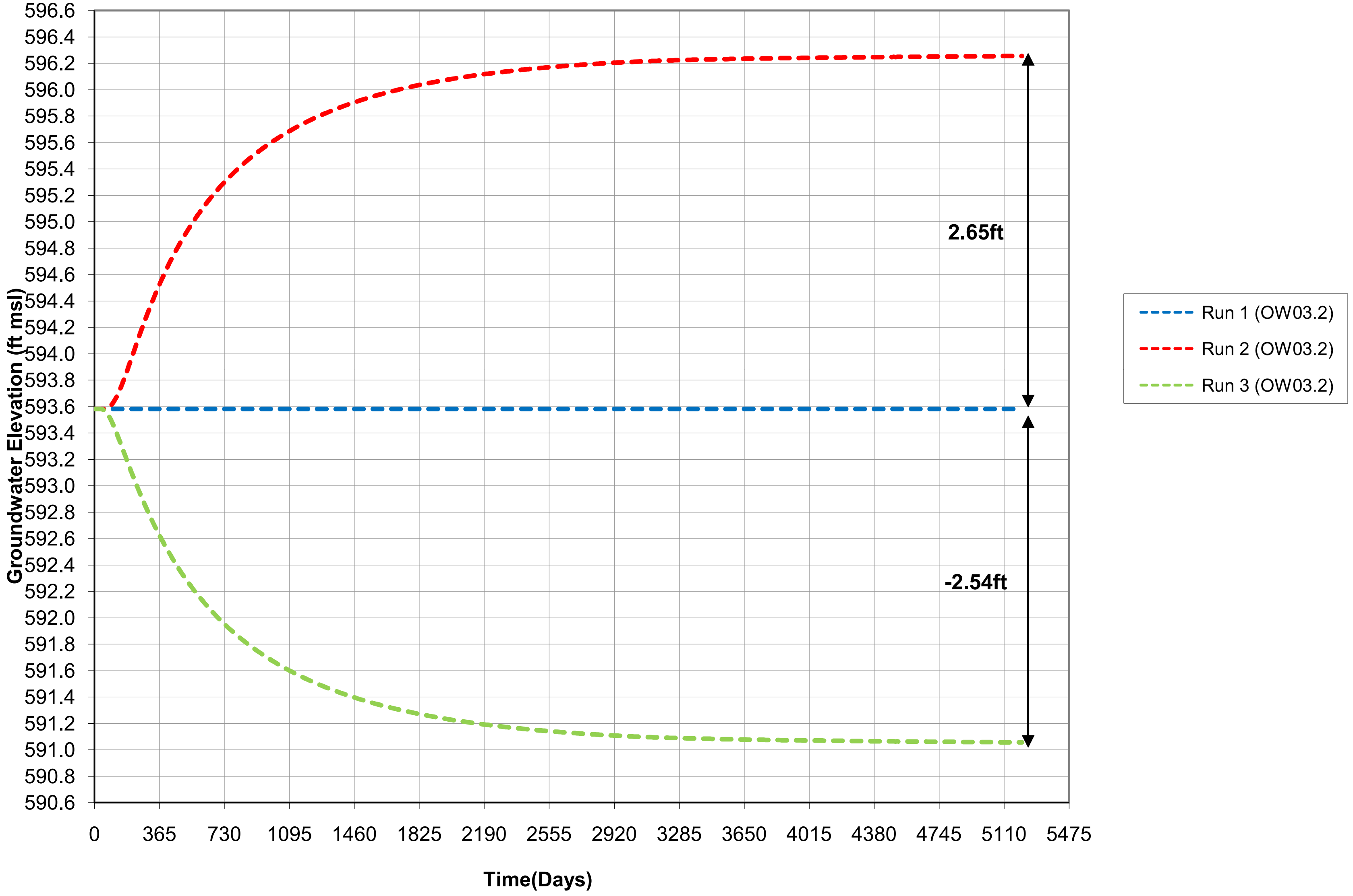


FIGURE 13
GROUNDWATER LEVEL CHANGE OVER TIME AT OW04

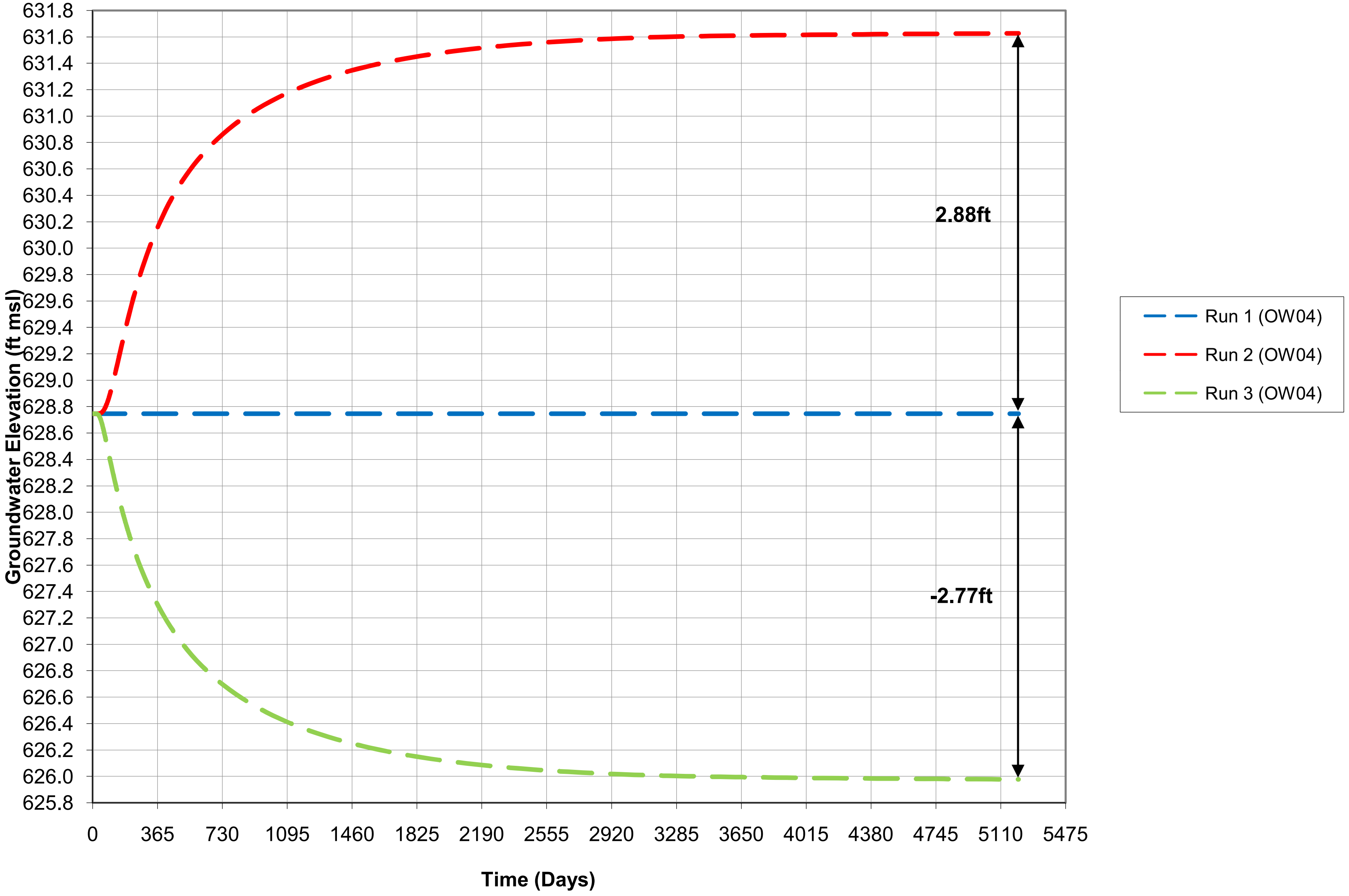
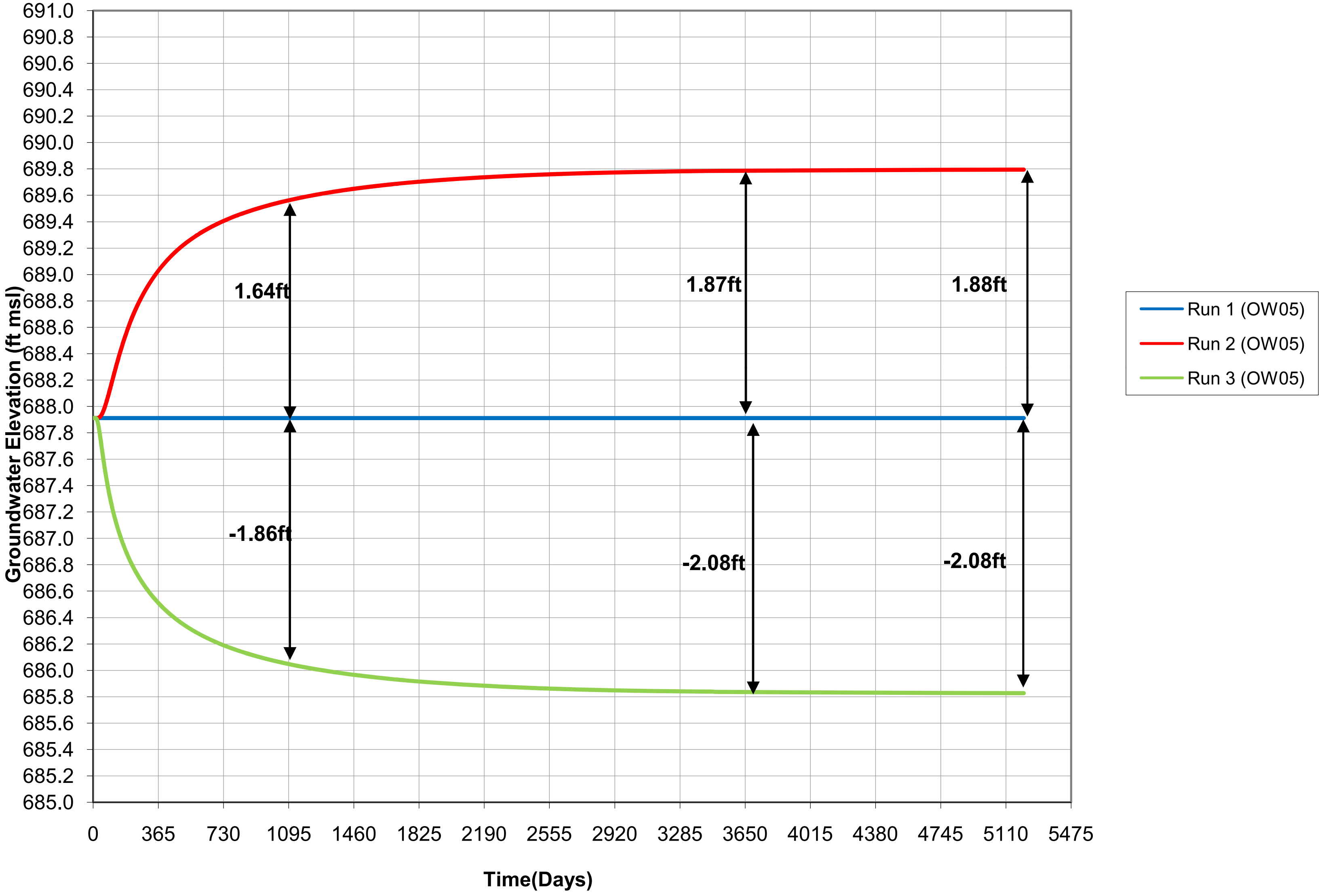
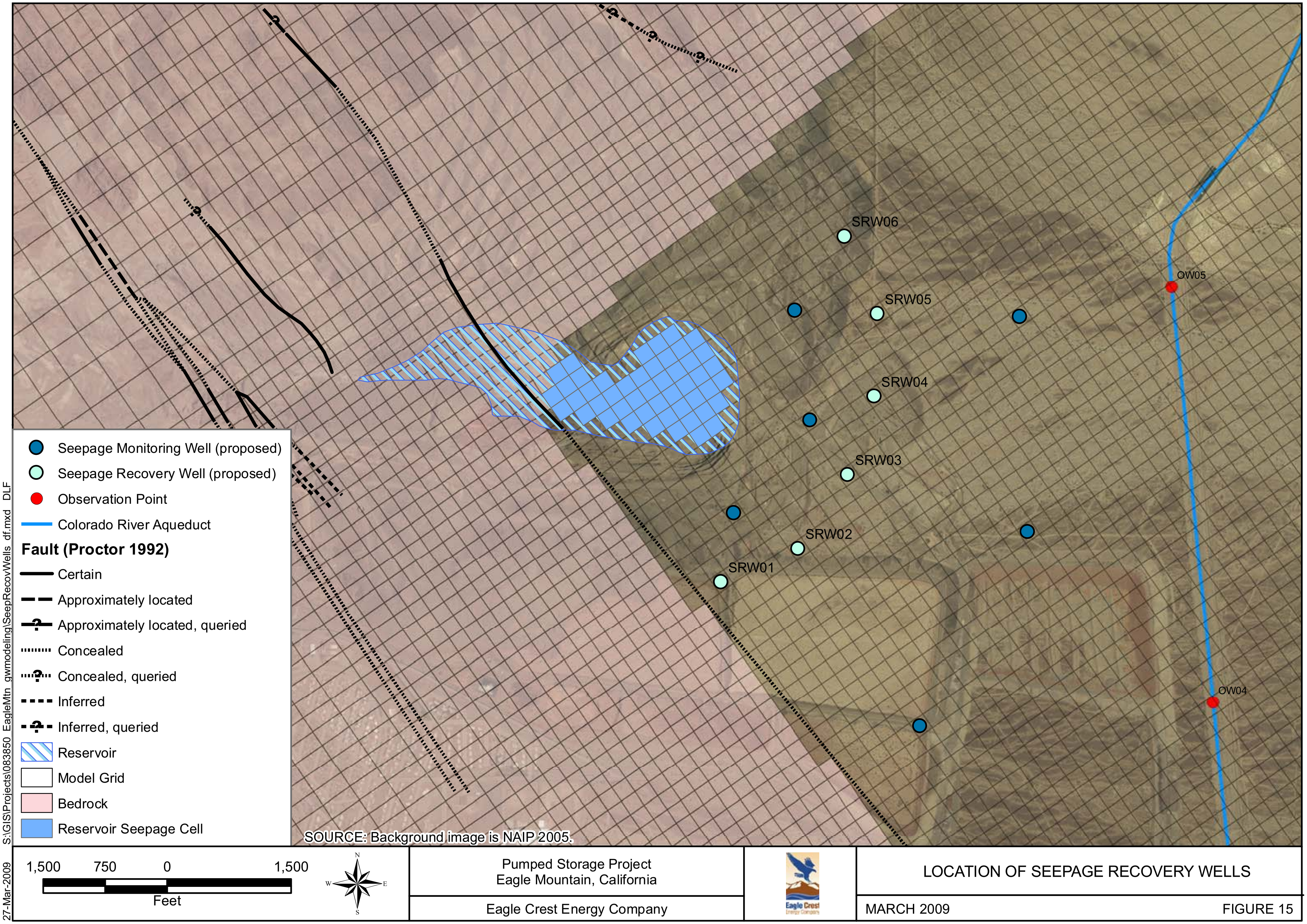


FIGURE 14
GROUNDWATER LEVEL CHANGE OVER TIME AT OW05





SOURCE: Background image is NAIP 2005.

Pumped Storage Project
Eagle Mountain, California

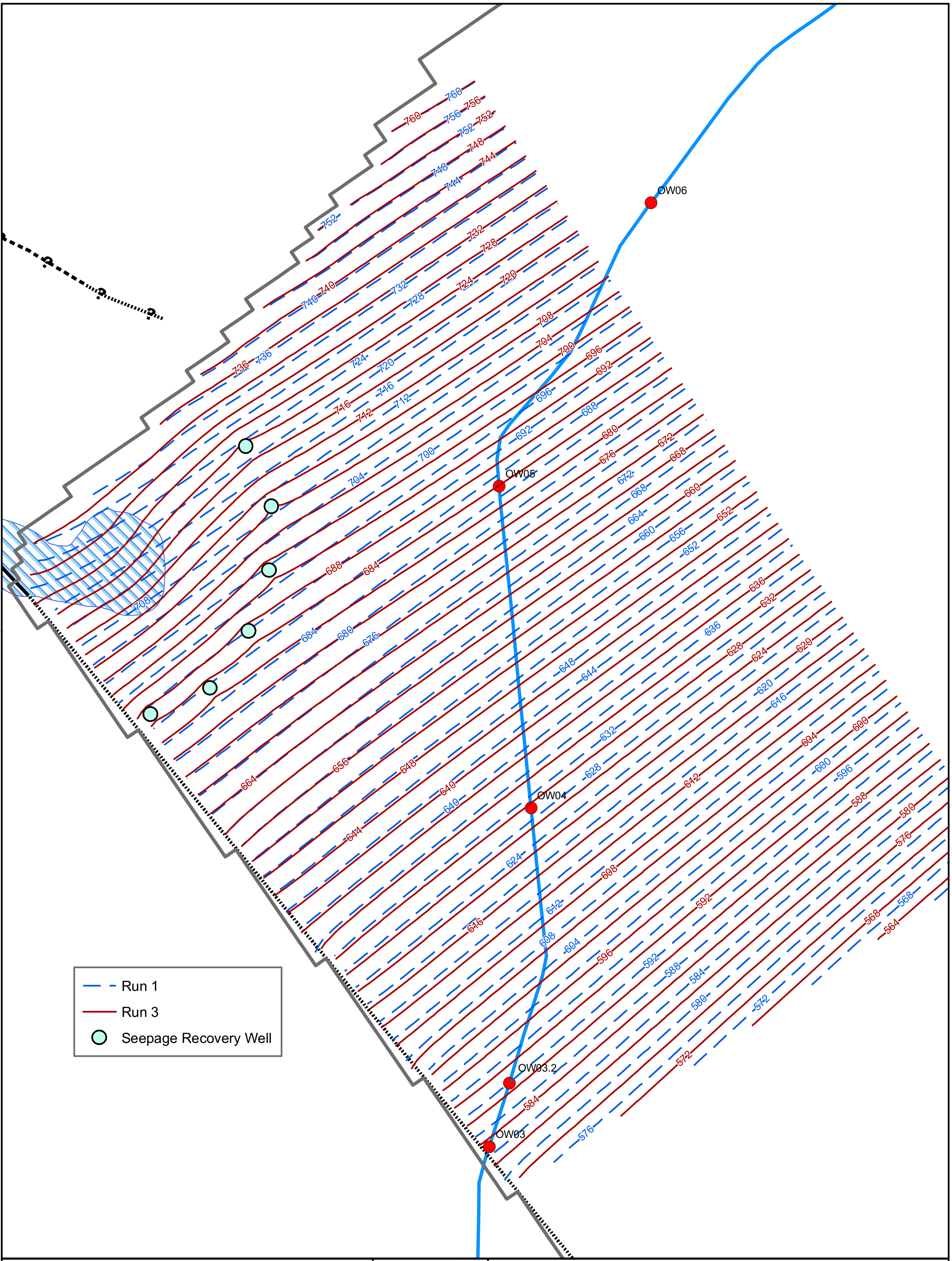
Eagle Crest Energy Company

LOCATION OF SEEPAGE RECOVERY WELLS

MARCH 2009

FIGURE 15

27-Mar-2009 S:\GIS\Projects\083850_EagleMtn_gwmodeling\SeepRecovWells_df.mxd DLF



30-Mar-2009 S:\GIS\Projects\083850_EagleMtn_gwmodeling\ModelRun3.mxd DLF

Pumped Storage Project
Eagle Mountain, California

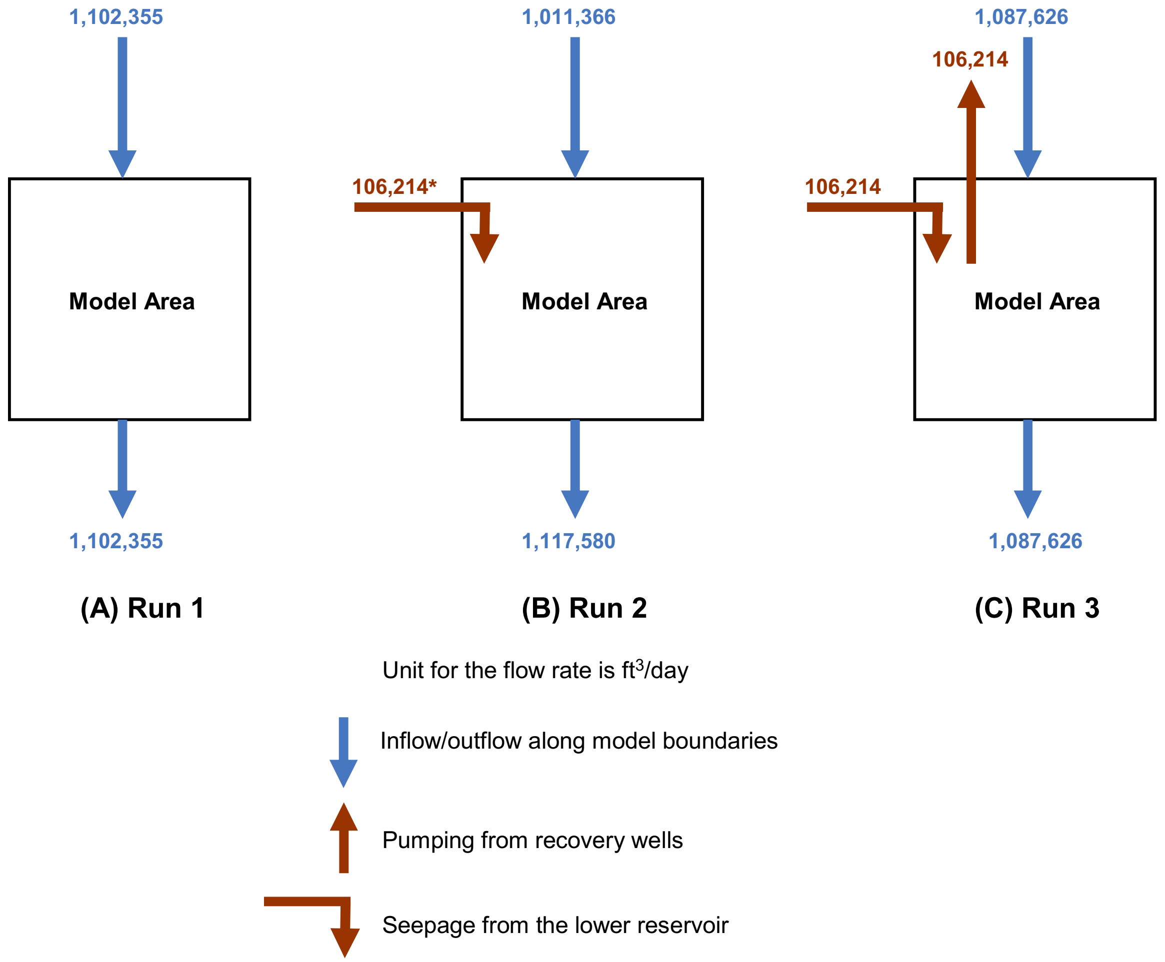
Eagle Crest Energy Company

MODEL RESULTS RUNS 1 AND 3

MARCH 2009

FIGURE16

Figure 17 Mass Balance for Three Model Runs



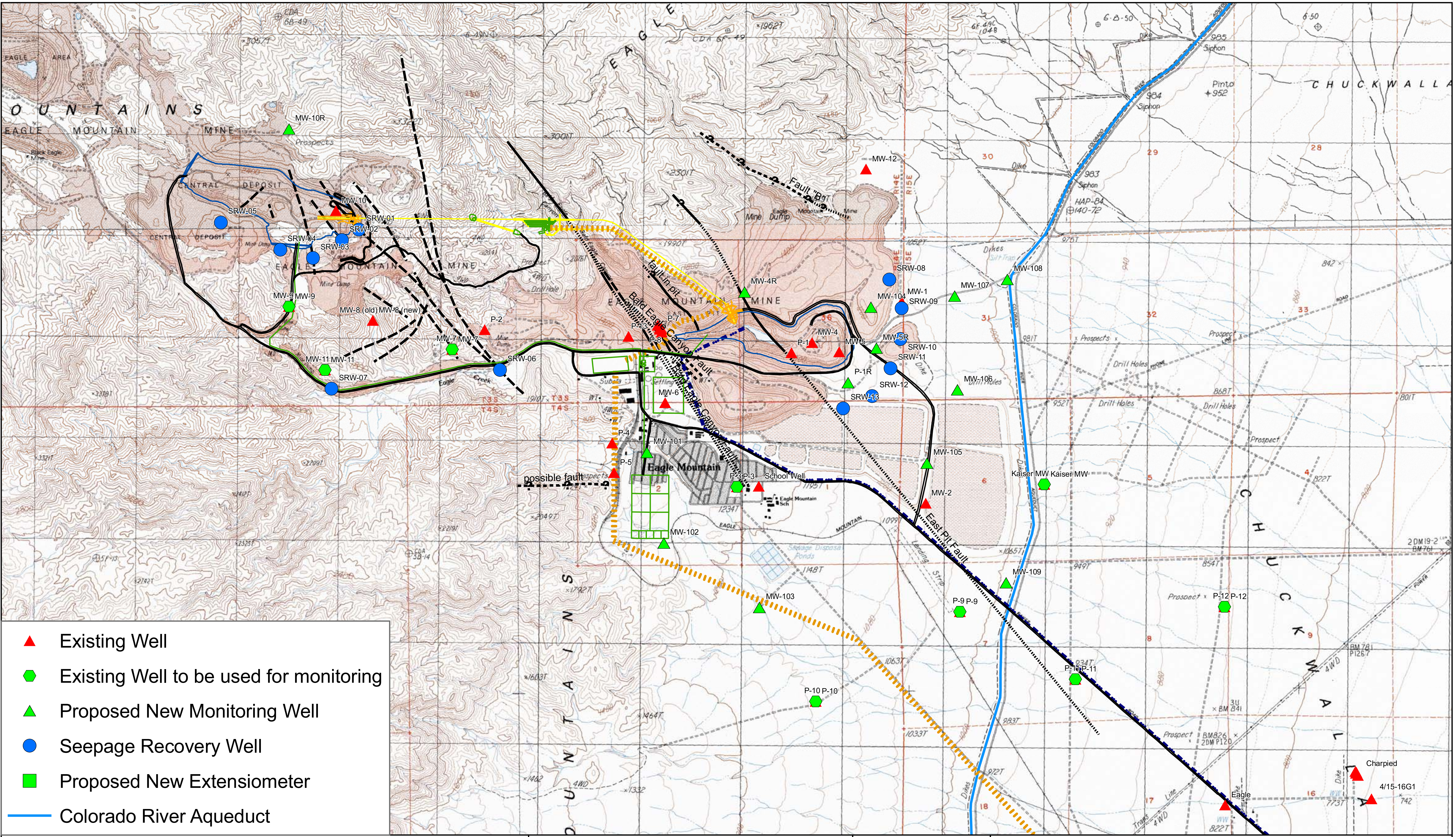
(A) Run 1

(B) Run 2

(C) Run 3

Unit for the flow rate is ft^3/day

*= 890 AFY



09-Apr-2009 S:\GIS\Projects\083850_EagleMtn_gwmodeling\SeepRecovNetwork.mxd

Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy Company

MITIGATION AND MONITORING NETWORK

APRIL 2009

FIGURE 18

Tables

Table 1
Aquifer Characteristics Near Project Site

Well No./Name	Aquifer Material	Screen Interval (feet bgs)	Flow Rate (gpm)	Drawdown (feet)	Saturated Aquifer Thickness (feet)	Hydraulic Conductivity (ft/day)	Transmissivity (gpd/ft)
MW-1	Alluvium	325 - 385			51	7.1	2,700
MW-2	Alluvium	394-455	33	37	65	0.02	10
MW-2					65	0.37	180
MW-3	Bedrock	289 - 350	3.3	33			200
MW-4	Bedrock	60 - 140	3.5	47	40	0.02	6
MW-4					40	0.50	150
MW-5	Alluvium	180 - 240	20	25	30	2.0	450
MW-5					30	2.2	500
MW-5					30	7.1	1,600
MW-6	Bedrock	560 - 620	5	12	65	0.1	50
					65	1.4	680
					65	1.8	870
School Well	Bedrock	475-740	75	11	265	0.5	1,000
					265	5.1	10,105

Source: CH2MHill, 1996

TABLE 2

Proposed Mitigation Well Network and Maximum Allowable Changes From Seepage Recovery Pumping[1]

Existing Monitoring Wells or Piezometer

Well No./Name	Aquifer Material	Monitoring Purpose	Total Borehole Depth (feet)	Borehole Diameter (inches)	Casing Diameter (inches)	Screen Interval (feet bgs)		Maximum Allowable Drawdown (feet)	Maximum Allowable Water Elevation (feet msl)
						Top	Bottom		
P-2	Bedrock	Water Level Beneath Landfill	960	6.5	2	905	955		1,620
P-3	Bedrock	Brine Pond Downgradient	675	6.0	Unknown	613	663		
P-4	Bedrock	Brine Pond Upgradient	625	5.5	Unknown	575	625		
P-5	Bedrock	Brine Pond Upgradient	625	5.5	Unknown	575	625		
P-9	Bedrock	Lower Reservoir Seepage	525	5.6	Unknown	470	520		
P-10	Bedrock	Upper Reservoir Seepage	675	5.6	Unknown	625	675		
P-11	Alluvium	Lower Reservoir Seepage	485	5.5	Unknown	350	470	2	
MW-7	Bedrock	Water Level Beneath Landfill	785	10.6	4	666	726		1,560
MW-8	Bedrock	Water Level Beneath Landfill	871	13.5	Unknown	792	844		1,880
MW-9	Bedrock	Water Level Beneath Landfill	1,544	6.5	Unknown	Unknown	Unknown		2,350
MW-11	Bedrock	Water Level Beneath Landfill	1,130	13.5	Unknown	663	917		1,940
Kaiser MW	Alluvium	CRA	Unknown	Unknown	Unknown	Unknown	Unknown	3	
Existing Monitoring Wells to be Replaced									
P-1R	Alluvium	Lower Reservoir Pumping Contol	550	10	4	490	540	6	
MW-4R	Bedrock	Background Lower Reservoir	774	10	4	704	764		
MW-5R	Alluvium	Lower Reservoir Pumping Contol	418	10	4	348	408	6	
MW-10R	Bedrock	Background Upper Reservoir	1,672	10	4	1,558	1,662		1,464
New Monitoring Wells to be Constructed									
MW-101A	Alluvium	Brine Pond Downgradient	110	10	4	60	100	dry	
MW-101B	Bedrock	Brine Pond Downgradient	599	10	4	549	589		
MW-102A	Alluvium	Brine Pond Downgradient	110	10	4	60	100	dry	
MW-102B	Bedrock	Brine Pond Downgradient	658	10	4	608	648		
MW-103A	Alluvium	Brine Pond Downgradient	200	10	4	150	190	dry	
MW-103B	Bedrock	Brine Pond Downgradient	658	10	4	608	648		
MW-104	Alluvium	Lower Reservoir Pumping Contol	575	10	4	525	565	6	
MW-105	Alluvium	Lower Reservoir Seepage	552	10	4	502	542	4	
MW-106	Alluvium	Lower Reservoir Seepage	383	10	4	333	373	4	
MW-107	Alluvium	Lower Reservoir Seepage	353	10	4	303	343	4	
MW-108	Alluvium	CRA	318	10	4	268	308	2	
MW-109	Alluvium	CRA	497	10	4	447	487	3	

Seepage Recovery Wells to be Constructed

Well No./Name	Aquifer Material	Purpose	Total Borehole Depth (feet)	Borehole Diameter (inches)	Casing Diameter (inches)	Screen Interval (feet bgs)		Maximum Allowable Drawdown (feet)	Maximum Allowable Water Elevation (feet msl)
						Top	Bottom		
SRW-01	Bedrock	Upper Reservoir Seepage Recovery	1,477	10	6	1,353	1,467		2,540
SRW-02	Bedrock	Upper Reservoir Seepage Recovery	1,421	10	6	1,297	1,411		586
SRW-03	Bedrock	Upper Reservoir Seepage Recovery	1,359	10	6	1,235	1,349		586
SRW-04	Bedrock	Upper Reservoir Seepage Recovery	1,297	10	6	1,173	1,287		586
SRW-05	Bedrock	Upper Reservoir Seepage Recovery	1,522	10	6	1,398	1,512		586
SRW-06	Bedrock	Upper Reservoir Seepage Recovery	696	10	6	614	686		940
SRW-07	Bedrock	Upper Reservoir Seepage Recovery	1,043	10	6	969	1,033		2,060
SRW-08	Alluvium	Lower Reservoir Seepage Recovery	650	18	12	493	640	7	
SRW-09	Alluvium	Lower Reservoir Seepage Recovery	495	18	12	328	485	7	
SRW-10	Alluvium	Lower Reservoir Seepage Recovery	645	18	12	463	635	7	1,560
SRW-11	Alluvium	Lower Reservoir Seepage Recovery	575	18	12	385	565	7	
SRW-12	Alluvium	Lower Reservoir Seepage Recovery	640	18	12	453	630	7	
SRW-13	Alluvium	Lower Reservoir Seepage Recovery	695	18	12	513	685	7	

Footnote: [1] Drawdown projections soley due to Seepage Recovery Pumping

12.7 Schedule, Manpower, and Equipment Utilization During Construction of the Eagle Mountain Pumped Storage Project

Eagle Mountain Pumped Storage Project – Schedule, Manpower and Equipment Utilization During Construction

Prepared by: Richard Westmore, P.E., GEI Consultants, Inc.

April 9, 2009

Preparation of an environmental evaluation of the Eagle Mountain Pumped Storage Project under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) includes an assessment of construction-related impacts associated with the project. These impacts typically include: air quality (fugitive dust and carbon emissions from construction equipment operation); noise generated during construction; night-time light “pollution”; water quality concerns (erosion and sedimentation entering surface water bodies, as well as hazardous spills that might affect surface and ground water supplies); and socio-economic impacts on the region. Assessment of these construction-related impacts requires an evaluation of the probable construction schedule and the estimated quantities of work (excavation, fill placement, concrete production and placement, tunneling by boring machine and conventional methods, etc.) to identify the types and numbers of equipment pieces that are likely to be used over time, as well as the required labor force.

At this early stage in project design and given the complexity of the Eagle Mountain Project, it is difficult to develop an overall schedule of equipment and man-power that will closely follow what actually will occur during construction. However, the estimates provided in Attachment 1 represent a reasonable estimate of the type, schedule and monthly use of construction equipment, as well as the monthly man-power utilization during construction of the project. These estimates are based on an overall construction period of about 4 years and engineering judgment and experience relative to construction methods and procedures.

The estimated construction schedule is provided on Figure 1. Key features of the estimated schedule are summarized below:

First Year of Construction

General:

- Mobilize and construct temporary office, storage, maintenance and staging facilities.
- Construct and improve permanent and construction access roads.

Water Conduits:

- Proceed and erect Tunnel Boring Machine and start excavation of tailrace tunnel.

Power Plant:

- Construct access tunnel portal and start excavation of access tunnel.

Upper Reservoir:

- Excavation of approach channel to inlet/outlet works.

Production Wells:

- Begin Construction

Lower Reservoir:

- Start moving unstable tailings pile.
- Start to line lower reservoir.

Monitoring Wells:

- Begin Construction

Switchyard:

- Start switchyard construction.

Transmission Line:

- Start construction of transmission line foundations.

Second Year of Construction

Upper Reservoir:

- Complete excavation of approach tunnel.
- Complete construction of the south and west dams.
- Start Construction of inlet/outlet structures.
- Start lining of Reservoir.

Production Wells:

- Complete Construction

Lower Reservoir:

- Complete moving unstable tailings pile.
- Seepage control liner blanketing.
- Construct inlet/outlet works.

- Install water pipeline from wells, pumping plant, and reverse osmosis system.
- Begin to fill lower reservoir.

Monitoring Wells:

- Complete Construction

Water Conduits:

- Complete tailrace tunnel, manifold and draft tube tunnels.
- Move and erect Tunnel Boring Machine and excavate upper pressure tunnel.
- Excavate lower pressure tunnel, manifold and penstock tunnels.
- Start to excavate pressure shaft.
- Start Installation of steel tunnel linings.

Power Plant:

- Complete majority of underground power plant access.
- Finish excavation of access tunnel.
- Excavate powerhouse cavern.
- Excavate transformer gallery caverns.
- Embed spiral cases and draft tube liners.
- Start to install pump/turbines and generators.
- Start first stage and second stage concrete.
- Start to install electrical and mechanical equipment.

Transmission Line:

- Build foundations and towers.
- String high voltage transmission wires.

Switchyard:

- Complete switchyard and install equipment.

Third Year of Construction

Upper Reservoir:

- Seepage Control by blanketing with fines and grouting.
- Complete inlet/outlet works.

Lower Reservoir:

- Continue filling lower reservoir.

Water Conduits:

- Finish excavation of pressure shaft.
- Construct downstream surge chambers.
- Concrete line penstock and draft tube manifolds.
- Install steel linings in penstocks and concrete linings in draft tube tunnels.

Power Plant:

- Complete excavation of transformer gallery caverns.
- Construct cable tunnel and shaft.
- Complete first stage concrete.
- Start and complete superstructure concrete.
- Continue installation of pump/turbines.

- Continue installation of motor/generators.
- Continue installation of other mechanical and electrical equipment.
- Install water delivery pipeline, pump, and reverse osmosis system.
- Installation of mechanical and electrical equipment.

Fourth Year of Construction

Power Plant:

- Finish installation of pump/turbines.
- Finish installation of motor/generators.
- Continue and Finish installation of other mechanical and electrical equipment.
- Start architectural construction.
- Start startup and testing of units.
- Commission unit 1.
- Commission units 2, 3 and 4 at three month intervals ending the beginning of April.
- Complete architectural work.

Transmission Line:

- Test and energize high voltage transmission line.

Commercial Operation:

- June 2016.

Attachment 1 is organized as follows:

- Bar chart showing the major features of the project construction and the estimated duration in months for construction.

- The schedule bar chart with an overlay graph showing the total number of persons working on the project per month. The peak work force is estimated to be 209 laborers. The total work force is estimated to be 4,674 person months over the duration of construction.

- The schedule bar chart with an overlay graph showing the total number of on-site equipment items, daily concrete trucks (on-site), and daily heavy trucks (on-site) required for the project per month. The peak monthly on-site equipment items are estimated to be 150 items. The peak daily concrete trucks (on-site) are estimated to be 210 trucks. This estimate assumes the trucks are traveling to and from an on-site batch plant. The peak daily heavy trucks (on-site) are estimated to be 258 trucks. This estimate assumes the trucks are hauling materials to and from locations on-site.

- The schedule bar chart with an overlay graph showing the total number of off-site trucks working on the project per month. The peak monthly off-site truck volume is estimated to be 75 trucks. The total off-site truck volume is estimated to be 925 trucks for the duration of construction. This estimate assumes the off-site trucks are importing the necessary construction materials to the site such as steel linings, steel reinforcement, electrical components, etc.

- The schedule bar chart with an overlay graph showing the total labor cost for staff working on the project per month. The peak monthly labor cost is estimated to be $2.51 million.

- The schedule bar chart with an overlay graph showing the cumulative total labor cost for staff working on the project. The cumulative labor cost for the project is estimated to be $58 million.

- A summary table showing the average crew size for each major feature of the project construction, the associated average duration in months, and the total number of person months for each item and for the complete project.

- A summary table showing the type and total number of equipment required for each major feature of the project construction.

- A summary table showing estimates of construction crew member's basic hourly wages and hourly wages including the contractor's overhead and profit.

- A summary table showing a typical pumped-storage project operations crew, and their associated annual salaries. Also shown is a table presenting the annual operations and maintenance costs expected to occur over the project duration.

- A table showing the typical equipment and task production rates used in calculations for the duration and quantity of equipment required for each major feature of the project construction.

- A list of major construction activities and items required for the pumped-storage project.

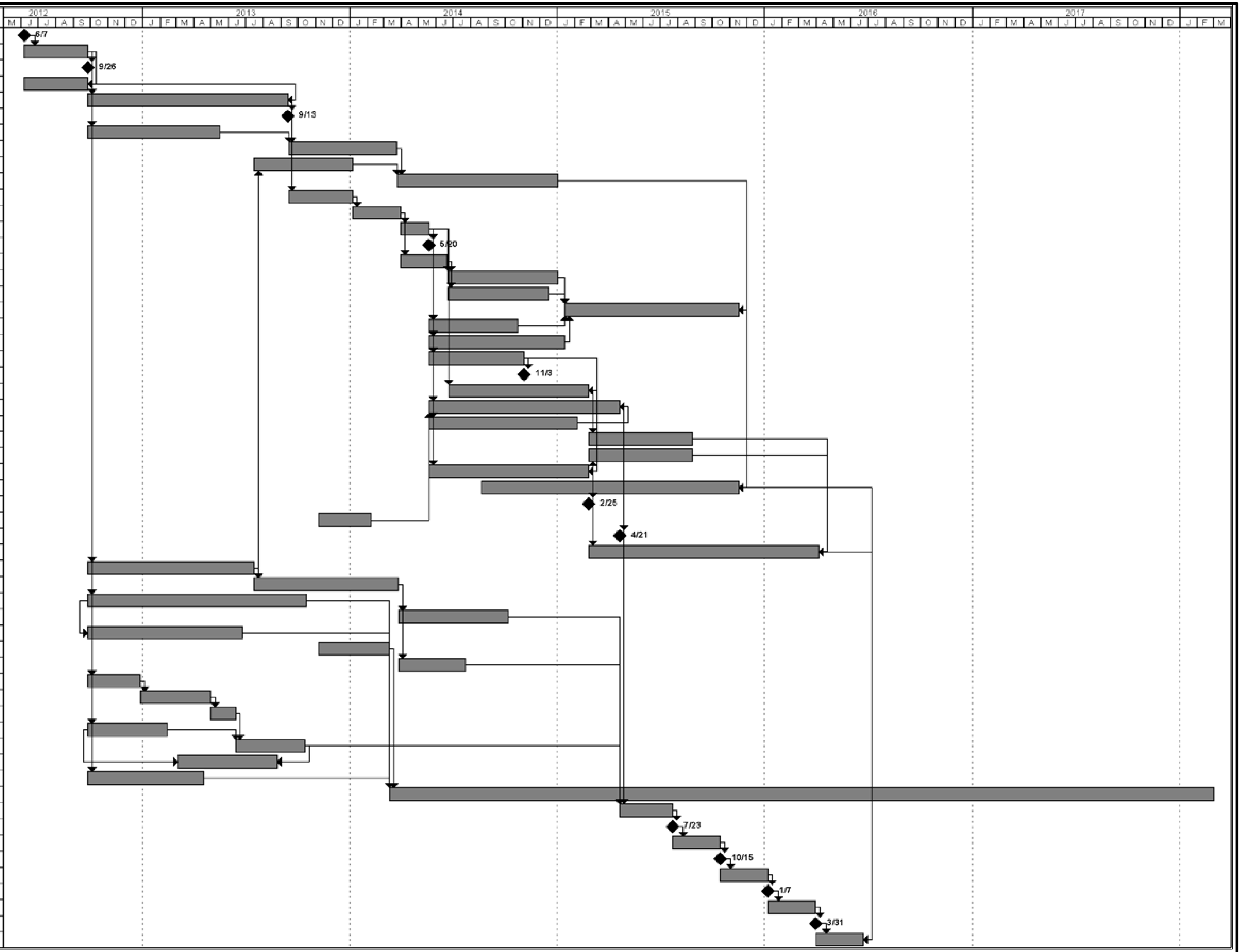
- Equipment and crew size calculation spreadsheets for each major feature of the project construction. Only project features with construction durations are presented.

- Tunnel excavation advancement rate calculation spreadsheet. The spreadsheet includes advancement rates for Tunnel Boring Machine (TBM) and Drill and Blast (D&B) excavation methods.

- Project features and cost estimate spreadsheet. Includes quantities and unit prices for major project features.

- Project reservoir filling calculations and associated charts.

ID	Task Name	Duration	Start	Finish
1	Notice to Proceed	0 days	Thu 6/7/12	Thu 6/7/12
2	Civil Contractor Mobilization	16 wks	Thu 6/7/12	Wed 9/26/12
3	Civil Contractor Mobilized	0 days	Wed 9/26/12	Wed 9/26/12
4	Construct Access Roads	16 wks	Thu 6/7/12	Wed 9/26/12
5	Excavate Power House Access Tunnel	50.4 wks	Thu 9/27/12	Fri 9/13/13
6	Complete Access Tunnel Excavation	0 days	Fri 9/13/13	Fri 9/13/13
7	Excavate Tailrace Tunnel	33.2 wks	Thu 9/27/12	Thu 5/16/13
8	Excavate Lower Pressure Tunnel	27.3 wks	Mon 9/16/13	Tue 3/25/14
9	Excavate Upper Pressure Tunnel	24.7 wks	Wed 7/17/13	Mon 1/6/14
10	Excavate Pressure Shaft	40.6 wks	Tue 3/25/14	Fri 1/2/15
11	Excavate Top Heading	16.1 wks	Mon 9/16/13	Mon 1/6/14
12	Roof Anchorage and Lining	12.1 wks	Mon 1/6/14	Mon 3/31/14
13	Excavate Remainder of Cavern	7.1 wks	Tue 4/1/14	Tue 5/20/14
14	Complete Power House Excavation	0 days	Tue 5/20/14	Tue 5/20/14
15	Excavate Transformer Gallery	11.8 wks	Tue 4/1/14	Fri 6/20/14
16	Excavate Tailrace Surge Chamber	27.8 wks	Mon 6/23/14	Thu 1/1/15
17	Excavate Cable Tunnel Shaft	25.4 wks	Mon 6/23/14	Tue 12/16/14
18	Line and Pave Cable Tunnel	43.6 wks	Thu 1/15/15	Mon 11/16/15
19	Line Penstocks and Draft Tube Manifolds	22.5 wks	Tue 5/20/14	Thu 10/23/14
20	Install Steel Tunnel Linings	34.3 wks	Tue 5/20/14	Wed 1/14/15
21	First Stage Concrete	23.9 wks	Tue 5/20/14	Mon 11/3/14
22	Complete Power House 1st Stage Concrete	0 days	Mon 11/3/14	Mon 11/3/14
23	Install Spiral Cases and Draft Tube Liners	35.3 wks	Tue 6/24/14	Wed 2/25/15
24	Install Pump-Turbines and Generators	48 wks	Tue 5/20/14	Tue 4/21/15
25	Embed Spiral Cases and Draft Liners	37.5 wks	Tue 5/20/14	Thu 2/5/15
26	Install Mechanical Equipment	26 wks	Thu 2/26/15	Wed 8/26/15
27	Install Electrical Equipment	26 wks	Thu 2/26/15	Wed 8/26/15
28	Complete Concrete Work (2nd StolConc)	40.3 wks	Tue 5/20/14	Wed 2/25/15
29	Structural and Architectural Construction	64.5 wks	Thu 8/21/14	Mon 11/16/15
30	Complete Draft Tube, Spiral Case and Powerhous	0 days	Wed 2/25/15	Wed 2/25/15
31	Electrical and Mechanical Mobilization	13.4 wks	Thu 11/7/13	Fri 2/7/14
32	Complete Installation of Pump-Turbines, Generato	0 days	Tue 4/21/15	Tue 4/21/15
33	Complete Electrical Construction	57.9 wks	Thu 2/26/15	Wed 4/6/16
34	Excavate Approach Channel - Upper Reservoir	41.8 wks	Thu 9/27/12	Tue 7/16/13
35	Construct Upper Reservoir Dam	36.4 wks	Wed 7/17/13	Thu 3/27/14
36	Move Unstable Soil - Lower Reservoir	55.1 wks	Thu 9/27/12	Thu 10/17/13
37	Line Upper Reservoir	27.4 wks	Fri 3/28/14	Mon 10/6/14
38	Line Lower Reservoir	38.9 wks	Thu 9/27/12	Wed 6/26/13
39	Construct I/O Structure - Lower Reservoir	17.8 wks	Thu 11/7/13	Tue 3/11/14
40	Construct I/O Structure - Upper Reservoir	16.8 wks	Fri 3/28/14	Wed 7/23/14
41	Switchyard Excavation	13.3 wks	Thu 9/27/12	Fri 12/28/12
42	Switchyard Foundations	17.6 wks	Fri 12/28/12	Wed 5/1/13
43	Switchyard Structures	6.4 wks	Wed 5/1/13	Fri 6/14/13
44	Transmission Line Foundations	20 wks	Thu 9/27/12	Wed 2/13/13
45	Transmission Line Stringing	17.2 wks	Fri 6/14/13	Mon 10/14/13
46	Transmission Line Structures	25 wks	Mon 3/4/13	Mon 8/26/13
47	Install Water Supply Pipeline and RO System	29.2 wks	Thu 9/27/12	Thu 4/18/13
48	Reservoir Filling	207.6 wks	Wed 3/12/14	Fri 3/2/18
49	Unit 1 Startup	13.4 wks	Tue 4/21/15	Thu 7/23/15
50	U-1 Start-up	0 days	Thu 7/23/15	Thu 7/23/15
51	Unit 2 Startup	12 wks	Thu 7/23/15	Thu 10/15/15
52	U-2 Start-up	0 days	Thu 10/15/15	Thu 10/15/15
53	Unit 3 Startup	12 wks	Thu 10/15/15	Thu 1/7/16
54	U-3 Start-up	0 days	Thu 1/7/16	Thu 1/7/16
55	Unit 4 Startup	12 wks	Thu 1/7/16	Thu 3/31/16
56	U-4 Start-up	0 days	Thu 3/31/16	Thu 3/31/16
57	Finish Project	12 wks	Thu 3/31/16	Thu 6/23/16



Task ▬ Progress ▬ Summary ▬ External Tasks ▬ Deadline ⇩
Split ┈ Milestone ◆ Project Summary ▬ External Milestone ◆

Eagle Mountain Pumped Storage Project
Eagle Mountain, California

Eagle Crest Energy

Project 080472

ESTIMATED PROJECT CONSTRUCTION SCHEDULE

February 2009 Figure 1

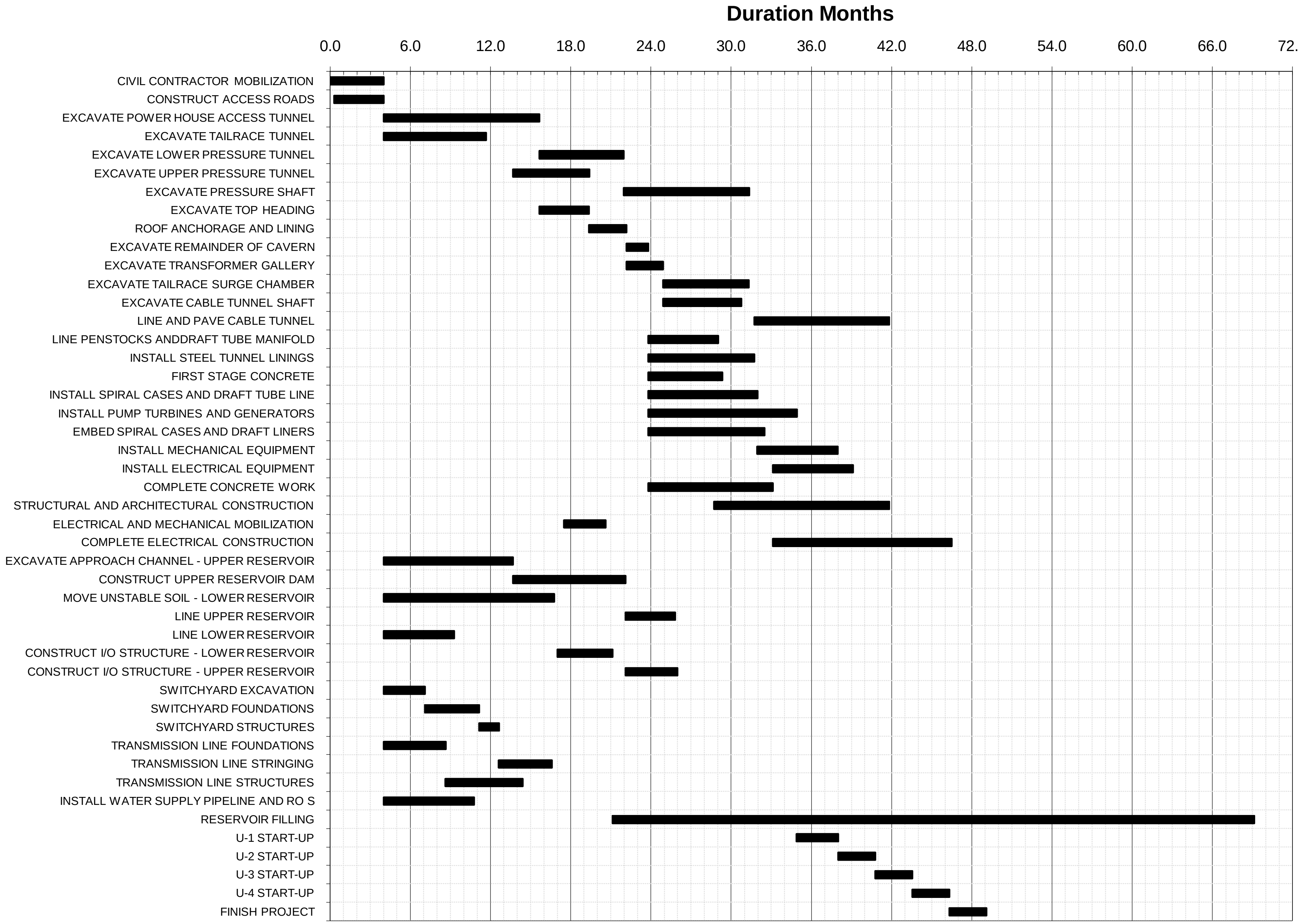
I:\NMiller\PROJECTS\080470 Eagle Mountain\Equipment\ Schedule.dwg Apr 2009

ATTACHMENT 1

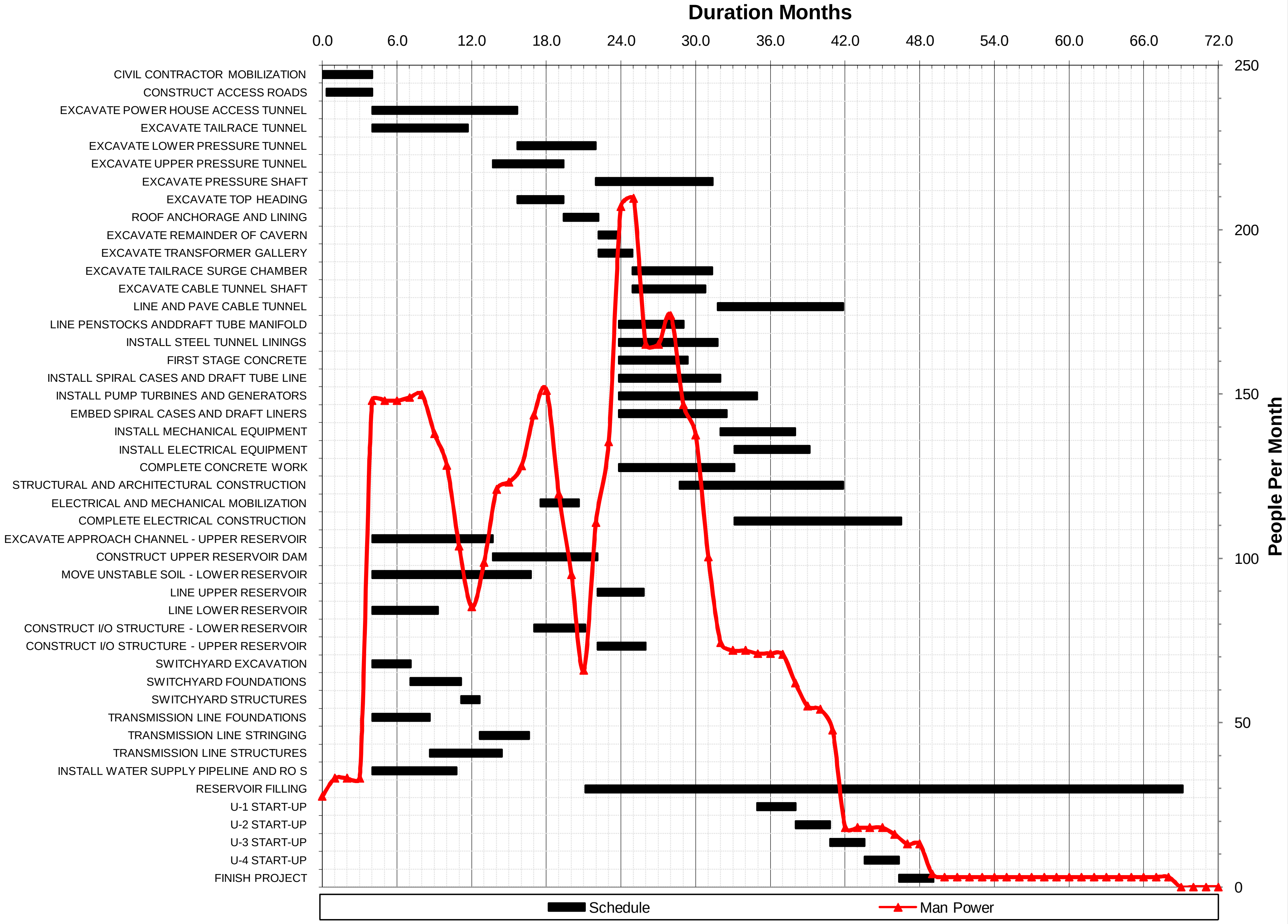
EAGLE MOUNTAIN
PUMPED STORAGE PROJECT

SCHEDULE, EQUIPMENT, AND MAN POWER ESTIMATES

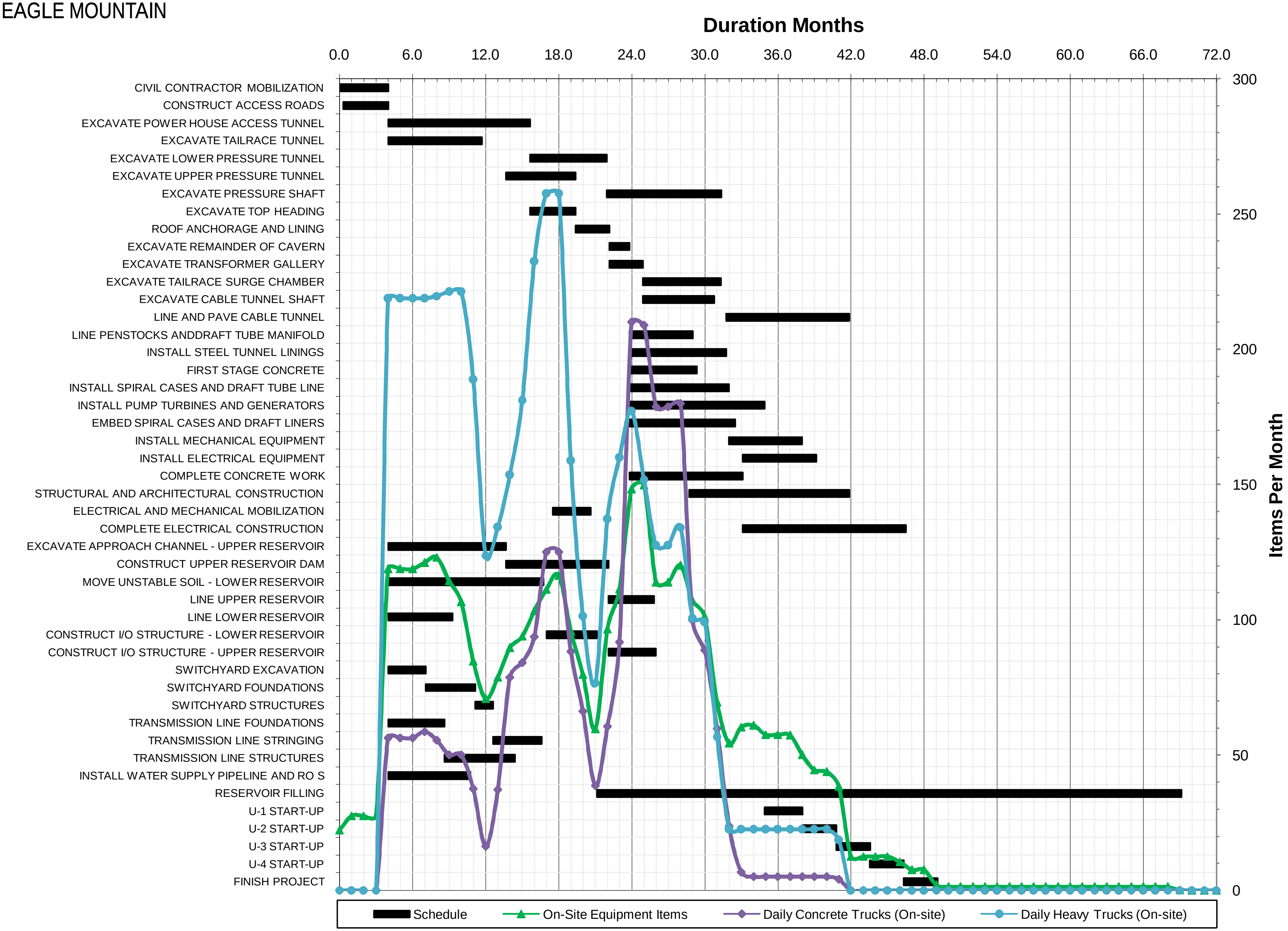
ESTIMATED CONSTRUCTION SCHEDULE
EAGLE MOUNTAIN



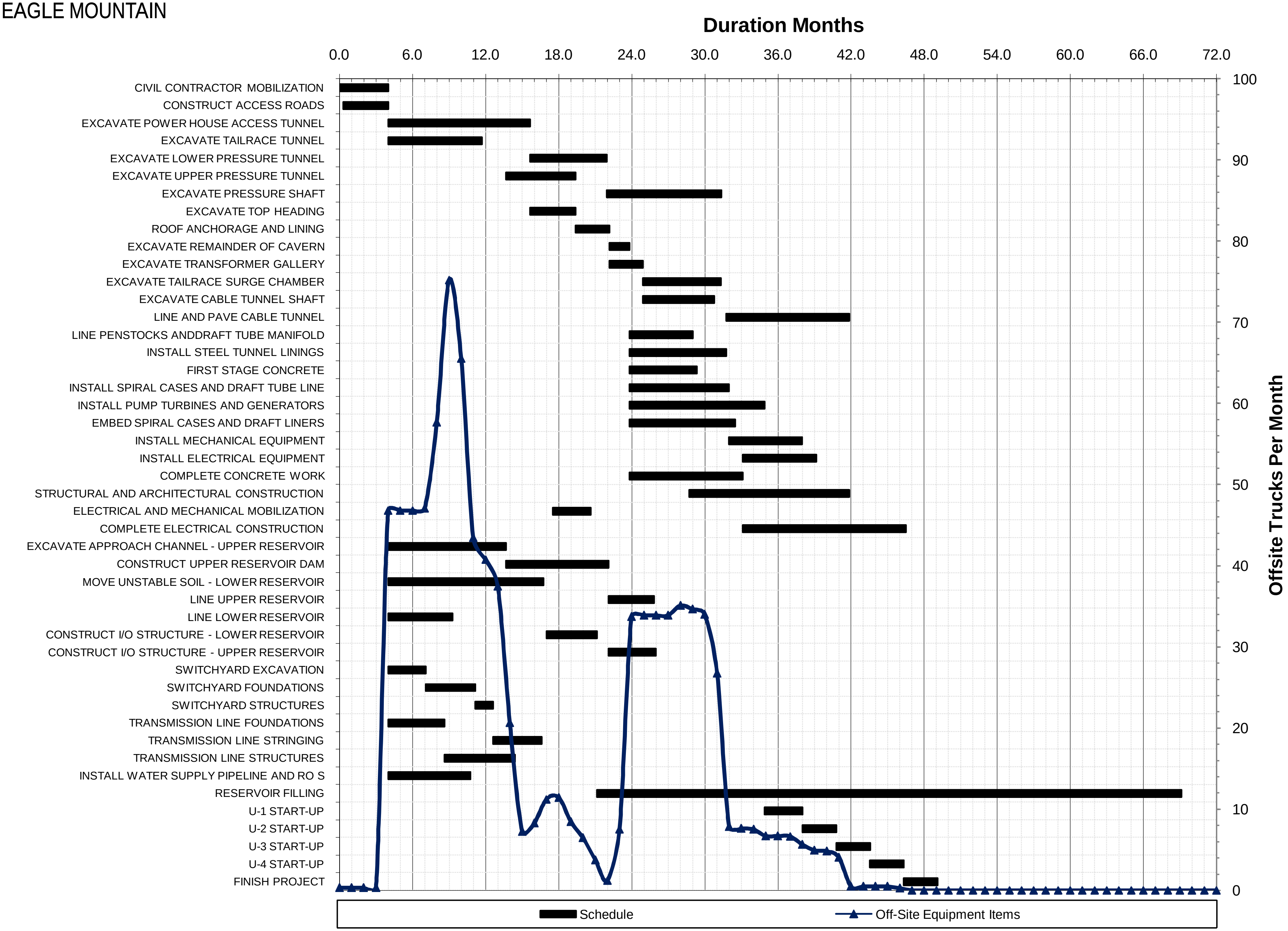
ESTIMATED CONSTRUCTION SCHEDULE & MAN POWER
EAGLE MOUNTAIN



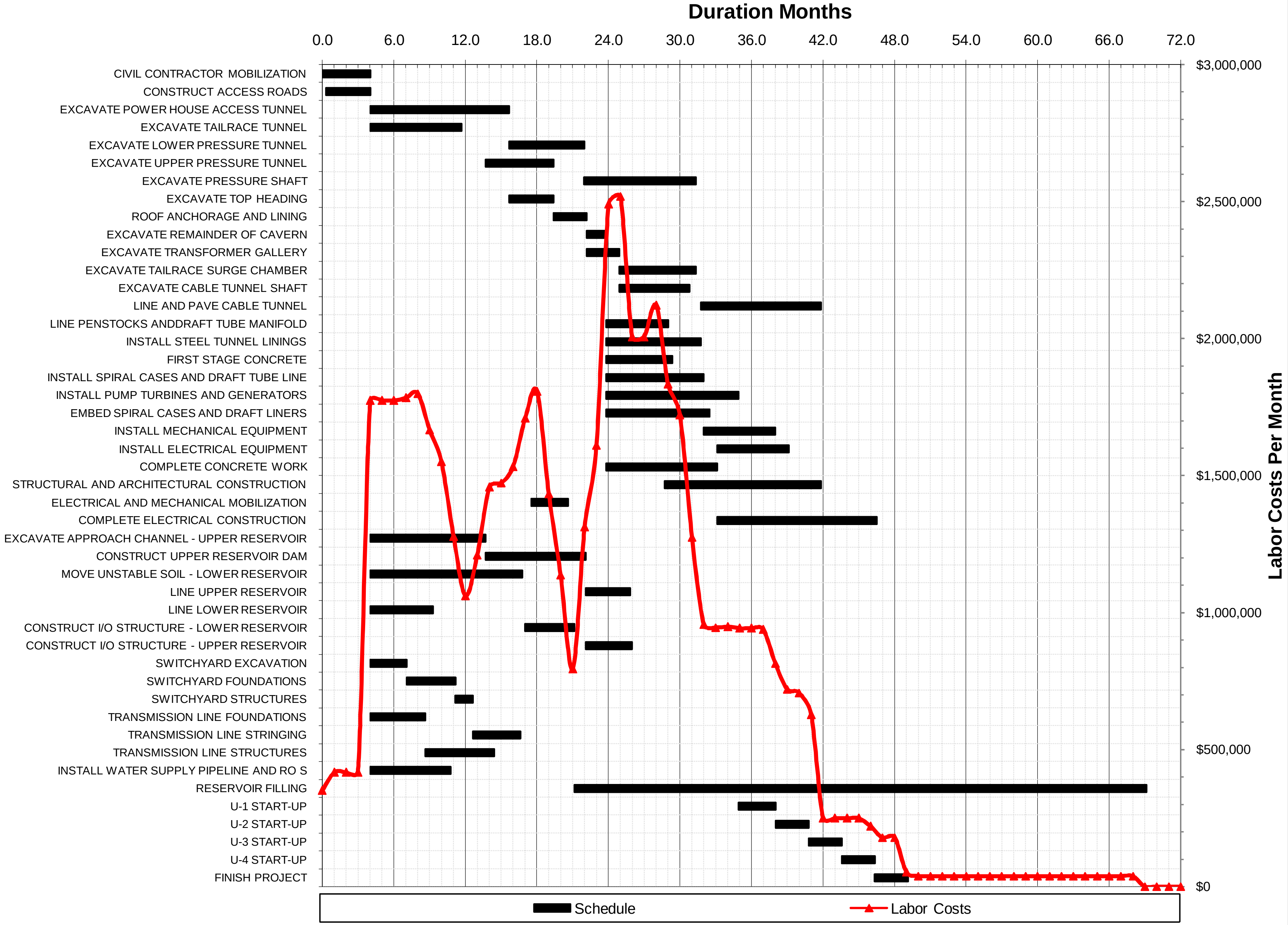
ESTIMATED CONSTRUCTION SCHEDULE & EQUIPMENT
EAGLE MOUNTAIN



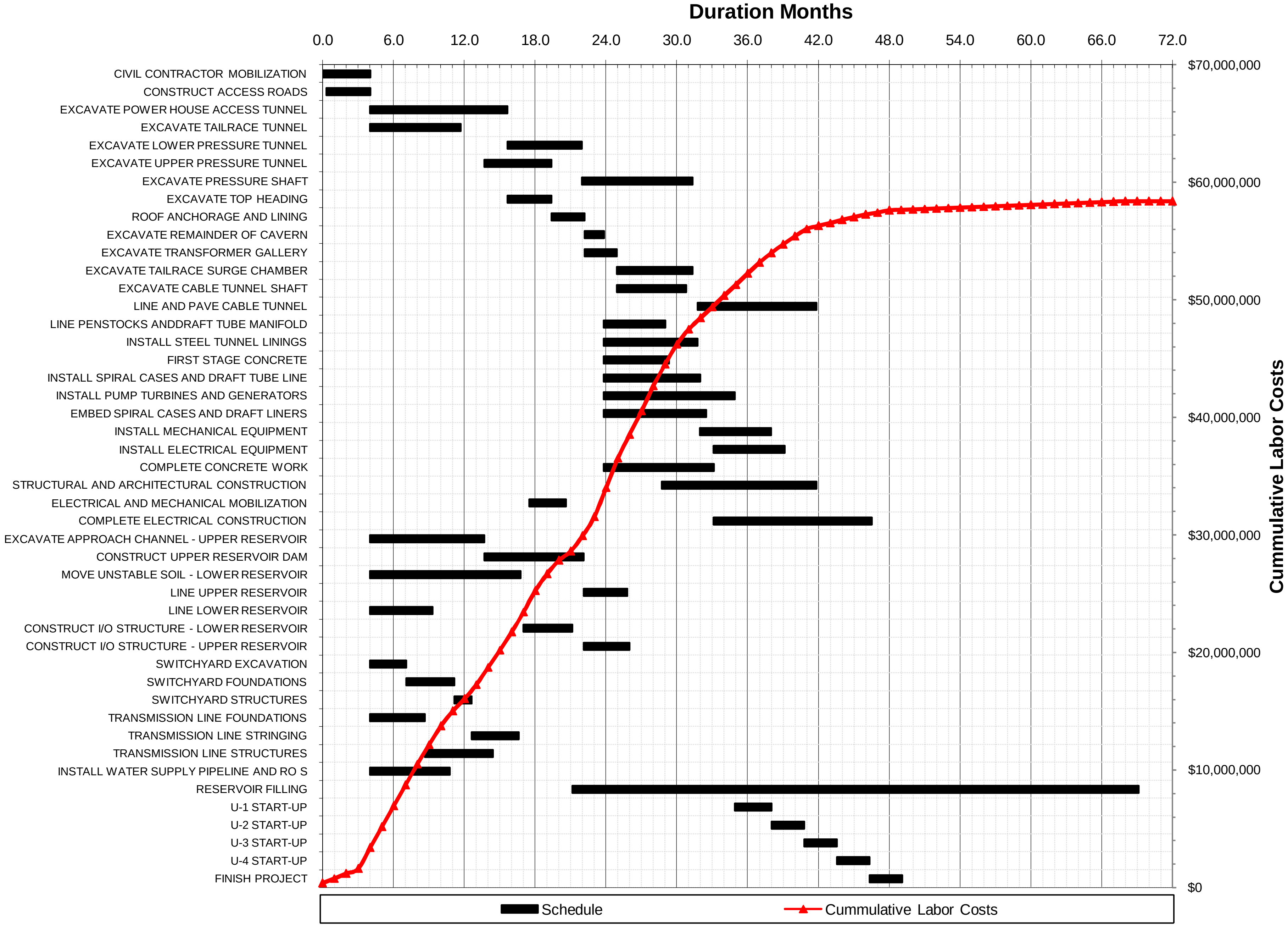
ESTIMATED CONSTRUCTION SCHEDULE & OFFSITE TRUCKS PER MONTH
EAGLE MOUNTAIN



ESTIMATED CONSTRUCTION SCHEDULE & MONTHLY LABOR COSTS
EAGLE MOUNTAIN



ESTIMATED CONSTRUCTION SCHEDULE & CUMMULATIVE LABOR COSTS
EAGLE MOUNTAIN



ESTIMATED CONSTRUCTION WORK FORCE
EAGLE MOUNTAIN PUMPED-STORAGE PROJECT

CONSTRUCTION SEGMENT	AVERAGE CREW SIZE (1)	AVERAGE DURATION (MONTHS) (2)	SHIFTS (3)		PERSON MONTHS (4)
			NUMBER	LENGTH (HRS)	
CIVIL CONTRACTOR MOBILIZATION	15	4	1	8	60
CONSTRUCT ACCESS ROADS	18	4	1	8	67
EXCAVATE POWER HOUSE ACCESS TUNNEL	23	12	1	8	268
EXCAVATE TAILRACE TUNNEL	26	8	1	8	199
EXCAVATE LOWER PRESSURE TUNNEL	16	6	1	8	101
EXCAVATE UPPER PRESSURE TUNNEL	29	6	1	8	166
EXCAVATE PRESSURE SHAFT	20	9	1	8	188
EXCAVATE TOP HEADING	27	4	1	8	100
ROOF ANCHORAGE AND LINING	6	3	1	8	17
EXCAVATE REMAINDER OF CAVERN	27	2	1	8	44
EXCAVATE TRANSFORMER GALLERY	18	3	1	8	49
EXCAVATE TAILRACE SURGE CHAMBER	16	6	1	8	103
EXCAVATE CABLE TUNNEL SHAFT	11	6	1	8	65
LINE AND PAVE CABLE TUNNEL	6	10	1	8	61
LINE PENSTOCKS ANDDRAFT TUBE MANIFOLD	36	5	1	8	187
INSTALL STEEL TUNNEL LININGS	22	8	1	8	175
FIRST STAGE CONCRETE	19	6	1	8	105
INSTALL SPIRAL CASES AND DRAFT TUBE LINE	8	8	1	8	65
INSTALL PUMP TURBINES AND GENERATORS	8	11	1	8	89
EMBED SPIRAL CASES AND DRAFT LINERS	7	9	1	8	61
INSTALL MECHANICAL EQUIPMENT	9	6	1	8	54
INSTALL ELECTRICAL EQUIPMENT	8	6	1	8	48
COMPLETE CONCRETE WORK	15	9	1	8	140
STRUCTURAL AND ARCHITECTURAL CONSTRUCTION	30	13	1	8	394
ELECTRICAL AND MECHANICAL MOBILIZATION	15	3	1	8	46
COMPLETE ELECTRICAL CONSTRUCTION	8	13	1	8	107
EXCAVATE APPROACH CHANNEL - UPPER RESERVOIR	23	10	1	8	222
CONSTRUCT UPPER RESERVOIR DAM	38	8	1	8	320
MOVE UNSTABLE SOIL - LOWER RESERVOIR	19	13	1	8	242
LINE UPPER RESERVOIR	23	4	1	8	85
LINE LOWER RESERVOIR	18	5	1	8	95
CONSTRUCT I/O STRUCTURE - LOWER RESERVOIR	26	4	1	8	107
CONSTRUCT I/O STRUCTURE - UPPER RESERVOIR	27	4	1	8	105
SWITCHYARD EXCAVATION	10	3	1	8	31
SWITCHYARD FOUNDATIONS	11	4	1	8	45
SWITCHYARD STRUCTURES	9	1	1	8	13
TRANSMISSION LINE FOUNDATIONS	10	5	1	8	46
TRANSMISSION LINE STRINGING	7	4	1	8	28
TRANSMISSION LINE STRUCTURES	12	6	1	8	69
INSTALL WATER SUPPLY PIPELINE AND RO S	19	7	1	8	128
RESERVOIR FILLING	3	24	1	8	72
U-1 START-UP	7	3	1	8	22
U-2 START-UP	7	3	1	8	19
U-3 START-UP	7	3	1	8	19
U-4 START-UP	7	3	1	8	19
FINISH PROJECT	10	3	1	8	28
				TOTAL	**4674**

(1) Average number of people on site during a construction activity, rounded to the nearest person.

(2) Estimated time to complete a construction activity if completed independent of other construction activities and without consideration of other construction and schedule constraints, rounded to the nearest month.

(3) Number and length of daily shifts.

(4) Rounded to nearest person month. One person month is equal to 173 hours. Calculated prior to rounding crew sizes and durations.

ESTIMATED CONSTRUCTION EQUIPMENT
EAGLE MOUNTAIN

TYPE OF EQUIPMENT	CIVIL CONTRACTOR MOBILIZATION	ACCESS ROADS	POWER HOUSE ACCESS TUNNEL	EXCAVATE TAILRACE TUNNEL	EXCAVATE LOWER PRESSURE TUNNEL	EXCAVATE UPPER PRESSURE TUNNEL	EXCAVATE PRESSURE SHAFT	EXCAVATE TOP HEADING	ROOF ANCHORAGE AND LINING	EXCAVATE REMAINDER OF CABIN
DURATION (5)	**4**	**4**	**12**	**8**	**6**	**6**	**9**	**4**	**3**	**2**
On-site										
Air Compressor	0.0	1.3	0.0	0.0	0.0	0.0	1.3	3.8	1.3	1.3
Backhoe / Front End Loader, Wheeled	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Backhoe, Tracked	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compactor, Sheepsfoot, Self-Propelled	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compactor, Vibratory, Self-Propelled	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Concrete Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crane - 40 Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crane - 70 Ton	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0
Dozer, D5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dozer, D6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dozer, D8	0.0	1.3	0.0	0.0	0.0	0.0	1.3	2.5	0.0	2.5
Drill, Tracked	0.0	1.3	2.5	1.3	1.3	0.0	1.3	3.8	1.3	3.8
Dump Truck, End Dump, 15 Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dump Truck, Off-Highway, 34 Ton	0.0	3.8	5.0	6.3	2.5	6.3	2.5	5.0	0.0	5.0
Excavator, 325	0.0	1.3	1.3	1.3	1.3	0.0	1.3	2.5	0.0	2.5
Forklift, Rough Terrain	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Front End Loader, Wheeled	0.0	1.3	2.5	2.5	2.5	1.3	2.5	5.0	0.0	5.0
Fuel Truck / Support Truck	1.3	1.3	0.0	0.0	0.0	1.3	1.3	1.3	1.3	1.3
Generator - Diesel	1.3	1.3	1.3	1.3	1.3	1.3	1.3	2.5	1.3	2.5
Grout Pump	0.0	0.0	1.3	1.3	1.3	0.0	1.3	0.0	1.3	0.0
Motor Grader	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pump truck - Concrete	0.0	0.0	1.3	2.5	2.5	0.0	2.5	0.0	0.0	0.0
Truck, Flatbed	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0
Tunnel Rig	0.0	0.0	1.3	1.3	1.3	1.3	0.0	0.0	0.0	0.0
Water Pump, Diesel	1.3	0.0	1.3	1.3	1.3	1.3	1.3	0.0	0.0	0.0
Water Truck	0.0	1.3	0.0	0.0	0.0	0.0	0.0	1.3	0.0	1.3
Welder and Generator Set	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**10.0**	**17.5**	**17.5**	**18.8**	**15.0**	**12.5**	**18.8**	**27.5**	**7.5**	**25.0**
Daily Vehicles(3)										
Daily Concrete Mixer Truck - 8 CY	0.0	0.0	16.3	31.3	31.3	62.5	31.3	0.0	3.8	0.0
Daily Semi Trailer Truck	0.0	0.0	71.3	97.5	76.3	81.3	30.0	75.0	0.0	50.0
Off-Site Vehicles										
Total Offsite Flatbed/Semi Trucks	1.3	0.0	11.3	6.3	16.3	32.5	8.8	0.0	2.5	0.0

(1) Rounded to nearest unit of equipment.
(2) Sum of estimated pieces of equipment times duration of construction activity. Calculated prior to rounding duration and equipment quantities. One equipment month is equal to 173 hours of operation.

(3) Number of daily vehicles on site.
(4) Pieces of equipment not equal to a whole number represent equipment not being utilized for entire duration of the activity.

(5) Rounded to the nearest month.

ESTIMATED CONSTRUCTION EQUIPMENT
EAGLE MOUNTAIN

TYPE OF EQUIPMENT	EXCAVATE TRANSFORMER GALLERY	EXCAVATE TAILRACE SURGE CHANBER	EXCAVATE CABLE TUNNEL SHAFT	LINE AND PAVE CABLE TUNNEL	LINE PENSTKS DRAFT TUBE MAN.	INSTALL STEEL TUNNEL LINES	FIRST STAGE CONCRETE	INSTALL CASES DRAFT TUBE LINE.	INSTALL PUMP TURBIN. AND GEN.	EMBED CASES AND DRAFT LINERS
DURATION $^{(5)}$	**3**	**6**	**6**	**10**	**5**	**8**	**6**	**8**	**11**	**9**
On-site										
Air Compressor	1.3	1.3	1.3	1.3	2.5	1.3	0.0	0.0	1.3	0.0
Backhoe / Front End Loader, Wheeled	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Backhoe, Tracked	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compactor, Sheepsfoot, Self-Propelled	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compactor, Vibratory, Self-Propelled	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Concrete Pump	0.0	0.0	0.0	1.3	0.0	0.0	0.0	1.3	0.0	0.0
Crane - 40 Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
Crane - 70 Ton	0.0	0.0	0.0	1.3	0.0	0.0	1.3	0.0	1.3	0.0
Dozer, D5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dozer, D6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dozer, D8	1.3	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
Drill, Tracked	2.5	1.3	1.3	1.3	0.0	1.3	0.0	0.0	0.0	0.0
Dump Truck, End Dump, 15 Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dump Truck, Off-Highway, 34 Ton	3.8	1.3	1.3	0.0	3.8	2.5	0.0	0.0	0.0	0.0
Excavator, 325	1.3	1.3	1.3	0.0	1.3	1.3	0.0	0.0	0.0	0.0
Forklift, Rough Terrain	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0
Front End Loader, Wheeled	2.5	2.5	2.5	0.0	3.8	2.5	0.0	0.0	0.0	0.0
Fuel Truck / Support Truck	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.0	1.3	1.3
Generator - Diesel	1.3	1.3	1.3	1.3	2.5	1.3	1.3	1.3	1.3	0.0
Grout Pump	0.0	0.0	0.0	1.3	0.0	0.0	1.3	0.0	0.0	0.0
Motor Grader	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pump truck - Concrete	0.0	1.3	0.0	0.0	5.0	2.5	2.5	0.0	0.0	1.3
Truck, Flatbed	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Tunnel Rig	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Pump, Diesel	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Truck	1.3	1.3	0.0	0.0	1.3	1.3	1.3	0.0	0.0	1.3
Welder and Generator Set	0.0	0.0	0.0	0.0	0.0	1.3	0.0	1.3	1.3	0.0
TOTAL	**16.3**	**12.5**	**11.3**	**10.0**	**22.5**	**17.5**	**8.8**	**5.0**	**6.3**	**3.8**
Daily Vehicles$^{(3)}$										
Daily Concrete Mixer Truck - 8 CY	0.0	0.0	0.0	1.3	62.5	31.3	31.3	1.3	0.0	5.0
Daily Semi Trailer Truck	50.0	18.8	3.8	0.0	50.0	25.0	0.0	0.0	0.0	0.0
Off-Site Vehicles										
Total Offsite Flatbed/Semi Trucks	0.0	1.3	0.0	2.5	11.3	192.5	10.0	13.8	10.0	3.8

(1) Rounded to nearest unit of equipment.
(2) Sum of estimated pieces of equipment times duration of construction activity. Calculated prior to rounding duration and equipment quantities. One equipment month is equal to 173 hours of operation.

(3) Number of daily vehicles on site.
(4) Pieces of equipment not equal to a whole number represent equipment not being utilized for entire duration of the activity.

(5) Rounded to the nearest month.

ESTIMATED CONSTRUCTION EQUIPMENT
EAGLE MOUNTAIN

TYPE OF EQUIPMENT	ESTIMATED AVERAGE PIECES OF EQUIPMENT FOR CONSTRUCTION ACTIVITIES[1]									
	INSTALL MECH. EQUIPMENT	INSTALL ELECT. EQUIPMENT	COMPLETE CONCRETE WK.	STRUCTURAL AND ARCHIT. CONST.	ELECTRICAL AND MECH. MOBE.	COMPLETE ELEC. CONSTRUCTION	EXCAVATE APPR. CHANNEL - UPPER	CONSTRUCT UPPER DAM	MOVE UNSTABLE SOIL - LOWER	LINE UPPER RESERVOIR
DURATION [5]	**6**	**6**	**9**	**13**	**3**	**13**	**10**	**8**	**13**	**4**
On-site										
Air Compressor	1.3	1.3	0.0	1.3	0.0	1.3	1.3	2.5	0.0	0.0
Backhoe / Front End Loader, Wheeled	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
Backhoe, Tracked	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compactor, Sheepsfoot, Self-Propelled	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compactor, Vibratory, Self-Propelled	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	1.3
Concrete Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crane - 40 Ton	0.0	0.0	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Crane - 70 Ton	1.3	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Dozer, D5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0
Dozer, D6	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
Dozer, D8	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	2.5	1.3
Drill, Tracked	0.0	0.0	0.0	1.3	0.0	0.0	2.5	0.0	0.0	0.0
Dump Truck, End Dump, 15 Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	0.0	0.0
Dump Truck, Off-Highway, 34 Ton	0.0	0.0	0.0	1.3	0.0	0.0	7.5	5.0	6.3	12.5
Excavator, 325	0.0	0.0	0.0	1.3	0.0	0.0	1.3	0.0	1.3	2.5
Forklift, Rough Terrain	0.0	1.3	0.0	2.5	1.3	1.3	0.0	0.0	0.0	0.0
Front End Loader, Wheeled	0.0	0.0	0.0	2.5	0.0	0.0	2.5	2.5	0.0	2.5
Fuel Truck / Support Truck	1.3	1.3	1.3	2.5	1.3	1.3	1.3	2.5	1.3	1.3
Generator - Diesel	1.3	1.3	1.3	2.5	1.3	2.5	0.0	0.0	0.0	0.0
Grout Pump	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Motor Grader	0.0	0.0	0.0	0.0	1.3	0.0	0.0	2.5	1.3	0.0
Pump truck - Concrete	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Truck, Flatbed	0.0	0.0	0.0	0.0	1.3	2.5	0.0	0.0	0.0	0.0
Tunnel Rig	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Pump, Diesel	0.0	0.0	0.0	1.3	1.3	0.0	0.0	0.0	0.0	0.0
Water Truck	0.0	0.0	1.3	0.0	0.0	0.0	1.3	2.5	1.3	1.3
Welder and Generator Set	2.5	1.3	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**7.5**	**6.3**	**6.3**	**21.3**	**10.0**	**8.8**	**20.0**	**33.8**	**13.8**	**22.5**
Daily Vehicles[3]										
Daily Concrete Mixer Truck - 8 CY	0.0	0.0	16.3	3.8	0.0	0.0	0.0	0.0	0.0	0.0
Daily Semi Trailer Truck	0.0	0.0	0.0	22.5	0.0	0.0	50.0	0.0	0.0	0.0
Off-Site Vehicles										
Total Offsite Flatbed/Semi Trucks	6.3	5.0	12.5	53.8	1.3	6.3	0.0	0.0	0.0	0.0

(1) Rounded to nearest unit of equipment.

(2) Sum of estimated pieces of equipment times duration of construction activity. Calculated prior to rounding duration and equipment quantities. One equipment month is equal to 173 hours of operation.

(3) Number of daily vehicles on site.

(4) Pieces of equipment not equal to a whole number represent equipment not being utilized for entire duration of the activity.

(5) Rounded to the nearest month.

ESTIMATED CONSTRUCTION EQUIPMENT
EAGLE MOUNTAIN

TYPE OF EQUIPMENT	LINE LOWER RESERVOIR	CONSTRUCT I/O STRUC. - LOWER	CONSTRUCT I/O STRUC. - UPPER	SWITCHYARD EXCAVATION	SWITCHYARD FOUNDATIONS	SWITCHYARD STRUCTURES	TRANS. LINE FOUNDATIONS	TRANS. LINE STRINGING	TRANS. LINE STRUCTURES	INSTALL H20 SUPPLY AND RO S	RESERVOIR FILLING
DURATION (5)	**5**	**4**	**4**	**3**	**4**	**1**	**5**	**4**	**6**	**7**	**24**
On-site											
Air Compressor	0.0	1.3	1.3	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
Backhoe / Front End Loader, Wheeled	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Backhoe, Tracked	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compactor, Sheepsfoot, Self-Propelled	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	1.3	0.0
Compactor, Vibratory, Self-Propelled	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Concrete Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crane - 40 Ton	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.5	2.5	0.0	0.0
Crane - 70 Ton	0.0	1.3	1.3	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
Dozer, D5	0.0	0.0	0.0	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Dozer, D6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dozer, D8	1.3	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0
Drill, Tracked	0.0	1.3	1.3	0.0	1.3	0.0	1.3	0.0	0.0	0.0	0.0
Dump Truck, End Dump, 15 Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	0.0
Dump Truck, Off-Highway, 34 Ton	6.3	5.0	6.3	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.0
Excavator, 325	2.5	1.3	1.3	1.3	0.0	0.0	0.0	0.0	0.0	1.3	0.0
Forklift, Rough Terrain	0.0	0.0	0.0	0.0	0.0	1.3	0.0	1.3	1.3	0.0	0.0
Front End Loader, Wheeled	2.5	1.3	1.3	1.3	0.0	0.0	1.3	0.0	0.0	1.3	0.0
Fuel Truck / Support Truck	1.3	1.3	1.3	1.3	1.3	2.5	1.3	2.5	2.5	1.3	1.3
Generator - Diesel	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
Grout Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Motor Grader	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Pump truck - Concrete	0.0	2.5	2.5	0.0	1.3	0.0	1.3	0.0	0.0	0.0	0.0
Truck, Flatbed	0.0	0.0	0.0	0.0	0.0	1.3	0.0	1.3	1.3	0.0	0.0
Tunnel Rig	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Pump, Diesel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Truck	1.3	1.3	1.3	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Welder and Generator Set	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	2.5	1.3	0.0
TOTAL	**16.3**	**17.5**	**18.8**	**12.5**	**15.0**	**8.8**	**6.3**	**7.5**	**11.3**	**13.8**	**1.3**
Daily Vehicles(3)											
Daily Concrete Mixer Truck - 8 CY	0.0	31.3	31.3	0.0	2.5	0.0	8.8	0.0	0.0	0.0	0.0
Daily Semi Trailer Truck	0.0	25.0	25.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0
Off-Site Vehicles											
Total Offsite Flatbed/Semi Trucks	0.0	11.3	0.0	0.0	1.3	12.5	30.0	0.0	200.0	260.0	0.0

(1) Rounded to nearest unit of equipment.
(2) Sum of estimated pieces of equipment times duration of construction activity. Calculated prior to rounding duration and equipment quantities. One equipment month is equal to 173 hours of operation.

(3) Number of daily vehicles on site.
(4) Pieces of equipment not equal to a whole number represent equipment not being utilized for entire duration of the activity.

(5) Rounded to the nearest month.

ESTIMATED CONSTRUCTION EQUIPMENT
EAGLE MOUNTAIN

TYPE OF EQUIPMENT	U-1 START-UP	U-2 START-UP	U-3 START-UP	U-4 START-UP	FINISH PROJECT		ESTIMATED EQUIPMENT MONTHS(2)
DURATION (5)	**3**	**3**	**3**	**3**	**3**		
On-site							
Air Compressor	1.3	1.3	1.3	1.3	1.3		220
Backhoe / Front End Loader, Wheeled	0.0	0.0	0.0	0.0	0.0		9
Backhoe, Tracked	0.0	0.0	0.0	0.0	0.0		5
Compactor, Sheepsfoot, Self-Propelled	0.0	0.0	0.0	0.0	0.0		13
Compactor, Vibratory, Self-Propelled	0.0	0.0	0.0	0.0	0.0		53
Concrete Pump	0.0	0.0	0.0	0.0	0.0		23
Crane - 40 Ton	0.0	0.0	0.0	0.0	0.0		57
Crane - 70 Ton	0.0	0.0	0.0	0.0	0.0		81
Dozer, D5	0.0	0.0	0.0	0.0	0.0		42
Dozer, D6	0.0	0.0	0.0	0.0	0.0		9
Dozer, D8	0.0	0.0	0.0	0.0	0.0		125
Drill, Tracked	0.0	0.0	0.0	0.0	0.0		188
Dump Truck, End Dump, 15 Ton	0.0	0.0	0.0	0.0	0.0		95
Dump Truck, Off-Highway, 34 Ton	0.0	0.0	0.0	0.0	0.0		629
Excavator, 325	0.0	0.0	0.0	0.0	0.0		190
Forklift, Rough Terrain	0.0	0.0	0.0	0.0	0.0		90
Front End Loader, Wheeled	0.0	0.0	0.0	0.0	0.0		328
Fuel Truck / Support Truck	0.0	0.0	0.0	0.0	3.8		340
Generator - Diesel	1.3	1.3	1.3	1.3	1.3		264
Grout Pump	0.0	0.0	0.0	0.0	0.0		83
Motor Grader	0.0	0.0	0.0	0.0	0.0		50
Pump truck - Concrete	0.0	0.0	0.0	0.0	0.0		179
Truck, Flatbed	0.0	0.0	0.0	0.0	0.0		72
Tunnel Rig	0.0	0.0	0.0	0.0	0.0		39
Water Pump, Diesel	0.0	0.0	0.0	0.0	0.0		83
Water Truck	0.0	0.0	0.0	0.0	0.0		127
Welder and Generator Set	0.0	0.0	0.0	0.0	0.0		98
TOTAL	**2.5**	**2.5**	**2.5**	**2.5**	**6.3**	**TOTAL**	**3492**
Daily Vehicles(3)							
Daily Concrete Mixer Truck - 8 CY	0.0	0.0	0.0	0.0	0.0		-
Daily Semi Trailer Truck	0.0	0.0	0.0	0.0	0.0		-
Off-Site Vehicles							
Total Offsite Flatbed/Semi Trucks	0.0	0.0	0.0	0.0	0.0		924

(1) Rounded to nearest unit of equipment.
(2) Sum of estimated pieces of equipment times duration of construction activity. Calculated prior to rounding duration and equipment quantities. One equipment month is equal to 173 hours of operation.

(3) Number of daily vehicles on site.
(4) Pieces of equipment not equal to a whole number represent equipment not being utilized for entire duration of the activity.

(5) Rounded to the nearest month.

Labor Costs

Client:	Eagle Crest Energy	Project	080473	Page	1
Subject:	Eagle Mountain Construction Schedule and Equipment	Date	3/19/2009	By	NDM
		Checked		By	
		Approved		By	

LABOR COSTS

Crew	Hourly Wages ($/hr)	Hourly Wages (including O &P) ($/hr)	Source
Blaster	$33.60	$52.10	R.S. Means 2009, Crew B-47, Blast Foreman
Carpenters	$39.95	$61.95	R.S. Means 2009, Carpenters
Cement Finisher	$38.30	$56.05	R.S. Means 2009, Cement Finishers
Driller	$31.60	$49.00	R.S. Means 2009, Crew B-47, Driller
Electricians	$47.00	$69.95	R.S. Means 2009, Electricians
Equipment Operators	$41.35	$62.15	R.S. Means 2009, Equipment Operator (Medium)
Grade Setter	$41.35	$62.15	R.S. Means 2009, Equipment Operator (Medium)
Foreman	$42.85	$66.35	R.S. Means 2009, Foreman Average (Outside)
Labor Foreman	$33.60	$52.10	R.S. Means 2009, Labor Foreman (Outside)
Laborers	$31.60	$49.00	R.S. Means 2009, Common Building Laborers
Mechanics	$42.70	$64.20	R.S. Means 2009, Equipment Operator, Master Mechanics
Painter	$35.20	$52.75	R.S. Means 2009, Painters, Ordinary
Pile Driver	$38.50	$62.50	R.S. Means 2009, Pile Drivers
Pipe Foreman	$49.35	$74.05	R.S. Means 2009, Pipe Fitter
Pipe Layer	$40.85	$63.25	R.S. Means 2009, Skilled Worker
Plumber	$48.75	$73.15	R.S. Means 2009, Plumber
Rigger	$40.85	$63.25	R.S. Means 2009, Skilled Worker
Survey/Rodmen	$39.75	$60.80	R.S. Means 2009, Average of: Instrument Man, Rodmen/Chainmen
Steel Worker	$44.70	$79.65	R.S. Means 2009, Structural Steel Workers
Steel Worker Foreman	$46.70	$83.20	R.S. Means 2009, Structural Steel Foremen
Truck Drivers	$31.95	$49.15	R.S. Means 2009, Truck Drivers (Heavy)
Welder	$44.70	$79.65	R.S. Means 2009, Welders

Operations Labor Costs

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Subject:	Eagle Mountain Operations	Date	1/21/2009	By	NDM
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OPERATIONS

Crew	Shift Quantity	Number of Daily Shifts	Total Operations Crew	Annual Salaries[1] ($/year)	Annual Labor Costs ($)
Mechanical Engineer	2	2	4	$63,000	$252,000
Electrical Engineer	2	2	4	$63,000	$252,000
Project Engineer	1	2	2	$62,000	$124,000
Project Manager	1	2	2	$75,000	$150,000
Construction Manager	1	2	2	$70,000	$140,000
Manager	1	2	2	$54,000	$108,000
Power Plant Operator	2	2	4	$58,000	$232,000
Plant Engineer	1	2	2	$63,000	$126,000
Mechanical Maintenance Technician	1	2	2	$37,000	$74,000
Scheduler	1	2	2	$57,000	$114,000
Field Service Engineer	1	2	2	$53,000	$106,000
Administration Staff	1	2	2	$57,000	$114,000
TOTAL =	**15**		**30**		**$1,792,000**

1) Source: http://www.simplyhired.com/a/salary/search/q-Hydro+Power (3/19/2009)

OPERATIONS AND MAINTENANCE COSTS

The operation and maintenance costs are those associated with Project operation and upkeep. They include the cost of the direct salaries and administrative support of plant administration, operating and maintenance personnel, and of maintenance equipment and materials and repairs and spare parts.

Eagle Mountain Pumped Storage Estimated Annual Project Costs

Operating Costs Elements	Amount ($/year)
Property Tax	$8,390,000
Land Leases	$2,000,000
Makeup Water and Pumping	$2,400,000
Water Treatment	$720,000
Property Insurance	$4,200,000
Salaries	$1,800,000
Home Office Administration	$900,000
Supplies and Parts	$2,500,000
FERC Fees	$1,500,000
Total Annual Operating Cost	**$24,410,000**

Note:

Table from Draft License Application - Exhibit D

Client:	Eagle Crest Energy	Project	080473	Page	1
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EAGLE MOUNTAIN PUMPED-STORAGE PROJECT --- TYPICAL EQUIPMENT AND TASK PRODUCTION RATES

TASK/EQUIPMENT	TYPICAL PRODUCTION RATES (SINGLE CREW ONLY)	
Tunnel Boring Machine	45 - 120	ft/day
Drill and Blast Excavation	200 - 400	cy/day
Benching Excavation	500	cy/day
Trench Excavation	200	lcy/hr
Prelining Shotcrete	200 - 300	sy/day
Concrete	100 - 200	cy/day
Grouting	450	cf/day
Roof & Wall Support	2000 - 2500	sf/day
Rock Anchors	400	lf/day
Misc. Steel	20	tons/day
Steel Liner	50	lf/day
Elevator Shaft	50	lf/day
Excavator	200 - 300	cy/hr
Compactor (large)	850	cy/hr
Compactor (small)	120	cy/hr
Grading	1200	cy/day
Gravel Placement	1500	cy/day
RCC Dams	1500	cy/day
Trashrack Installation	200	sf/day
Peir Foundations	4 - 10	peirs/day
Fencing Installation	300	lf/day
Transmission Line Stringing	8000	ft/day
Pipeline Installation	1000	ft/day

GEI Consultants, Inc.
080473 Eagle Mountain Pumped Storage Project
Construction Schedule Item List
1/20/2009
NDM

1 **NOTICE TO PROCEED**
2 **CIVIL CONTRACTOR MOBILIZATION**
3 **CIVIL CONTRACTOR MOBILIZED**
4 **CONSTRUCT ACCESS ROADS**
5 **EXCAVATE POWER HOUSE ACCESS TUNNEL**
6 **COMPLETE ACCESS TUNNEL EXCAVATION**
7 **EXCAVATE TAILRACE TUNNEL**
8 **EXCAVATE LOWER PRESSURE TUNNEL**
9 **EXCAVATE UPPER PRESSURE TUNNEL**
10 **EXCAVATE PRESSURE SHAFT**
11 **EXCAVATE TOP HEADING**
12 **ROOF ANCHORAGE AND LINING**
13 **EXCAVATE REMAINDER OF CAVERN**
14 **COMPLETE POWER HOUSE EXCAVATION**
15 **EXCAVATE TRANSFORMER GALLERY**
16 **EXCAVATE TAILRACE SURGE CHAMBER**
17 **EXCAVATE CABLE TUNNEL SHAFT**
18 **LINE AND PAVE CABLE TUNNEL**
19 **LINE PENSTOCKS ANDDRAFT TUBE MANIFOLD**
20 **INSTALL STEEL TUNNEL LININGS**
21 **FIRST STAGE CONCRETE**
22 **COMPLETE POWER HOUSE 1ST STAGE CONCRETE**
23 **INSTALL SPIRAL CASES AND DRAFT TUBE LINE**
24 **INSTALL PUMP TURBINES AND GENERATORS**
25 **EMBED SPIRAL CASES AND DRAFT LINERS**
26 **INSTALL MECHANICAL EQUIPMENT**
27 **INSTALL ELECTRICAL EQUIPMENT**
28 **COMPLETE CONCRETE WORK**
29 **STRUCTURAL AND ARCHITECTURAL CONSTRUCTION**
30 **COMPLETE DRAFT TUBE, SPIRAL CASE AND POWERHOUSE, 2ND STAGE CONCRETE**
31 **ELECTRICAL AND MECHANICAL MOBILIZATION**
32 **COMPLETE INSTALLATION OF PUMP-TURBINES, GENERATOR**
33 **COMPLETE ELECTRICAL CONSTRUCTION**
34 **EXCAVATE APPROACH CHANNEL - UPPER RESERVOIR**
35 **CONSTRUCT UPPER RESERVOIR DAM**
36 **MOVE UNSTABLE SOIL - LOWER RESERVOIR**
37 **LINE UPPER RESERVOIR**
38 **LINE LOWER RESERVOIR**
39 **CONSTRUCT I/O STRUCTURE - LOWER RESERVOIR**
40 **CONSTRUCT I/O STRUCTURE - UPPER RESERVOIR**
41 **SWITCHYARD EXCAVATION**
42 **SWITCHYARD FOUNDATIONS**
43 **SWITCHYARD STRUCTURES**
44 **TRANSMISSION LINE FOUNDATIONS**
45 **TRANSMISSION LINE STRINGING**
46 **TRANSMISSION LINE STRUCTURES**
47 **INSTALL WATER SUPPLY PIPELINE AND RO S**
48 **RESERVOIR FILLING**
49 **UNIT-1 START-UP**
50 **U-1 START-UP**
51 **UNIT-2 START-UP**
52 **U-2 START-UP**
53 **UNIT-3 START-UP**
54 **U-3 START-UP**
55 **UNIT-4 START-UP**
56 **U-4 START-UP**
57 **FINISH PROJECT**

2 Civil Contractor Mobe

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	1
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	1
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	1
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump	
Hydroseed Sprayer, Truck Mounted	
Motor Grader	1
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	1
Tunnel Rig	
Water Pump, Diesel	1
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	1
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Duration: **4.0** Months **16.0** Weeks

NOTES:

Mobilization to include installing field offices, preparing staging area, minor road grading, temporary utility connections, security fencing, bringing equipment to site, prepartion of equipment, and lighting

Crew	**Quantity**
Blaster	
Carpenters	2
Cement Finisher	
Driller	
Electricians	2
Equipment Operators	5
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	1
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	1
Welder	

Total Crew Size	15
Monthly Labor Cost	$195,100

4 Accesss Roads

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EQUIPMENT	**Quantity**	
On Site		
Air Compressor	1	
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked	1	
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled	1	
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5		
Dozer, D6		
Dozer, D8	1	
Dozer, D10		
Drill, Tracked	1	
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton	3	hauling onsite
Dump Truck, Semi-Trailer		
Excavator, 325	1	
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	1	
Fuel Truck / Support Truck	1	
Generator - Diesel	1	
Grout Pump/Plant		
Hydroseed Sprayer, Truck Mounted		
Grader, H14	1	
Pile Driver		
Pump Truck - Concrete		
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM) **(3)**		
Water Pump, Diesel		
Water Truck	1	Dust Control
Welder and Generator Set		
Total Offsite Flatbed/Semi Trucks		
Daily Concrete Mixer Truck - 8 CY		
Daily Semi Trailer Truck		

Duration: **3.7** Months **16.0** Weeks

1.0 - CONSTRUCTION AND ACCESS ROADS					
SCHEDULE					
Existing Unpaved Mining Roads					
1.1	Construction Road to Saddle Dams			13,800	LF
1.2	Road from South Dam to Intake Platform			1,800	LF
	Total Existing			15,600	LF
	Width			30	FT
	Depth			2	FT
	Volume			34,667	CY
	Production Rate	900	FT/DAY	2000	CY/DAY
				10	HR/DAY
				216.25	HRS/MONTH
	Initial Duration			0.8	MONTHS
	Contingency			15	%
	Final Duration			0.9	MONTHS
	Final Duration			4.0	WEEKS
New Dirt Roads					
1.3	Road from intake platform down to Channel			2,000	LF
1.4	Road from South Dam to Power Tunnel Portal Const.			10,100	LF
1.5	Extension to Cable, Elevator Shafts & Surge Tank			4,400	LF
1.5	Access road to Lower Inlet Platform			4,000	LF
1.6	Inlet Platform Down to Channel			3,000	LF
	Total Existing			23,500	LF
	Width			30	FT
	Depth			2	FT
	Volume			52,222	CY
	Production Rate	450	FT/DAY	1000	CY/DAY
				10	HR/DAY
				216.25	HRS/MONTH
	Initial Duration			2.4	MONTHS
	Contingency			15	%
	Final Duration			2.8	MONTHS
	Final Duration			12.0	WEEKS

Assumptions:

New road construction will require rock blasting and excavtion.
Hauling of material (onsite)
Survey control
Dust control
Grading
Compacting

Access Roads:

Equipment: Air Compressor, Backhoe, Sheepsfoot Compactor, Dozer, Tracked Drill, Dump Trucks, Excavator, FE Loader, Support Truck, Generator, Grader, Water Truck.
Crew: 1 Driller, 2 Blasters, 6 Equip Opr., 2 survey, 3 DT Driver, 1 Foreman, 1 Grade Setter, 2 Survey.
Schedule: Additive activities, Existing + New.

Crew	**Quantity**
Blaster	2
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	6
Grade Setter	1
Foreman	1
Labor Foreman	
Laborers	
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	5
Welder	

Total Crew Size	18
Monthly Labor Cost	$221,300

5 Power House Access Tunnel

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EQUIPMENT	Quantity	
On Site		
Air Compressor		
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5		
Dozer, D6		
Dozer, D8		
Dozer, D10		
Drill, Tracked	2	
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton	4	Haul Cuttings
Dump Truck, Semi-Trailer		
Excavator, 325	1	
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	2	Load cuttings
Fuel Truck / Support Truck		
Generator - Diesel	1	
Grout Pump/Plant	1	
Hydroseed Sprayer, Truck Mounted		
Grader, H14		
Pile Driver		
Pump Truck - Concrete	1	
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM)	1	
Water Pump, Diesel	1	
Water Truck		
Welder and Generator Set		
Total Offsite Flatbed/Semi Trucks	9	
Daily Concrete Mixer Truck - 8 CY	13	
Daily Semi Trailer Truck	57	

Crew	Quantity
Blaster	2
Carpenters	
Cement Finisher	
Driller	2
Electricians	
Equipment Operators	5
Grade Setter	
Foreman	2
Labor Foreman	
Laborers	4
Mechanics	1
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	5
Welder	

Total Crew Size	23
Monthly Labor Cost	$275,600

Duration:	**11.6**	Months	**50.4**	Weeks	
CONSTANTS:	10	HR/DAY		216.25	HRS/MONTH

2.0 - CONSTRUCTION TUNNELS
SCHEDULE

2.1	To Machine Hall Roof			2,900	CY
2.2	To Transformer Hall Roof			1,700	CY
2.3	To Power Shaft Construction			8,500	CY
2.4	To Tailrace Surge Tank Construction Access			1,900	CY
	Total Volume			15,000	CY
	D&B Production Rate	38	FT/DAY	250	CY/DAY
	Initial Duration			2.8	MONTHS
	Contingency			25	%
	Final Duration			3.5	MONTHS
	Final Duration			15.0	WEEKS

EQUIPMENT/TRUCKING

DUMP TRUCKS	30	CY/TRUCK
	500	# OF TRUCKS FOR TASK
	9	LOADS/DAY
	1.0	CYCLE TIME (HRS)
	1	REQUIRED # OF TRUCKS
SEMIS	20	CY/TRUCK
	750	# OF TRUCKS FOR TASK
	13	TRUCKS/DAY

3.0 - ACCESS TUNNEL
SCHEDULE

3.1 Main Access Tunnel (6628') to Power House

3.1.1	Excavation (TBM)			192,500	CY
	Duration (from Tunnel Exc. Spreadsheet)			27.1	WEEKS
	Average Production Rate			1,136	CY/DAY
	Contingency			25	%
Final Duration				7.8	MONTHS
Final Duration				33.9	WEEKS
3.1.2	Prelining Shotcrete(w/wire-mesh)			20,600	SY
	Production Rate			200	SY/DAY
	Duration			4.8	MONTHS
	Contingency			25	%
Final Duration				6.0	MONTHS
Final Duration				25.8	WEEKS
Lag				2.0	WEEKS
Maximum Duration				27.8	WEEKS
3.1.3	Invert concrete			6,900	CY
	Production Rate			100	CY/DAY
	Duration			3.2	MONTHS
	Contingency			25	%
Final Duration				4.0	MONTHS
Final Duration				17.3	WEEKS
Lag				2.0	WEEKS
Maximum Duration				19.3	WEEKS
3.1.4	Rock anchors (15' long)			5,000	EA
	Total Bolt Length			75,000	FT
	Production Rate		(2 crews)	800	FT/DAY
	Duration			4.3	MONTHS
	Contingency			25	%
Final Duration				5.4	MONTHS
Final Duration				23.4	WEEKS
Lag				2.0	WEEKS
Maximum Duration				25.4	WEEKS

3.2 Drainage Gallery Access Tunnel (L=80')

3.2.1	Excavation			800	CY
	D&B Production Rate	38	FT/DAY	250	CY/DAY
	Initial Duration			0.1	MONTHS
	Contingency			25	%
Final Duration				0.2	MONTHS
Final Duration				0.8	WEEKS
3.2.2	Invert Concrete			10	CY
	Production Rate			100	CY/DAY
	Duration			0.005	MONTHS
	Contingency			25	%
Final Duration				0.006	MONTHS
Final Duration				0.025	WEEKS
Lag				0.5	WEEKS
Maximum Duration				0.5	WEEKS
3.2.3	Prelining			200	SY
	Production Rate			200	SY/DAY
	Duration			0.0	MONTHS
	Contingency			25	%
Final Duration				0.1	MONTHS
Final Duration				0.3	WEEKS
Lag				0.5	WEEKS
Maximum Duration				0.8	WEEKS

5 Power House Access Tunnel

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3.3 Tailrace Rock Trap Access Tunnel (L = 100')	100	LF
D&B Production Rate	37	FT/DAY
Initial Duration	0.1	MONTHS
Contingency	25	%
Final Duration	0.2	MONTHS
Final Duration	0.7	WEEKS
EQUIPMENT/TRUCKING		
DUMP TRUCKS	193954	TOTAL VOLUME, CY
	30	CY/TRUCK
	6,417	# OF TRUCKS FOR TASK
	38	LOADS/DAY
	1.0	CYCLE TIME (HRS)
	4	REQUIRED # OF TRUCKS
OFFSITE TRUCKS	168	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;	20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete	9	# OF TRUCKS
CONCRETE TRUCKS	8643	TOTAL VOLUME, CY
	8	CY/TRUCK
	1,080	# OF TRUCKS FOR TASK
	13	TRUCKS/DAY
CONCRETE PUMP TRUCKS (15 TRUCKS)-->	120	CY/DAY
	1	# OF TRUCKS
SEMIS	20	CY/TRUCK
	9,698	# OF TRUCKS FOR TASK
	57	TRUCKS/DAY

Assumptions:

Const. Tunnel Diameter = 15', = 177sf
D&B advancement rate = 37 ft/day, = 250cy/day
Excavation Then Haul Offsite
Survey Control
Shotcrete/Prelining = 3" thick

Construction Tunnels:

Process: Drill, Blast, Excavate, Load, Haul, Dump, Load, Haul offsite.
Equipment: Track Drill, Excavator, FE Loader, Dump Trucks, FE Loader, Semis.
Crew: 1 Driller, 2 Blasters, 4 Equip Opr., 2 survey, 1 DT Driver

Access Tunnels:

Process: TBM bore, Excavate, Load, Haul, Dump, Load, Haul offsite; Rock Anchors; Shotcrete; Invert Concrete.
Equipment: TBM, Excavator, FE Loader, Dump Trucks, FE Loader, 2 Track Drill, Semis; Grout Pump; Concrete

7 Excavate Tailrace Tunnel

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EQUIPMENT	**Quantity**	
On Site		
Air Compressor		
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5		
Dozer, D6		
Dozer, D8		
Dozer, D10		
Drill, Tracked	1	
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton	5	Haul Cuttings
Dump Truck, Semi-Trailer		
Excavator, 325	1	
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	2	Load cuttings
Fuel Truck / Support Truck		
Generator - Diesel	1	
Grout Pump/Plant	1	
Hydroseed Sprayer, Truck Mounted		
Grader, H14		
Pile Driver		
Pump Truck - Concrete	2	
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM)	1	
Water Pump, Diesel	1	
Water Truck		
Welder and Generator Set		
Total Flatbed/Semi Trucks	5	
Daily Concrete Mixer Truck - 8 CY	25	
Daily Semi Trailer Truck	78	

Crew	**Quantity**
Blaster	2
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	3
Grade Setter	
Foreman	1
Labor Foreman	1
Laborers	8
Mechanics	1
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	7
Welder	

Total Crew Size	26
Monthly Labor Cost	$298,700

Duration: **7.7** Months **33.2** Weeks

CONSTANTS: 10 HR/DAY 216.25 HRS/MONTH

12.0 - TAILRACE TUNNEL SCHEDULE

12.1	**Tailrace Tunnel Excavation (TBM)**			223,100	CY
		Duration (from Tunnel Exc. Spreadsheet)		23.1	WEEKS
		Average Production Rate		1,544	CY/DAY
		Contingency		25	%
	Final Duration			6.7	MONTHS
	Final Duration			28.9	WEEKS
12.2	Prelining Shotcrete & Support			78,700	SY
		Production Rate	(3-4 crews)	800	SY/DAY
		Duration		4.5	MONTHS
		Contingency		25	%
	Final Duration			5.7	MONTHS
	Final Duration			24.6	WEEKS
	Lag			2.0	WEEKS
	Maximum Duration			26.6	WEEKS
12.3	Plug Concrete Construction			3,400	CY
		Production Rate		200	CY/DAY
		Duration		0.8	MONTHS
		Contingency		25	%
	Final Duration			1.0	MONTHS
	Final Duration			4.3	WEEKS
12.4	Plug Grout Injection			4,273	SY
		Production Rate	(1.5 crews)	300	SY/DAY
		Duration		0.7	MONTHS
		Contingency		25	%
	Final Duration			0.8	MONTHS
	Final Duration			3.6	WEEKS
	Lag			0.5	WEEKS
	Maximum Duration			4.1	WEEKS
12.5	Tailrace Rock Trap Construction			1,133	CY
		D&B Production Rate		250	CY/DAY
		Duration		0.21	MONTHS
		Contingency		25	%
	Final Duration			0.26	MONTHS
	Final Duration			1.1	WEEKS
12.6	Excavate Tailrace Surge Tank (shown on different schedule task)				

EQUIPMENT/TRUCKING

DUMP TRUCKS		224,233	TOTAL VOLUME, CY
		30	CY/TRUCK
		7,474	# OF TRUCKS FOR TASK
		46	LOADS/DAY
		1.0	CYCLE TIME (HRS)
		5	REQUIRED # OF TRUCKS
OFFSITE TRUCKS		80	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		5	# OF TRUCKS
CONCRETE TRUCKS		9958	TOTAL VOLUME, CY
		8	CY/TRUCK
		1,245	# OF TRUCKS FOR TASK
		25	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		2	# OF TRUCKS
SEMIS		20	CY/TRUCK
		11,212	# OF TRUCKS FOR TASK
		78	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite
Survey Control
Shotcrete/Prelining = 3" thick

Tailrace Tunnel:

Process: TBM bore, Excavate, Load, Haul, Dump, Load, Haul offsite; Shotcrete; Plug Concrete.
Equipment: TBM, Excavator, FE Loader, Dump Trucks, FE Loader, Semis; Grout Pump; Concrete Pump Truck.
Crew: 1 TBM Operator, 2 TBM Laborers, 3 Equip Opr., 2 survey, 5 DT Drivers;
(Activities do not overlap, therefore use maximum of activities to find equipment and crew estimates)

Tailrace Rock Trap:

Process: Drill, Blast, Excavate, Load, Haul, Dump, Load, Haul offsite.
Equipment: Track Drill, Excavator, FE Loader, Dump Trucks, FE Loader, Semis.
Crew: 1 Driller, 2 Blasters, 3 Equip Opr., 2 survey, 1 DT Driver
Schedule: Excavation and Plug construction = duration, other activies + lag are less, Rock trap constructed concurrently.

8 Excavate Lower Pres. Tunnel

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Subject:	Eagle Mountain Construction Schedule and Equipment	Date	1/21/2009	By	NDM
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EQUIPMENT	Quantity	
On Site		
Air Compressor		
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5		
Dozer, D6		
Dozer, D8		
Dozer, D10		
Drill, Tracked	1	
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton	2	haul cuttings
Dump Truck, Semi-Trailer		
Excavator, 325	1	
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	2	Load cuttings
Fuel Truck / Support Truck		
Generator - Diesel	1	
Grout Pump/Plant	1	
Hydroseed Sprayer, Truck Mounted		
Grader, H14		
Pile Driver		
Pump Truck - Concrete	2	
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM)	1	
Water Pump, Diesel	1	
Water Truck		
Welder and Generator Set		
Total Offsite Flatbed/Semi Trucks	13	
Daily Concrete Mixer Truck - 8 CY	25	
Daily Semi Trailer Truck	61	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	3
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	4
Mechanics	1
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	4
Welder	

Total Crew Size	16
Monthly Labor Cost	$190,600

Duration:	**6.3**	Months	**27.3**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

8.0 - LOWER PRESSURE TUNNEL SCHEDULE

8.1	**Lower Pressure Tunnel Excavation (TBM)**			52,600	CY
		Duration (from Tunnel Exc. Spreadsheet)		6.9	WEEKS
		Average Production Rate		1,214	CY/DAY
		Contingency		25	%
	Final Duration			2.0	MONTHS
	Final Duration			8.7	WEEKS
8.2	Prelining Shotcrete & Support (6")			13,900	SY
		Production Rate	(2 crews)	500	SY/DAY
		Duration		1.3	MONTHS
		Contingency		25	%
	Final Duration			1.6	MONTHS
	Final Duration			7.0	WEEKS
	Lag			2.0	WEEKS
	Maximum Duration			9.0	WEEKS
8.3	Tunnel Lining			14,300	CY
		Production Rate		200	CY/DAY
		Duration		3.3	MONTHS
		Contingency		25	%
	Final Duration			4.1	MONTHS
	Final Duration			17.9	WEEKS
	Lag			2.0	WEEKS
	Maximum Duration			19.9	WEEKS
8.4	Miscellaneous Concrete (bends, plug, etc.)			5,900	CY
		Production Rate		200	CY/DAY
		Duration		1.4	MONTHS
		Contingency		25	%
	Final Duration			1.7	MONTHS
	Final Duration			7.4	WEEKS
8.5	Contact Grouting			10,700	CF
		Production Rate		450	CF/DAY
		Duration		1.10	MONTHS
		Contingency		25	%
	Final Duration			1.37	MONTHS
	Final Duration			5.9	WEEKS
	Lag			1.0	WEEKS
	Maximum Duration			6.9	WEEKS
8.6	Curtain Grouting			5,800	CF
		Production Rate		450	CF/DAY
		Duration		0.60	MONTHS
		Contingency		25	%
	Final Duration			0.75	MONTHS
	Final Duration			3.2	WEEKS
	Lag			1.0	WEEKS
	Maximum Duration			4.2	WEEKS

EQUIPMENT/TRUCKING

DUMP TRUCKS		52,600	TOTAL VOLUME, CY
		30	CY/TRUCK
		1,753	# OF TRUCKS FOR TASK
		13	LOADS/DAY
		1.0	CYCLE TIME (HRS)
		2	REQUIRED # OF TRUCKS
OFFSITE TRUCKS		249	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		13	# OF TRUCKS
CONCRETE TRUCKS		23,128	TOTAL VOLUME, CY
		8	CY/TRUCK
		2,891	# OF TRUCKS FOR TASK
		25	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		2	# OF TRUCKS
SEMIS		20	CY/TRUCK
		2,630	# OF TRUCKS FOR TASK
		61	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite
Survey Control
Shotcrete/Prelining = 3" thick

Lower Pressure Tunnel:

Process: TBM bore, Excavate, Load, Haul, Dump, Load, Haul offsite; Shotcrete; Concrete Lining, Grouting.
Equipment: TBM, Excavator, FE Loader, Dump Trucks, FE Loader, Semis; Concrete Pump Truck; Drill, Grout
Crew: 1 TBM Operator, 2 TBM Laborers, 3 Equip Opr., 2 survey, 2 DT Drivers;
Schedule: Tunnel lining + Misc. Concrete = duration, other activies + lag are less, other activies constructed concurrently.

9 Excavate Upper Pres. Tunnel

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Subject:	Eagle Mountain Construction Schedule and Equipment	Date	1/21/2009	By	NDM
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EQUIPMENT	Quantity	
On Site		
Air Compressor		
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5		
Dozer, D6		
Dozer, D8		
Dozer, D10		
Drill, Tracked		
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton	5	haul cuttings
Dump Truck, Semi-Trailer		
Excavator, 325		
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	1	Load cuttings
Fuel Truck / Support Truck	1	
Generator - Diesel	1	
Grout Pump/Plant		
Hydroseed Sprayer, Truck Mounted		
Grader, H14		
Pile Driver		
Pump Truck - Concrete		
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM)	1	
Water Pump, Diesel	1	
Water Truck		
Welder and Generator Set		
Total Offsite Flatbed/Semi Trucks	26	
Daily Concrete Mixer Truck - 8 CY	50	
Daily Semi Trailer Truck	65	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	4
Grade Setter	
Foreman	1
Labor Foreman	1
Laborers	10
Mechanics	1
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	10
Welder	

Total Crew Size	29
Monthly Labor Cost	$332,200

Duration:	5.7	Months	24.7	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

5.0 - UPPER PRESSURE TUNNEL SCHEDULE

5.1	**Upper Pressure Tunnel Excavation (TBM)**		133,300	CY
	Duration (from Tunnel Exc. Spreadsheet)		16.6	WEEKS
	Average Production Rate		1,284	CY/DAY
	Contingency		25	%
	Final Duration		4.8	MONTHS
	Final Duration		20.8	WEEKS
5.2	Prelining Shotcrete & Support (6")		35,300	SY
	Production Rate	(2 crews)	500	SY/DAY
	Duration		3.3	MONTHS
	Contingency		25	%
	Final Duration		4.1	MONTHS
	Final Duration		17.7	WEEKS
	Lag		2.0	WEEKS
	Maximum Duration		19.7	WEEKS
5.3	Tunnel Lining		36,300	CY
	Production Rate	(2 crews)	400	CY/DAY
	Duration		4.2	MONTHS
	Contingency		25	%
	Final Duration		5.2	MONTHS
	Final Duration		22.7	WEEKS
	Lag		2.0	WEEKS
	Maximum Duration		24.7	WEEKS
5.4	Miscellaneous Concrete (bends, plug, etc.)		5,400	CY
	Production Rate		200	CY/DAY
	Duration		1.2	MONTHS
	Contingency		25	%
	Final Duration		1.6	MONTHS
	Final Duration		6.8	WEEKS
5.5	Contact Grouting		27,200	CF
	Production Rate		450	CF/DAY
	Duration		2.80	MONTHS
	Contingency		25	%
	Final Duration		3.5	MONTHS
	Final Duration		15.1	WEEKS
	Lag		1.0	WEEKS
	Maximum Duration		16.1	WEEKS

EQUIPMENT/TRUCKING

DUMP TRUCKS		133,300	TOTAL VOLUME, CY
		30	CY/TRUCK
		4,443	# OF TRUCKS FOR TASK
		43	LOADS/DAY
		1.0	CYCLE TIME (HRS)
		5	REQUIRED # OF TRUCKS
OFFSITE TRUCKS		518	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		26	# OF TRUCKS
CONCRETE TRUCKS		45,649	TOTAL VOLUME, CY
		8	CY/TRUCK
		5,706	# OF TRUCKS FOR TASK
		50	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		4	# OF TRUCKS
SEMIS		20	CY/TRUCK
		6,665	# OF TRUCKS FOR TASK
		65	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite

Survey Control

Shotcrete/Prelining = 3" thick

Lower Pressure Tunnel:

Process: TBM bore, Excavate, Load, Haul, Dump, Load, Haul offsite; Shotcrete; Concrete Lining, Grouting.

Equipment: TBM, Excavator, FE Loader, Dump Trucks, FE Loader, Semis; Concrete Pump Truck; Grout Pump,

Crew: 1 TBM Operator, 2 TBM Laborers, 3 Equip Opr., 2 survey, 5 DT Drivers;

Schedule: Maximum of All Activities = duration, other activies + lag are less, other activies constructed concurrently.

10 Excavate Pressure Shaft

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EQUIPMENT	**Quantity**	
On Site		
Air Compressor	1	
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton	1	shaft work
Dozer, D5		
Dozer, D6		
Dozer, D8	1	Benching
Dozer, D10		
Drill, Tracked	1	
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton	2	
Dump Truck, Semi-Trailer		
Excavator, 325	1	Larger Model
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	2	
Fuel Truck / Support Truck	1	
Generator - Diesel	1	
Grout Pump/Plant	1	
Hydroseed Sprayer, Truck Mounted		
Grader, H14		
Pile Driver		
Pump Truck - Concrete	2	
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM)		
Water Pump, Diesel	1	
Water Truck		
Welder and Generator Set		
Total Offsite (3) Flatbed/Semi Trucks	8	
Daily Concrete Mixer Truck - 10 CY	25	
Daily Semi Trailer Truck	24	

(3)

Crew	**Quantity**
Blaster	2
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	4
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	4
Mechanics	1
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	5
Welder	

Total Crew Size	20
Monthly Labor Cost	$237,200

Duration:	**9.4**	Months	**40.6**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

7.0 - POWER SHAFT SCHEDULE			
7.1 Power Shaft Excavation (D&B)		40,600	CY
	Duration (from Tunnel Exc. Spreadsheet)	11.6	WEEKS
	Average Production Rate	467	CY/DAY
	Contingency	50	%
Final Duration		4.0	MONTHS
Final Duration		17.4	WEEKS
7.2 Shaft Prelining & Support		2,200	SF
	Production Rate	100	SF/DAY
	Duration	1.0	MONTHS
	Contingency	25	%
Final Duration		1.3	MONTHS
Final Duration		5.5	WEEKS
Lag		2.0	WEEKS
Maximum Duration		7.5	WEEKS
7.3 Concrete Lining		11,100	CY
	Production Rate	200	CY/DAY
	Duration	2.6	MONTHS
	Contingency	25	%
Final Duration		3.2	MONTHS
Final Duration		13.9	WEEKS
Lag		2.0	WEEKS
Maximum Duration		15.9	WEEKS
7.4 Contact Grouting		9,300	CF
	Production Rate	450	CF/DAY
	Duration	1.0	MONTHS
	Contingency	25	%
Final Duration		1.2	MONTHS
Final Duration		5.2	WEEKS
Lag		2.0	WEEKS
Maximum Duration		7.2	WEEKS

EQUIPMENT/TRUCKING			
DUMP TRUCKS		40,600	TOTAL VOLUME, CY
		30	CY/TRUCK
		1,353	# OF TRUCKS FOR TASK
		16	LOADS/DAY
		1.0	CYCLE TIME (HRS)
		2	REQUIRED # OF TRUCKS
OFFSITE TRUCKS		133	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		7	# OF TRUCKS
CONCRETE TRUCKS		11,628	TOTAL VOLUME, CY
		8	CY/TRUCK
		1,453	# OF TRUCKS FOR TASK
		25	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		2	# OF TRUCKS
SEMIS		20	CY/TRUCK
		2,030	# OF TRUCKS FOR TASK
		24	TRUCKS/DAY

6.0 - SURGE TANK SCHEDULE			
6.1 Shaft Excavation (D&B)		8,900	CY
	Production Rate	400	CY/DAY
	Duration	1.0	MONTHS
	Contingency	25	%
Final Duration		1.3	MONTHS
Final Duration		5.6	WEEKS
6.2 Benching Excavation		35,300	CY
	Production Rate	500	CY/DAY
	Duration	3.3	MONTHS
	Contingency	25	%
Final Duration		4.1	MONTHS
Final Duration		17.7	WEEKS

10 Excavate Pressure Shaft

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6.3	Concrete Works	700	CY
	Production Rate	100	CY/DAY
	Duration	0.3	MONTHS
	Contingency	25	%
	Final Duration	0.4	MONTHS
	Final Duration	1.8	WEEKS
	Lag	2.0	WEEKS
	Maximum Duration	3.8	WEEKS

EQUIPMENT/TRUCKING

OFFSITE TRUCKS		8	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		1	# OF TRUCKS
CONCRETE TRUCKS		700	TOTAL VOLUME, CY
		8	CY/TRUCK
		88	# OF TRUCKS FOR TASK
		13	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		1	# OF TRUCKS
SEMIS		20	CY/TRUCK
		2,210	# OF TRUCKS FOR TASK
		20	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite
Survey Control
Shotcrete/Prelining = 3" thick
Power Shaft:
Process: Drill, Blast, Excavate, Crane Hoist, Load, Haul, Dump, Load, Haul offsite.
Equipment: Track Drill, Excavator, Crane, FE Loader, Dump Trucks, FE Loader, Semis; Grout Pump, Concrete
Crew: 1 Driller, 2 Blasters, 4 Equip Opr., 2 survey, 2 DT Driver;
Surge Tank:
Process: D&B: Drill, Blast, Excavate, Crane Hoist, Load, Haul offsite.
Equipment: D&B: Track Drill, Excavator, Crane, FE Loader, Dump Trucks, FE Loader, Semis; Grout Pump,
Crew: 1 Driller, 2 Blasters, 4 Equip Opr., 2 survey;
Schedule: Shaft Exc. + Surge Exc. + Bench Exc. = duration, other activies + lag are less, other activies constructed concurrently.

11 Excavate Top Heading

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EQUIPMENT	**Quantity**	
On Site		
Air Compressor	3	
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5		
Dozer, D6		
Dozer, D8	2	
Dozer, D10		
Drill, Tracked	3	
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton	4	
Dump Truck, Semi-Trailer		
Excavator, 325	2	Larger Model
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	4	
Fuel Truck / Support Truck	1	
Generator - Diesel	2	
Grout Pump/Plant		
Hydroseed Sprayer, Truck Mounted		
Grader, H14		
Pile Driver		
Pump Truck - Concrete		
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM) **(3)**		
Water Pump, Diesel		
Water Truck	1	
Welder and Generator Set		
Total Offsite Flatbed/Semi Trucks		
Daily Concrete Mixer Truck - 8 CY		
Daily Semi Trailer Truck	60	

Duration: **3.7** Months **16.1** Weeks

CONSTANTS: 10 HR/DAY 216.25 HRS/MONTH

13.0 MACHINE HALL SCHEDULE				
13.1-C	Hall Benching Excavation (El. 18, El. 85)		64,000	CY
	Production Rate	(3 crews)	1,200	CY/DAY
	Duration		2.5	MONTHS
	Contingency		25	%
	Final Duration		3.1	MONTHS
	Final Duration		13.3	WEEKS
13.1-D	Roof Excavation (El. 85, El. 100)		9,900	CY
	Production Rate	(2-3 crews)	900	CY/DAY
	Duration		0.5	MONTHS
	Contingency		25	%
	Final Duration		0.6	MONTHS
	Final Duration		2.8	WEEKS
EQUIPMENT/TRUCKING				
DUMP TRUCKS			73,900	TOTAL VOLUME, CY
			30	CY/TRUCK
			2,463	# OF TRUCKS FOR TASK
			40	LOADS/DAY (MAX.)
			1.0	CYCLE TIME (HRS)
			4	REQUIRED # OF TRUCKS
SEMIS			20	CY/TRUCK
			3,695	# OF TRUCKS FOR TASK
			60	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite

Survey Control

Excavate Top Heading

Process: Drill, Blast, Excavate, Load, Haul, Dump, Load, Haul offsite.

Equipment: Track Drills, 2 Excavators, 2 Dozers, 4 FE Loaders, Dump Trucks, Semis, Water Truck, Support Truck.

Crew: 3 Drillers, 6 Blasters, 8 Equip Opr., 2 survey, 4 DT Drivers, 2 Foreman, 1 Water Truck Driver, 1 Support Driver.

Schedule: Activities are additive.

Crew	**Quantity**
Blaster	6
Carpenters	
Cement Finisher	
Driller	3
Electricians	
Equipment Operators	8
Grade Setter	
Foreman	2
Labor Foreman	
Laborers	1
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	5
Welder	

Total Crew Size	27
Monthly Labor Cost	$326,000

12 Roof Anchorage and Lining

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EQUIPMENT	**Quantity**	
On Site		
Air Compressor	1	
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5		
Dozer, D6		
Dozer, D8		
Dozer, D10		
Drill, Tracked	1	drill anchor holes
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton		
Dump Truck, Semi-Trailer		
Excavator, 325		
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled		
Fuel Truck / Support Truck	1	
Generator - Diesel	1	
Grout Pump/Plant	1	shotcrete
Hydroseed Sprayer, Truck Mounted		
Grader, H14		
Pile Driver		
Pump Truck - Concrete		
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed	1	
Tunnel Rig (TBM)		
Water Pump, Diesel		
Water Truck		
Welder and Generator Set		
Total Offsite Flatbed/Semi Trucks	2	
Daily Concrete Mixer Truck - 8 CY	3	
Daily Semi Trailer Truck		

Duration:	**2.8**	Months	**12.1**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

13.0 MACHINE HALL SCHEDULE				
13.2	Roof & Walls Support (3")		96,700	SF
	Production Rate	(1 crew)	2,200	SF/DAY
	Duration		2.0	MONTHS
	Contingency		25	%
	Final Duration		2.5	MONTHS
	Final Duration		11.0	WEEKS
NA	Rock Bolts			
	Assume Bolts Lengths are:		20.0	LF
	Assume 1 bolt per:		100.0	SF
	Total Length		19340.0	LF
	Production Rate		400	LF/DAY
	Duration		2.2	MONTHS
	Contingency		25	%
	Final Duration		2.8	MONTHS
	Final Duration		12.1	WEEKS

EQUIPMENT/TRUCKING		
OFFSITE TRUCKS	25	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;	20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete	2	# OF TRUCKS
CONCRETE TRUCKS	895	TOTAL VOLUME, CY
	8	CY/TRUCK
	112	# OF TRUCKS FOR TASK
	3	TRUCKS/DAY

Assumptions:

Roof and Walls Support is 3" thick shotcrete
Grout for rockbolts is included in shotcrete volume
Roof and Walls Support:
Process: Drill, Install Rock Bolts, Grout Bolts, Shotcrete Surface.
Equipment: Track Drill, Support Truck, Flatbed Truck for rock bolts.
Crew: 1 Driller, 3 Laborers, 1 Foreman, 1 Truck Driver.

Schedule: Activities are additive.

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	1
Welder	

Total Crew Size	6
Monthly Labor Cost	$67,500

13 Excavate Remainder of Cavern

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	2
Dozer, D10	
Drill, Tracked	3
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	4
Dump Truck, Semi-Trailer	
Excavator, 325	2
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	4
Fuel Truck / Support Truck	1
Generator - Diesel	2
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	40

Crew	**Quantity**
Blaster	6
Carpenters	
Cement Finisher	
Driller	3
Electricians	
Equipment Operators	8
Grade Setter	
Foreman	1
Labor Foreman	1
Laborers	1
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	5
Welder	

Total Crew Size	27
Monthly Labor Cost	$322,900

Duration:	**1.6**	Months	**7.1**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

13.0 MACHINE HALL SCHEDULE				
13.1-A Excavation Draft Tubes (El. -16,El. -36)			4,600	CY
Production Rate		(2 crews)	800	CY/DAY
Duration			0.3	MONTHS
Contingency			25	%
Final Duration			0.3	MONTHS
Final Duration			1.4	WEEKS
13.1-B Benching Excavation (El. -16, El. 18)			22,700	CY
Production Rate		(2-3 crews)	1,000	CY/DAY
Duration			1.0	MONTHS
Contingency			25	%
Final Duration			1.3	MONTHS
Final Duration			5.7	WEEKS
EQUIPMENT/TRUCKING				
DUMP TRUCKS			27,300	TOTAL VOLUME, CY
			30	CY/TRUCK
			910	# OF TRUCKS FOR TASK
			33	LOADS/DAY (MAX.)
			1.0	CYCLE TIME (HRS)
			4	REQUIRED # OF TRUCKS
SEMIS			20	CY/TRUCK
			1,365	# OF TRUCKS FOR TASK
			40	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite

Survey Control

Excavate Remainder of Cavern

Process: Drill, Blast, Excavate, Load, Haul, Dump, Load, Haul offsite.

Equipment: Track Drills, 2 Excavators, 2 Dozers, 4 FE Loaders, Dump Trucks, Semis, Water Truck, Support Truck.

Crew: 3 Drillers, 6 Blasters, 8 Equip Opr., 2 survey, 4 DT Drivers, 2 Foreman, 1 Water Truck Driver, 1 Support Driver.

Schedule: Activities are additive.

15 Excavate Transformer Gallery

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	1
Dozer, D10	
Drill, Tracked	2
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	3
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	2
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	40

Crew	**Quantity**
Blaster	2
Carpenters	
Cement Finisher	
Driller	2
Electricians	
Equipment Operators	5
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	1
Mechanics	1
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	4
Welder	

Total Crew Size	18
Monthly Labor Cost	$218,800

Duration: **2.7** **Months** **11.8** **Weeks**

CONSTANTS: 10 HR/DAY 216.25 HRS/MONTH

15.1 TRANSFORMER HALL EXCAVATION (D&B) SCHEDULE

15.1-A	Transformer Hall Excavation			30,900	CY
		Production Rate	(2 crews)	800	CY/DAY
		Duration		1.8	MONTHS
		Contingency		25	%
	Final Duration			2.2	MONTHS
	Final Duration			9.7	WEEKS
15.1-B	Nishe Excavation			2,700	CY
		Production Rate	(1crew)	400	CY/DAY
		Duration		0.3	MONTHS
		Contingency		25	%
	Final Duration			0.4	MONTHS
	Final Duration			1.7	WEEKS
15.1-C	Cable Gallery Excavation			700	CY
		Production Rate	(1crew)	400	CY/DAY
		Duration		0.1	MONTHS
		Contingency		25	%
	Final Duration			0.1	MONTHS
	Final Duration			0.4	WEEKS
15.1-D	A/C Gallery Excavation			100	CY
		Production Rate	(1crew)	400	CY/DAY
		Duration		0.0	MONTHS
		Contingency		25	%
	Final Duration			0.0	MONTHS
	Final Duration			0.1	WEEKS

EQUIPMENT/TRUCKING

DUMP TRUCKS	34,400	TOTAL VOLUME, CY
	30	CY/TRUCK
	1,147	# OF TRUCKS FOR TASK
	27	LOADS/DAY (MAX.)
	1.0	CYCLE TIME (HRS)
	3	REQUIRED # OF TRUCKS
SEMIS	20	CY/TRUCK
	1,720	# OF TRUCKS FOR TASK
	40	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite

Survey Control

Excavate Transformer Gallery:

Process: Drill, Blast, Excavate, Load, Haul, Dump, Load, Haul offsite.

Equipment: Track Drills, 1 Excavators, 1 Dozer, 3 FE Loaders, Dump Trucks, Semis, Water Truck, Support Truck.

Crew: 2 Drillers, 4 Blasters, 5 Equip Opr., 2 survey, 3 DT Drivers, 1 Foreman, 1 Water Truck Driver, 1 Support Driver.

Schedule: Activities are additive.

16 Exc. Tailrace Surge Chamber

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	1
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	1
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	2
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	1
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	1
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	15

Crew	**Quantity**
Blaster	2
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	3
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	4
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	3
Welder	

Total Crew Size	16
Monthly Labor Cost	$188,600

Duration: 6.4 Months 27.8 Weeks

CONSTANTS: 10 HR/DAY 216.25 HRS/MONTH

12.6 D/S Surge Tank Construction (D&B)
SCHEDULE

NA	Surge Tank Excavation (D&B)			19,000	CY
		Production Rate	(1 crew)	300	CY/DAY
		Duration	(Reduced Production - Limited Access)	2.9	MONTHS
		Contingency		25	%
	Final Duration			3.7	MONTHS
	Final Duration			15.8	WEEKS
NA	Roof & Walls Support (3")			105,000	SF
		Production Rate	(1 crew)	2,200	SF/DAY
		Duration		2.2	MONTHS
		Contingency		25	%
	Final Duration			2.8	MONTHS
	Final Duration			11.9	WEEKS

EQUIPMENT/TRUCKING

DUMP TRUCKS	19,000	TOTAL VOLUME, CY
	30	CY/TRUCK
	633	# OF TRUCKS FOR TASK
	10	LOADS/DAY (MAX.)
	1.0	CYCLE TIME (HRS)
	1	REQUIRED # OF TRUCKS
OFFSITE TRUCKS	6	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;	20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete	1	# OF TRUCKS
SEMIS	20	CY/TRUCK
	950	# OF TRUCKS FOR TASK
	15	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite

Survey Control

Excavate Transformer Gallery:

Process: Drill, Blast, Excavate, Load, Haul, Dump, Load, Haul offsite.

Equipment: Track Drill, 1 Excavators, 2 FE Loaders, Dump Truck, Semis, Water Truck, Support Truck.

Crew: 1 Driller, 2 Blasters, 3 Equip Opr., 2 survey, 1 DT Driver, 1 Water Truck Driver, 1 Support Driver.

Shotcrete Crew: 1 Forman, 2 Laborers, 1 CPT Driver.

Schedule: Activities are additive.

17 Excavate Cable Tunnel Shaft

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EQUIPMENT	**Quantity**	
On Site		
Air Compressor	1	
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5		
Dozer, D6		
Dozer, D8		
Dozer, D10		
Drill, Tracked	1	
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton	1	
Dump Truck, Semi-Trailer		
Excavator, 325	1	Larger Model
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	2	
Fuel Truck / Support Truck	1	
Generator - Diesel	1	
Grout Pump/Plant		
Hydroseed Sprayer, Truck Mounted		
Grader, H14		
Pile Driver		
Pump Truck - Concrete		
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM)		
Water Pump, Diesel	1	
Water Truck		
Welder and Generator Set		
Total Offsite Flatbed/Semi Trucks		
Daily Concrete Mixer Truck - 8 CY		
Daily Semi Trailer Truck	3	

Duration: **5.9** **Months** **25.4** **Weeks**

CONSTANTS: 10 HR/DAY 216.25 HRS/MONTH

15.1-E CABLE SHAFT EXCAVATION SCHEDULE					
NA	Cable Shaft Excavation (D&B)			4,700	CY
		Production Rate	(1 crew)	50	CY/DAY
		Duration	(Low production - restricted work area)	4.3	MONTHS
		Contingency		35	%
	Final Duration			5.9	MONTHS
	Final Duration			25.4	WEEKS
EQUIPMENT/TRUCKING					
DUMP TRUCKS				4,700	TOTAL VOLUME, CY
				30	CY/TRUCK
				157	# OF TRUCKS FOR TASK
				2	LOADS/DAY (MAX.)
				1.0	CYCLE TIME (HRS)
				1	REQUIRED # OF TRUCKS
SEMIS				20	CY/TRUCK
				235	# OF TRUCKS FOR TASK
				3	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite

Survey Control

Excavate Transformer Gallery:

Process: Drill, Blast, Excavate, Crane Hoist, Load, Haul, Dump, Load, Haul offsite.

Equipment: Track Drill, Excavator, Crane, FE Loader, Dump Truck, FE Loader, Semis, Support Truck.

Crew: 1 Driller, 2 Blasters, 4 Equip Opr., 2 survey, 1 DT Driver, 1 Support Driver.

Crew	**Quantity**
Blaster	2
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	4
Grade Setter	
Foreman	
Labor Foreman	
Laborers	1
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	1
Welder	

Total Crew Size	11
Monthly Labor Cost	$134,600

18 Line and Pave Cable Tunnel

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		Approved		By	

EQUIPMENT	Quantity
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	1
Crane - 40 Ton	
Crane - 70 Ton	1
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	1
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	1
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	1
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	2
Daily Concrete Mixer Truck - 8 CY	1
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	1
Welder	

Total Crew Size	6
Monthly Labor Cost	$67,500

Duration:	**10.1**	Months	**43.6**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

15.0 TRANSFORMER HALL
SCHEDULE

15.2-E	Roof & Walls Support - Cable Shaft			56,900	SF
		Production Rate	(1 crew)	500	SF/DAY
		Duration	(Low production - restricted work area)	5.3	MONTHS
		Contingency		25	%
	Final Duration			6.6	MONTHS
	Final Duration			28.5	WEEKS
NA	Rock Bolts				
	Assume Bolts Lengths are:			5.5	LF
	Assume 1 bolt per:			45.0	SF
	Total Length			6954	LF
		Production Rate		200	LF/DAY
		Duration	(Low production - restricted work area)	1.6	MONTHS
		Contingency		25	%
	Final Duration			2.0	MONTHS
	Final Duration			8.7	WEEKS
NA	Ladders, Platforms, Cable Installation				
	Total Length			1300	LF
		Production Rate		50	LF/DAY
		Duration		1.2	MONTHS
		Contingency		25	%
	Final Duration			1.5	MONTHS
	Final Duration			6.5	WEEKS

EQUIPMENT/TRUCKING

OFFSITE TRUCKS	36	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;	20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete	2	# OF TRUCKS
CONCRETE TRUCKS	527	TOTAL VOLUME, CY
	8	CY/TRUCK
	66	# OF TRUCKS FOR TASK
	1	TRUCKS/DAY

Assumtions:

Roof and Walls Support is 3" thick shotcrete
Grout for rockbolts is included in shotcrete volume
Roof and Walls Support:
Process: Drill, Install Rock Bolts, Grout Bolts, Shotcrete Surface, Install Equipment.
Equipment: Track Drill, Hoist, Support Truck, Flatbed Truck for rock bolts, Pump.
Crew: 1 Driller, 3 Laborers, 1 Foreman, 1 Truck Driver.
Schedule: Activities are additive.

19 Penstock & Draft Tube Man.

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	2
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	1
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	3
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	3
Fuel Truck / Support Truck	1
Generator - Diesel	2
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	4
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	9
Daily Concrete Mixer Truck - 8 CY	50
Daily Semi Trailer Truck	40

Crew	**Quantity**
Blaster	4
Carpenters	
Cement Finisher	
Driller	2
Electricians	
Equipment Operators	5
Grade Setter	
Foreman	3
Labor Foreman	3
Laborers	9
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	8
Welder	

Total Crew Size	36
Monthly Labor Cost	$417,400

Duration:	**5.2**	**Months**	**22.5**	**Weeks**
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

9.0 PENSTOCK MANIFOLD SCHEDULE

9.1	Manifold Tunnel Excavation (D&B)			7,400	CY
		Production Rate	(2 crews)	800	CY/DAY
		Duration		0.4	MONTHS
		Contingency		25	%
	Final Duration			0.5	MONTHS
	Final Duration			2.3	WEEKS
9.2	Manifold Tunnel Prelining & Support (3", 75%)			2,400	SY
		Production Rate	(2 crews)	500	SY/DAY
		Duration		0.2	MONTHS
		Contingency		25	%
	Final Duration			0.3	MONTHS
	Final Duration			1.2	WEEKS
9.3	Concrete Lining			1,800	CY
		Production Rate	(2 crews)	400	CY/DAY
		Duration		0.2	MONTHS
		Contingency		25	%
	Final Duration			0.3	MONTHS
	Final Duration			1.1	WEEKS
9.4	Concrete Plug			10,700	CY
		Production Rate	(1crew)	200	CY/DAY
		Duration		2.5	MONTHS
		Contingency		25	%
	Final Duration			3.1	MONTHS
	Final Duration			13.4	WEEKS

EQUIPMENT/TRUCKING			
DUMP TRUCKS		7,400	TOTAL VOLUME, CY
		30	CY/TRUCK
		247	# OF TRUCKS FOR TASK
		27	LOADS/DAY (MAX.)
		1.0	CYCLE TIME (HRS)
		3	REQUIRED # OF TRUCKS
OFFSITE TRUCKS		151	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		8	# OF TRUCKS
CONCRETE TRUCKS		12700	TOTAL VOLUME, CY
		8	CY/TRUCK
		1,588	# OF TRUCKS FOR TASK
		50	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		4	# OF TRUCKS
SEMIS		20	CY/TRUCK
		370	# OF TRUCKS FOR TASK
		40	TRUCKS/DAY

11.0 DRAFT TUBE MANIFOLD SCHEDULE

11.1	Manifold Tunnel Excavation (D&B)			7,400	CY
		Production Rate	(2 crews)	800	CY/DAY
		Duration		0.4	MONTHS
		Contingency		25	%
	Final Duration			0.5	MONTHS
	Final Duration			2.3	WEEKS
11.2	Manifold Tunnel Prelining & Support (3", 75%)			2,400	SY
		Production Rate	(2 crews)	500	SY/DAY
		Duration		0.2	MONTHS
		Contingency		25	%
	Final Duration			0.3	MONTHS
	Final Duration			1.2	WEEKS
11.3	Concrete Lining			1,600	CY
		Production Rate	(2 crews)	400	CY/DAY
		Duration		0.2	MONTHS
		Contingency		25	%
	Final Duration			0.2	MONTHS
	Final Duration			1.0	WEEKS

EQUIPMENT/TRUCKING			
DUMP TRUCKS		7,400	TOTAL VOLUME, CY
		30	CY/TRUCK
		247	# OF TRUCKS FOR TASK
		27	LOADS/DAY (MAX.)
		1.0	CYCLE TIME (HRS)
		3	REQUIRED # OF TRUCKS
OFFSITE TRUCKS		20	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		1	# OF TRUCKS
CONCRETE TRUCKS		1800	TOTAL VOLUME, CY
		8	CY/TRUCK
		225	# OF TRUCKS FOR TASK
		50	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		4	# OF TRUCKS
SEMIS		20	CY/TRUCK
		370	# OF TRUCKS FOR TASK
		40	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite

Survey Control

(Activities do not overlap, therefore use maximum of activities to find equimpent and crew estimates)

20 Install Steel Tunnel Linings

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	1
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	2
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	1
Front End Loader, Tracked	
Front End Loader, Wheeled	2
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	2
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	1
Total Offsite Flatbed/Semi Trucks	154
Daily Concrete Mixer Truck - 8 CY	25
Daily Semi Trailer Truck	20

Crew	**Quantity**
Blaster	2
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	3
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	4
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	2
Steel Worker Foreman	
Truck Drivers	5
Welder	2

Total Crew Size	22
Monthly Labor Cost	$278,800

Duration:	**7.9**	**Months**	**34.3**	**Weeks**
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

10.0 PENSTOCKS
SCHEDULE

10.1	Penstock Tunnel Excavation - D&B			18,900	CY
		Production Rate	(1 crew)	400	CY/DAY
		Duration		2.2	MONTHS
		Contingency		25	%
	Final Duration			2.7	MONTHS
	Final Duration			11.8	WEEKS
10.2	Penstock Tunnel Prelining & Support (3", 30%)			3,800	SY
		Production Rate	(1 crew)	200	SY/DAY
		Duration		0.9	MONTHS
		Contingency		25	%
	Final Duration			1.1	MONTHS
	Final Duration			4.8	WEEKS
10.3	Steel Liner Installation			3,000	TONS
		Assumed Unit Weight of Steel Liner		475	LBS/CF
		Tunnel Diameter		15	FT
		Thickness		1.625	INCHES
		Unit Weight		1.5	TONS/FT
		Length		2,000	FT
		Production Rate		50	LF/DAY
		Duration		1.8	MONTHS
		Contingency		25	%
	Final Duration			2.3	MONTHS
	Final Duration			10.0	WEEKS
10.4	Concrete Filling Around Liner			5,200	CY
		Production Rate	(2 crews)	400	CY/DAY
		Duration		0.6	MONTHS
		Contingency		25	%
	Final Duration			0.8	MONTHS
	Final Duration			3.3	WEEKS
10.5	Contact Grouting			2,000	LF
		Diameter		15	FT
		Contact Grouting Area Percent		25	%
		Grout Volume		5,890	CF
		Production Rate	(1 crew)	450	CF/DAY
		Duration		0.6	MONTHS
		Contingency		25	%
	Final Duration			0.8	MONTHS
	Final Duration			3.3	WEEKS
10.6	Curtain Grouting				
		Assumed Grout Curtain Diameter		30	FT
		Grout Curtain Thickness		1	FT
		Penstock Diameter		15	FT
		Number of Penstocks		4	
		Volume of Grout		2,200	CF
		Production Rate		450	CF/DAY
		Duration		0.23	MONTHS
		Contingency		25	%
	Final Duration			0.28	MONTHS
	Final Duration			1.2	WEEKS

EQUIPMENT/TRUCKING

DUMP TRUCKS		18,900	TOTAL VOLUME, CY
		30	CY/TRUCK
		630	# OF TRUCKS FOR TASK
		13	LOADS/DAY (MAX.)
		1.0	CYCLE TIME (HRS)
		2	REQUIRED # OF TRUCKS
CONCRETE TRUCKS		5816	TOTAL VOLUME, CY
		8	CY/TRUCK
		727	# OF TRUCKS FOR TASK
		25	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		2	# OF TRUCKS
OFFSITE TRUCKS		3064	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		154	# OF TRUCKS
SEMIS		20	CY/TRUCK
		945	# OF TRUCKS FOR TASK
		20	TRUCKS/DAY

Assumptions:

Excavation Then Haul Offsite
Survey Control
Penstock & Draft Tube Manifolds:
Process: Drill, Blast, Excavate, Load, Haul, Dump, Load, Haul offsite; Shotcrete; Steel Lining, Concrete Lining, Contact Grouting, Curtain Grouting.
Equipment: Track Drill, 1 Excavator, 2 FE Loaders, Dump Trucks, Semis, Water Truck, Support Truck.
Crew: 1 Driller, 2 Blasters, 3 Equip Opr., 2 survey, 2 DT Drivers, 1 Foreman, 1 Water Truck Driver, 1 Support Driver.
Steel Lining Crew: 2 Welders, 2 Steel Workers, 1 Equip Opr.
Shotcrete/Concrete/Grouting Crew: 1 Foreman, 4 Laborers, 2 CPT Drivers.
Schedule: Activities are additive.

21 First Stage Concrete

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		Approved		By	

EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	1
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	1
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	2
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	8
Daily Concrete Mixer Truck - 8 CY	25
Daily Semi Trailer Truck	

Crew	**Quantity**	
Blaster		
Carpenters		
Cement Finisher	2	
Driller		
Electricians		
Equipment Operators	1	
Grade Setter		
Foreman	1	
Labor Foreman	1	
Laborers	9	form work
Mechanics		
Painter		
Pile Driver		
Pipe Foreman		
Pipe Layer		
Plumber		
Rigger		
Survey/Rodmen		
Steel Worker	2	rebar
Steel Worker Foreman		
Truck Drivers	3	
Welder		

Total Crew Size	19
Monthly Labor Cost	$225,300

Duration: **5.5** **Months** **23.9** **Weeks**

CONSTANTS: 10 HR/DAY 216.25 HRS/MONTH

FIRST STAGE CONCRETE - MULTIPLE ITEMS
SCHEDULE

13.3-B	Machine Hall (El.-16,El.-12)		2,700	CY
	Production Rate	(1 crew)	200	CY/DAY
	Duration		0.6	MONTHS
	Contingency		25	%
	Final Duration		0.8	MONTHS
	Final Duration		3.4	WEEKS
13.3-C	Machine Hall (El.-12,El.+9)		10,100	CY
	Production Rate	(1 crew)	200	CY/DAY
	Duration		2.3	MONTHS
	Contingency		25	%
	Final Duration		2.9	MONTHS
	Final Duration		12.6	WEEKS
15.2-A	Roof & Wall Support Transformer Hall		44,300	SF
	Production Rate	(1 crew)	2,200	SF/DAY
	Duration		0.9	MONTHS
	Contingency		25	%
	Final Duration		1.2	MONTHS
	Final Duration		5.0	WEEKS
15.2-B	Roof & Wall Support Nishe Excavation		2,500	SF
	Production Rate	(1 crew)	500	SF/DAY
	Duration	(Low production - restricted work area)	0.2	MONTHS
	Contingency		25	%
	Final Duration		0.3	MONTHS
	Final Duration		1.3	WEEKS
15.2-C	Roof & Wall Support Cable Gallery		3,200	SF
	Production Rate	(1 crew)	500	SF/DAY
	Duration	(Low production - restricted work area)	0.30	MONTHS
	Contingency		25	%
	Final Duration		0.37	MONTHS
	Final Duration		1.6	WEEKS
15.2-D	Roof & Wall Support A/C Gallery		100	SF
	Production Rate	(1 crew)	500	SF/DAY
	Duration	(Low production - restricted work area)	0.01	MONTHS
	Contingency		25	%
	Final Duration		0.01	MONTHS
	Final Duration		0.1	WEEKS

EQUIPMENT/TRUCKING

OFFSITE TRUCKS		156	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		8	# OF TRUCKS
CONCRETE TRUCKS		13,264	TOTAL VOLUME, CY
		8	CY/TRUCK
		1,658	# OF TRUCKS FOR TASK
		25	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		2	# OF TRUCKS

Assumptions:

Process: Form, Pump, Finish.
Equipment: Concrete Trucks, Concrete Pump Trucks, 1 Water Truck, 1 Support Truck, Hoist Crane.
Crew: 1 Foreman, 1 Laborer Foreman, 8 Laborers, 2 Cement Finishers, 2 Steel Workers, 1 Water Truck Driver, 1 Support Driver, 2 CPT Drivers, 1 Crane Oper.
Schedule: Activities are additive.

23 Spiral Cases & Draft Tube

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Subject:	Eagle Mountain Construction Schedule and Equipment	Date	1/21/2009	By	NDM
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EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	1
Crane - 40 Ton	1
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	1
Total Offsite Flatbed/Semi Trucks	11
Daily Concrete Mixer Truck - 8 CY	1
Daily Semi Trailer Truck	

Duration:	**8.2**	**Months**	**35.3**	**Weeks**
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

13.4 Spiral Cases & Draft Tube Liners				
SCHEDULE				
13.4-A Draft Tube Steel Liner			220	TONS
	Assumed Unit Weight of Steel Liner		475	LBS/CF
	Average Draft Tube Diameter		10	FT
	Thickness		1.625	INCHES
	Unit Weight		1.0	TONS/FT
	Length		300	FT
	Production Rate	(1 crew)	5	LF/DAY
	Duration	(Very low production - very restricted work area)	2.8	MONTHS
	Contingency		25	%
Final Duration			3.5	MONTHS
Final Duration			15.0	WEEKS
10.5 Contact Grouting			8,100	CF
	Production Rate	(1 crew)	100	CF/DAY
	Duration	(Very low production - very restricted work area)	3.7	MONTHS
	Contingency		25	%
Final Duration			4.7	MONTHS
Final Duration			20.3	WEEKS
EQUIPMENT/TRUCKING				
CONCRETE TRUCKS			300	TOTAL VOLUME, CY
			8	CY/TRUCK
			38	# OF TRUCKS FOR TASK
			1	TRUCKS/DAY
OFFSITE TRUCKS			220	TOTAL WEIGHT, TONS
			20	TONS/TRUCK
			11	# OF TRUCKS

Assumptions:

Process: Steel Lining, Contact Grouting.
Equipment: Crane, Concrete Pump, Welder.
Steel Lining Crew: 1 Welders, 2 Steel Workers, 1 Equip Opr.
Grouting Crew: 1 Foreman, 2 Laborers, 1 CPT Drivers.
Schedule: Activities are additive.

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller (3)	
Electricians	
Equipment Operators	1
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	2
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	2
Steel Worker Foreman	
Truck Drivers	1
Welder	1

Total Crew Size	8
Monthly Labor Cost	$111,400

24 Pump Turbines and Generators

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EQUIPMENT	Quantity
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	1
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	1
Total Offsite Flatbed/Semi Trucks	8
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	2
Equipment Operators	1
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	
Welder	1

Total Crew Size	8
Monthly Labor Cost	$107,200

Duration:	**11.1**	**Months**	**48.0**	**Weeks**
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

14.0 TURBINES & GENERATORS SCHEDULE		
14.1 & .2 Install Water to Wire Package	4	EA
Production Rate	50	DAYS/EA
Duration	9.2	MONTHS
Contingency	20	%
Final Duration	11.1	MONTHS
Final Duration	48.0	WEEKS
EQUIPMENT/TRUCKING		
OFF SITE FLATBED SEMIS	0.5	UNITS/TRUCK
	8	# OF TRUCKS FOR TASK
	1	TRUCKS/DAY

Assumptions:

Equipment: Crane, Welder, Air Compressor (tools), Support Truck, Generator, Semis.

Installation Crew: 1 Welder, 2 Electricians, 1 Equip Opr., 1 Foreman, 2 Laborers, 1 Support Truck Driver.

25 Embed Spiral Case&Draft Tube

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EQUIPMENT	Quantity
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	1
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	3
Daily Concrete Mixer Truck - 8 CY	4
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	1
Driller	
Electricians	
Equipment Operators	
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	2
Welder	

Total Crew Size	7
Monthly Labor Cost	$79,600

Duration:	**8.7**	**Months**	**37.5**	**Weeks**	
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH	

13.0 MACHINE HALL SCHEDULE			
13.3-A Concrete Draft Tubes (El. -41,El. -16)		4,500	CY
Production Rate	(1 crew)	30	CY/DAY
Duration	(Very low production - very restricted work area)	6.9	MONTHS
Contingency		25	%
Final Duration		8.7	MONTHS
Final Duration		37.5	WEEKS
EQUIPMENT/TRUCKING			
OFFSITE TRUCKS		54	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		3	# OF TRUCKS
CONCRETE TRUCKS		4,500	TOTAL VOLUME, CY
		8	CY/TRUCK
		563	# OF TRUCKS FOR TASK
		4	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		1	# OF TRUCKS

Assumptions:

Process: Form, Pump, Finish.

Equipment: Concrete Trucks, Concrete Pump Truck, 1 Water Truck, 1 Support Truck.

Crew: 1 Foreman, 2 Laborers, 1 Cement Finisher, 1 Water Truck Driver, 1 Support Driver, 1 CPT Driver.

26 Install Mech. Equip.

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EQUIPMENT	Quantity
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	1
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	2
Total Offsite Flatbed/Semi Trucks	5
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	1
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	2
Steel Worker Foreman	
Truck Drivers	
Welder	2

Total Crew Size	9
Monthly Labor Cost	$128,600

Duration:	**6.0**	**Months**	**26.0**	**Weeks**
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

INSTALL MECHANICAL EQUIPMENT SCHEDULE			
13.8	96" Dia. Spherical Valve	4	EA
	Production Rate	20	DAYS/EA
	Duration	3.7	MONTHS
	Contingency	25	%
	Final Duration	4.6	MONTHS
	Final Duration	20.0	WEEKS
NA	350 Ton Bridge Crane	1.0	EA
	Production Rate	24	DAYS/EA
	Duration	1.1	MONTHS
	Contingency	25	%
	Final Duration	1.4	MONTHS
	Final Duration	6.0	WEEKS
EQUIPMENT/TRUCKING			
OFFSITE FLATBED SEMIS		1.0	UNITS/TRUCK
		5	# OF TRUCKS FOR TASK
		1	TRUCKS/DAY

Assumptions:

Equipment: Crane, Welder, Air Compressor (tools), Support Truck, Generator, Semis.

Installation Crew: 2 Welders, 2 Steel Workers, 1 Equip Opr., 1 Foreman, 2 Laborers, 1 Support Truck Driver.
Schedule: Activities are additive.

27 Install Elec. Equip.

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EQUIPMENT	Quantity
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	1
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	1
Total Offsite Flatbed/Semi Trucks	4
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	2
Equipment Operators	1
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	
Welder	1

Total Crew Size	8
Monthly Labor Cost	$107,200

Duration:	**6.0**	**Months**	**26.0**	**Weeks**
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

INSTALL ELECTRICAL EQUIPMENT SCHEDULE		
NA Install Electrical Equipment (1300 MW)	1,300	MW
Production Rate	60	MW/WEEK
Duration	5.0	MONTHS
Contingency	20	%
Final Duration	6.0	MONTHS
Final Duration	26.0	WEEKS

Assumptions:

Equipment: Forklift, Welder, Air Compressor (tools), Support Truck, Generator.

Installation Crew: 1 Welder, 2 Electricians, 1 Equip Opr., 1 Foreman, 2 Laborers, 1 Support Truck Driver.

28 Complete Concrete Work

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	1
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	1
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	10
Daily Concrete Mixer Truck - 8 CY	13
Daily Semi Trailer Truck	

Crew	**Quantity**	
Blaster		
Carpenters		
Cement Finisher	2	
Driller		
Electricians		
Equipment Operators	1	
Grade Setter		
Foreman	1	
Labor Foreman		
Laborers	5	
Mechanics		
Painter		
Pile Driver		
Pipe Foreman		
Pipe Layer		
Plumber		
Rigger		
Survey/Rodmen	2	
Steel Worker	2	rebar
Steel Worker Foreman		
Truck Drivers	2	
Welder		

Total Crew Size	15
Monthly Labor Cost	$187,200

Duration:	**9.3**	**Months**	**40.3**	**Weeks**
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

COMPLETE CONCRETE WORK (2ND STAGE) - MULTIPLE ITEMS SCHEDULE

13.3-D	Machine Hall (El.9,El.19)			1,100	CY
		Production Rate	(1 crew)	100	CY/DAY
		Duration	(Half Production - Detailed Finishing)	0.5	MONTHS
		Contingency		25	%
	Final Duration			0.6	MONTHS
	Final Duration			2.8	WEEKS
13.3-E	Machine Hall (El.19,El.21)			1,900	CY
		Production Rate	(1 crew)	100	CY/DAY
		Duration	(Half Production - Detailed Finishing)	0.9	MONTHS
		Contingency		25	%
	Final Duration			1.1	MONTHS
	Final Duration			4.8	WEEKS
13.3-F	Machine Hall Slab (El.38)			1,000	CY
		Production Rate	(1 crew)	100	CY/DAY
		Duration	(Half Production - Detailed Finishing)	0.5	MONTHS
		Contingency		25	%
	Final Duration			0.6	MONTHS
	Final Duration			2.5	WEEKS
13.3-G	Machine Hall Walls (El.9,El.18)			500	CY
		Production Rate	(1 crew)	100	CY/DAY
		Duration	(Half Production - Detailed Finishing)	0.2	MONTHS
		Contingency		25	%
	Final Duration			0.3	MONTHS
	Final Duration			1.3	WEEKS
13.3-H	Machine Hall Walls (El.18,El.85)			5,100	CY
		Production Rate	(1 crew)	100	CY/DAY
		Duration	(Half Production - Detailed Finishing)	2.4	MONTHS
		Contingency		25	%
	Final Duration			2.9	MONTHS
	Final Duration			12.8	WEEKS
13.3-I	Machine Hall Roof			2,600	CY
		Production Rate	(1 crew)	100	CY/DAY
		Duration	(Half Production - Detailed Finishing)	1.2	MONTHS
		Contingency		25	%
	Final Duration			1.5	MONTHS
	Final Duration			6.5	WEEKS
15.3	Transformer Hall Concrete Works			3,900	CY
		Production Rate	(1 crew)	100	CY/DAY
		Duration	(Half Production - Detailed Finishing)	1.8	MONTHS
		Contingency		25	%
	Final Duration			2.3	MONTHS
	Final Duration			9.8	WEEKS

EQUIPMENT/TRUCKING

OFFSITE TRUCKS		193	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		10	# OF TRUCKS
CONCRETE TRUCKS		16,100	TOTAL VOLUME, CY
		8	CY/TRUCK
		2,013	# OF TRUCKS FOR TASK
		13	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		1	# OF TRUCKS

Assumptions:

Process: Form, Pump, Finish.

Equipment: Concrete Trucks, Concrete Pump Truck, 1 Water Truck, 1 Support Truck, Hoist Crane.

Crew: 1 Foreman, 4 Laborers, 2 Cement Finishers, 2 Steel Workers, 1 Water Truck Driver, 1 Support Driver, 1 CPT Driver, 1 Crane Oper., 2 Survey

Schedule: Activities are additive.

29 Struc. & Archit. Construct.

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	1
Crane - 70 Ton	1
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	1
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	1
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	2
Front End Loader, Tracked	
Front End Loader, Wheeled	2
Fuel Truck / Support Truck	2
Generator - Diesel	2
Grout Pump/Plant	1
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	1
Water Truck	
Welder and Generator Set	1
Total Offsite Flatbed/Semi Trucks	43
Daily Concrete Mixer Truck - 8 CY	3
Daily Semi Trailer Truck	18

Crew	**Quantity**
Blaster	2
Carpenters	4
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	4
Grade Setter	
Foreman	2
Labor Foreman	
Laborers	5
Mechanics	1
Painter	2
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	2
Rigger	
Survey/Rodmen	2
Steel Worker	2
Steel Worker Foreman	
Truck Drivers	2
Welder	1

Total Crew Size	30
Monthly Labor Cost	$390,100

Duration: **13.1** **Months** **64.5** **Weeks**

CONSTANTS: 10 HR/DAY 216.25 HRS/MONTH

STRUCTURAL & ARCHITECTURAL CONSTRUCTION SCHEDULE			
NA	Structural & Architectural Construction		
	Machine Hall Volume	144,000	CY
	Transformer Hall Volume	27,300	CY
	Total Struc. & Arch. Const. Volume	171,300	CY
	Production Rate	1,000	CY/DAY
	Duration	7.9	MONTHS
	Contingency	25	%
	Final Duration	9.9	MONTHS
	Final Duration	42.8	WEEKS
13.5	Elevator Shaft Construction	1,250	LF
	Production Rate	50	LF/DAY
	Duration	1.2	MONTHS
	Contingency	25	%
	Final Duration	1.4	MONTHS
	Final Duration	6.3	WEEKS
13.6	Miscellaneous Metal Works - Machine Hall		
	Assumed Steel Weight	250	TONS
	Production Rate	20	TONS/DAY
	Duration	0.6	MONTHS
	Contingency	25	%
	Final Duration	0.7	MONTHS
	Final Duration	3.1	WEEKS
NA	Drainage Gallery Excavation - D&B	6,200	CY
	D&B Production Rate	200	CY/DAY
	Duration	1.4	MONTHS
	Contingency	25	%
	Final Duration	1.8	MONTHS
	Final Duration	7.8	WEEKS
13.7	Drainage Gallery S&A Construction Volume	6,200	CY
	Production Rate	1,000	CY/DAY
	Duration	0.3	MONTHS
	Contingency	25	%
	Final Duration	0.4	MONTHS
	Final Duration	1.6	WEEKS
13.6	Miscellaneous Steel - Transformer Hall		
	Assumed Steel Weight	240	TONS
	Production Rate	20	TONS/DAY
	Duration	0.6	MONTHS
	Contingency	25	%
	Final Duration	0.7	MONTHS
	Final Duration	3.0	WEEKS
EQUIPMENT/TRUCKING			
DUMP TRUCKS		6,200	TOTAL VOLUME, CY
		30	CY/TRUCK
		207	# OF TRUCKS FOR TASK
		7	LOADS/DAY (MAX.)
		1.0	CYCLE TIME (HRS)
		1	REQUIRED # OF TRUCKS
CONCRETE TRUCKS (Elevator Construction)		463	TOTAL VOLUME, CY
		8	CY/TRUCK
		58	# OF TRUCKS FOR TASK
		3	TRUCKS/DAY
OFFSITE FLATBED SEMIS (MISC. METAL)		490	TOTAL WEIGHT, TONS
		20	TONS/TRUCK
		25	# OF TRUCKS FOR TASK
		7	TRUCKS/DAY
OFFSITE FLATBED SEMIS (STRUCT. & ARCH. WORK)		355	TOTAL WEIGHT, TONS
(assume 1 ton of materials per 500 CY of Volume)		20	TONS/TRUCK
		18	# OF TRUCKS FOR TASK
		1	TRUCKS/DAY
SEMIS - DUMP		20	CY/TRUCK
		310	# OF TRUCKS FOR TASK
		10	TRUCKS/DAY

Assumptions:

Structural & Architectural work consists of interior walls (i.e. wood, alum., drywall, offices, restrooms, etc.)
Excavation Then Haul Offsite
Survey Control

Structural, Architectural, & Misc. Metal Work:

Equipment: Crane Hoist, Air Compressor, Generator, Flatbed Semis, Fork Lifts, Support Truck.
Crew: 1 Equip. Oper., 2 Foremans, 4 Carpenters, 4 Laborers, 2 Painters, 2 Plumbers, 1 Welder, 2 Steel Workers.

Elevator & Drainage Gallery Construction:

Process: Drill, Blast, Excavate, Crane Hoist, Load, Haul, Dump, Load, Haul offsite; Shotcrete.
Equipment: Track Drill, Excavator, Crane, FE Loader, Dump Truck, FE Loader, Semis; Grout Pump, Support Truck, Water Pump.
Crew: 1 Driller, 2 Blasters, 4 Equip Opr., 2 survey, 1 DT Driver; Shotecrete/Concrete: 2 Laborers, 1 Forman, 1 Support Driver.
Schedule: Activities are additive.

31 Elec. and Mech. Mobe

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EQUIPMENT	Quantity
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	1
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	1
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	1
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	1
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	1
Tunnel Rig (TBM)	
Water Pump, Diesel	1
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	1
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Duration:	**3.1**	Months	**13.4**	Weeks

NOTES:

Mobilization to include installing field offices, preparing staging area, minor road grading, temporary utility connections, security fencing, bringing equipment to site, prepartion of equipment, and lighting

Crew	Quantity
Blaster	
Carpenters	2
Cement Finisher	
Driller	
Electricians	2
Equipment Operators	5
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	1
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	1
Welder	

Total Crew Size	15
Monthly Labor Cost	$195,100

33 Complete Elec. Const.

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	1
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	2
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	2
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	5
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	4
Equipment Operators	1
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	2
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	
Welder	

Total Crew Size	8
Monthly Labor Cost	$109,600

Duration: **13.4** **Months** **57.9** **Weeks**

CONSTANTS: 10 HR/DAY 216.25 HRS/MONTH

COMPLETE ELECTRICAL CONSTRUCTION SCHEDULE			
NA	Complete Electrical Construction		
	Machine Hall Volume	144,000	CY
	Transformer Hall Volume	27,300	CY
	Total Electircal Const. Volume	171,300	CY
	Production Rate	800	CY/DAY
	Duration	9.9	MONTHS
	Contingency	25	%
	Final Duration	12.4	MONTHS
	Final Duration	53.5	WEEKS
13.5	Cable Shaft Electrical Construction	1,300	LF
	Production Rate	75	LF/DAY
	Duration	0.8	MONTHS
	Contingency	25	%
	Final Duration	1.0	MONTHS
	Final Duration	4.3	WEEKS

Assumptions:

Completing electrical work consists of wiring lighting, power outlets, controls systems, IT requirments, etc.
Equipment: Fork Lift, Air Compressor, Generator, Flatbed Trucks, Semis, Support Truck.
Crew: 1 Equip. Oper., 4 Electricians, 1 Foreman, 2 Laborers.

Schedule: Activities are additive.

34 Exc. Approach Channel Upper

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		Approved		By	

EQUIPMENT	**Quantity**	
On Site		
Air Compressor	1	
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled		
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5		
Dozer, D6		
Dozer, D8	2	
Dozer, D10		
Drill, Tracked	2	
Dump Truck, End Dump, 15 Ton		
Dump Truck, Off-Highway, 34 Ton	6	
Dump Truck, Semi-Trailer		
Excavator, 325	1	
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	2	
Fuel Truck / Support Truck	1	
Generator - Diesel		
Grout Pump/Plant		
Hydroseed Sprayer, Truck Mounted		
Grader, H14		
Pile Driver		
Pump Truck - Concrete		
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM)		
Water Pump, Diesel		
Water Truck	1	dust control
Welder and Generator Set		
Total Offsite Flatbed/Semi Trucks		
Daily Concrete Mixer Truck - 8 CY		
Daily Semi Trailer Truck	40	

Crew	**Quantity**
Blaster	4
Carpenters	
Cement Finisher	
Driller	2
Electricians	
Equipment Operators	5
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	2
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	7
Welder	

Total Crew Size	23
Monthly Labor Cost	$270,000

Duration:	**9.7**	Months	**41.8**	Weeks	
CONSTANTS:	10	HR/DAY		216.25	HRS/MONTH

UPPER RESERVOIR INTAKE APPROACH CHANNEL EXCAVATION SCHEDULE			
NA Excavate Approach Channel		376,250	CY
Excavator Hourly Production Rate		225	CY/HR
Assume: cycle time = 40 sec, 3.0 cy bucket, 83% eff.			
# of Excavators		1	
Production Rate		2,250	CY/DAY
Duration		7.7	MONTHS
Contingency		25	%
Final Duration		9.7	MONTHS
Final Duration		41.8	WEEKS
NA Approach Channel Rock Excavation (D&B) (20%)		75,250	CY
Production Rate	(2 crew)	800	CY/DAY
Duration		4.3	MONTHS
Contingency		25	%
Final Duration		5.4	MONTHS
Final Duration		23.5	WEEKS
EQUIPMENT/TRUCKING			
DUMP TRUCKS		376,250	TOTAL VOLUME, CY
		30	CY/TRUCK
		12,542	# OF TRUCKS FOR TASK
		75	LOADS/DAY (MAX.)
		0.75	CYCLE TIME (HRS)
		6	REQUIRED # OF TRUCKS
SEMIS		20	CY/TRUCK
		3,763	# OF TRUCKS FOR TASK
		40	TRUCKS/DAY

Assumptions:

Standard Excavation Haul & Dump Onsite
Rock Excavation Haul Offsite
Survey Control
Drilling and blast rock sections (~20%) while excavator works concurrently, therefore use maximum.

Upper Reservoir Approach Channel Excavation:

Process: Excavate, Load, Haul, Dump; Drill, Blast, Excavate, Load, Haul offsite.

Equipment: Track Drills, 1 Excavator, 2 Dozers, 2 FE Loaders, Dump Trucks, Semis, Water Truck, Support Truck.

Crew: 2 Drillers, 4 Blasters, 5 Equip Opr., 1 Laborer, 2 survey, 6 DT Drivers, 1 Foreman, 1 Water Truck Driver, 1 Support Driver.

Schedule: Activities are additive.

35 Construct Upper Res Dams

Client:	Eagle Crest Energy	Project	080473	Page	1
Subject:	Eagle Mountain Construction Schedule and Equipment	Date	1/21/2009	By	NDM
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EQUIPMENT	**Quantity**	
On Site		
Air Compressor	2	Tools
Backhoe / Front End Loader, Wheeled		
Backhoe, Tracked		
Chipper, Wood		
Compactor, Sheepsfoot, Self-Propelled		
Compactor, Vibratory, Self-Propelled	4	
Concrete Pump		
Crane - 40 Ton		
Crane - 70 Ton		
Dozer, D5	4	
Dozer, D6		
Dozer, D8		
Dozer, D10		
Drill, Tracked		
Dump Truck, End Dump, 15 Ton	5	
Dump Truck, Off-Highway, 34 Ton	4	
Dump Truck, Semi-Trailer		
Excavator, 325		
Forklift, Rough Terrain		
Front End Loader, Tracked		
Front End Loader, Wheeled	2	
Fuel Truck / Support Truck	2	
Generator - Diesel		
Grout Pump/Plant		
Hydroseed Sprayer, Truck Mounted		
Grader, H14	2	
Pile Driver		
Pump Truck - Concrete		
Powder Truck		
Scraper, Self-propelled, 21 CY		
Truck, Flatbed		
Tunnel Rig (TBM)		
Water Pump, Diesel		
Water Truck	2	
Welder and Generator Set		
Total Offsite Flatbed/Semi Trucks		
Daily Concrete Mixer Truck - 8 CY		
Daily Semi Trailer Truck		

Crew	**Quantity**	
Blaster		
Carpenters	4	form work
Cement Finisher		
Driller		
Electricians		
Equipment Operators	12	
Grade Setter		
Foreman	2	
Labor Foreman		
Laborers	6	
Mechanics	1	
Painter		
Pile Driver		
Pipe Foreman		
Pipe Layer		
Plumber		
Rigger		
Survey/Rodmen	2	
Steel Worker		
Steel Worker Foreman		
Truck Drivers	11	
Welder		

Total Crew Size	38
Monthly Labor Cost	$464,700

Duration:	**8.4**	Months	**36.4**	Weeks	
CONSTANTS:	10	HR/DAY		216.25	HRS/MONTH

4.0 UPPER RESERVOIR SADDLE DAMS **SCHEDULE**		
4.1 South Saddle Dam	218,400	CY
Production Rate	1,500	CY/DAY
Duration	6.7	MONTHS
Contingency	25	%
Final Duration	8.4	MONTHS
Final Duration	36.4	WEEKS
4.2 West Saddle Dam	72,100	CY
Production Rate	1,500	CY/DAY
Duration	2.2	MONTHS
Contingency	25	%
Final Duration	2.8	MONTHS
Final Duration	12.0	WEEKS
EQUIPMENT/TRUCKING		
DUMP TRUCKS (for aggregate material, 90%)	261,450	TOTAL VOLUME, CY
(End Dump 15 Ton)	15	CY/TRUCK
	17,430	# OF TRUCKS FOR TASK
	100	LOADS/DAY (MAX.)
(From processed material stockpile onsite, to batch plant)	0.50	CYCLE TIME (HRS)
	5	REQUIRED # OF TRUCKS
CONCRETE TRUCKS (assume 10% of material)	29,050	TOTAL VOLUME, CY
	8	CY/TRUCK
	3,631	# OF TRUCKS FOR TASK
	38	TRUCKS/DAY
DUMP TRUCKS RCC MATERIAL	290,500	TOTAL VOLUME, CY
(End Dump 34 Ton)	30	CY/TRUCK
	9,683	# OF TRUCKS FOR TASK
	100	LOADS/DAY (MAX.)
(From batch plant to dam site)	0.33	CYCLE TIME (HRS)
	4	REQUIRED # OF TRUCKS

Assumptions:

South and West dams will be constructed concurrently, therefore, equipment and labor is additive for this task.
Survey Control
Upper Reservoir Dams:
Process: Haul Materials, Mix Batch, Haul to Dam Site, Place, Spread, Vibrotory Compaction.
Equipment: Dump Trucks (15,34 ton), 2 FE Loaders, 4 Dozers, 2 Graders, 4 Compactors, Water Trucks, Support Trucks.
Crew: 12 Equip Opr., 4 Laborers, 4 Carpenters, 2 survey, 9 DT Drivers, 2 Foreman, 2 Water Truck Driver, 2 Support Driver, 1 Mechanics.
Schedule: Activities are additive.

36 Move Unstable Soil LR

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Subject:	Eagle Mountain Construction Schedule and Equipment	Date	1/21/2009	By	NDM
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EQUIPMENT	Quantity
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	2
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	5
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	1
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	6
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	4
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	6
Welder	

Total Crew Size	19
Monthly Labor Cost	$227,700

Duration:	**12.7**	Months	**55.1**	Weeks	
CONSTANTS:	10	HR/DAY		216.25	HRS/MONTH

MOVE UNSTABLE SOIL - LOWER RESERVOIR SCHEDULE		
16.1 Platform Excavation	661,000	CY
Excavator Hourly Production Rate	300	CY/HR
Assume: cycle time = 30 sec, 3.0 cy bucket, 83% eff.		
# of Excavators	1	
Production Rate	3,000	CY/DAY
Duration	10.2	MONTHS
Contingency	25	%
Final Duration	12.7	MONTHS
Final Duration	55.1	WEEKS
EQUIPMENT/TRUCKING		
DUMP TRUCKS	330,500	TOTAL VOLUME, CY
(assume 50% moved by trucks, 50% moved by equipment)	30	CY/TRUCK
	11,017	# OF TRUCKS FOR TASK
	100	LOADS/DAY (MAX.)
	0.50	CYCLE TIME (HRS)
	5	REQUIRED # OF TRUCKS

Assumptions:

Standard Excavation Haul & Dump Onsite

Survey Control

50% of material moved by Dozers & Loaders, other 50% loaded onto dump trucks and hauled to onsite location.

Move Unstable Soil Lower Reservoir:

Process: Excavate, Load, Haul, Dump.

Equipment: 1 Excavator, 1 Grader, 2 Dozers, 2 FE Loaders, Dump Trucks, Water Truck, Support Truck.

Crew: 6 Equip Opr., 3 Laborers, 2 survey, 5 DT Drivers, 1 Foreman, 1 Water Truck Driver, 1 Support Driver.

37 Line Upper Res.

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EQUIPMENT	Quantity
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	1
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	1
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	10
Dump Truck, Semi-Trailer	
Excavator, 325	2
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	2
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	6
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	11
Welder	

Total Crew Size	23
Monthly Labor Cost	$270,300

Duration:	**3.7**	Months	**27.4**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

LINE UPPER RESERVOIR SCHEDULE			
NA	Upper Reservoir Lining (Bottom 3rd of reservoir)	385,587	SY
	Lining Depth	3	FT
	Total Lining Volume	385,587	CY
	Excavator Hourly Production Rate	300	CY/HR
	Assume: cycle time = 30 sec, 3.0 cy bucket, 83% eff.		
	# of Excavators	2	
	Production Rate	6,000	CY/DAY
	Duration	3.0	MONTHS
	Contingency	25	%
	Final Duration	3.7	MONTHS
	Final Duration	16.1	WEEKS
NA	Compaction of Upper Reservoir Lining	385,587	SY
	Compactor Hourly Production Rate	847	CY/HR
	Assume: Drum Width = 84", Lift = 12", Passes = 6, V = 4mph		
	# of Compactors	1	
	Production Rate	8,470	CY/DAY
	Duration	2.1	MONTHS
	Contingency	25	%
	Final Duration	2.6	MONTHS
	Final Duration	11.4	WEEKS
EQUIPMENT/TRUCKING			
DUMP TRUCKS		385,587	TOTAL VOLUME, CY
		30	CY/TRUCK
		12,853	# OF TRUCKS FOR TASK
		200	LOADS/DAY (MAX.)
		0.50	CYCLE TIME (HRS)
		10	REQUIRED # OF TRUCKS

Assumptions:

Standard Excavation Haul & Dump Onsite
Survey Control
Line Upper Reservoir:
Process: Excavate, Load, Haul, Dump, Compact.
Equipment: 2 Excavators, 1 Dozer, 1 Compactor, 2 FE Loaders, Dump Trucks, Water Truck, Support Truck.
Crew: 6 Equip Opr., 2 Laborers, 10 DT Drivers, 1 Foreman, 1 Water Truck Driver, 1 Support Driver, 2 survey.

Schedule: Activities are additive.

38 Line Lower Res.

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	1
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	1
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	5
Dump Truck, Semi-Trailer	
Excavator, 325	2
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	2
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	6
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	6
Welder	

Total Crew Size	18
Monthly Labor Cost	$217,100

Duration:	**5.3**	Months	**38.9**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

LINE LOWER RESERVOIR SCHEDULE				
NA	Lower Reservoir Lining (Bottom half of reservoir)		546,920	SY
		Lining Depth	3	FT
		Total Lining Volume	546,920	CY
		Excavator Hourly Production Rate	300	CY/HR
		Assume: cycle time = 30 sec, 3.0 cy bucket, 83% eff.		
		# of Excavators	2	
		Production Rate	6,000	CY/DAY
		Duration	4.2	MONTHS
		Contingency	25	%
	Final Duration		5.3	MONTHS
	Final Duration		22.8	WEEKS
NA	Compaction of Upper Reservoir Lining		546,920	SY
		Compactor Hourly Production Rate	847	CY/HR
		Assume: Drum Width = 84", Lift = 12", Passes = 6, V = 4mph		
		# of Compactors	1	
		Production Rate	8,470	CY/DAY
		Duration	3.0	MONTHS
		Contingency	25	%
	Final Duration		3.7	MONTHS
	Final Duration		16.1	WEEKS

EQUIPMENT/TRUCKING		
DUMP TRUCKS	546,920	TOTAL VOLUME, CY
	30	CY/TRUCK
	18,231	# OF TRUCKS FOR TASK
	200	LOADS/DAY (MAX.)
	0.25	CYCLE TIME (HRS)
	5	REQUIRED # OF TRUCKS

Assumptions:

Standard Excavation Haul & Dump Onsite
Survey Control
Line Lower Reservoir:
Process: Excavate, Load, Haul, Dump, Compact.
Equipment: 2 Excavators, 1 Dozer, 1 Compactor, 2 FE Loaders, Dump Trucks, Water Truck, Support Truck.
Crew: 6 Equip Opr., 2 Laborers, 5 DT Drivers, 1 Foreman, 1 Water Truck Driver, 1 Support Driver, 2 survey.

Schedule: Activities are additive.

39 Construct IO Struc. Lower

Client:	Eagle Crest Energy	Project	080473	Page	1
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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	1
Dozer, D5	
Dozer, D6	
Dozer, D8	1
Dozer, D10	
Drill, Tracked	1
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	4
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	1
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	2
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	9
Daily Concrete Mixer Truck - 8 CY	25
Daily Semi Trailer Truck	20

Crew	**Quantity**
Blaster	2
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	4
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	9
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	7
Welder	

Total Crew Size	26
Monthly Labor Cost	$297,600

Duration:	**4.1**	Months	**17.8**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

CONSTRUCT LOWER I/O STRUCTURE SCHEDULE				
16.3	Intake Structure Excavation		13,900	CY
	Excavator Hourly Production Rate		225	CY/HR
	Assume: cycle time = 40 sec, 3.0 cy bucket, 83% eff.			
	# of Excavators		1	
	Production Rate		2,250	CY/DAY
	Duration		0.3	MONTHS
	Contingency		25	%
	Final Duration		0.4	MONTHS
	Final Duration		1.5	WEEKS
NA	Intake Structure Rock Excavation (D&B) (20%)		2,780	CY
	Production Rate	(1 crew)	400	CY/DAY
	Duration		0.3	MONTHS
	Contingency		25	%
	Final Duration		0.4	MONTHS
	Final Duration		1.7	WEEKS
16.2	Access Tunnel Portal Concrete		180	CY
	Production Rate	(1 crew)	200	CY/DAY
	Duration		0.0	MONTHS
	Contingency		25	%
	Final Duration		0.1	MONTHS
	Final Duration		0.2	WEEKS
16.4	Intake Structure Concrete		6,400	CY
	Production Rate	(1 crew)	200	CY/DAY
	Duration		1.5	MONTHS
	Contingency		25	%
	Final Duration		1.8	MONTHS
	Final Duration		8.0	WEEKS
16.5	Trashracks, Misc. Metals		100	TONS
	Assumed Unit Weight of Steel		475	LBS/CF
	Area		5,040	SQ FT
	Thickness		6	INCHES
	Percent Openings		85	%
	Unit Weight		35.6	LBS/SQ FT
	Production Rate		200	SQ FT/DAY
	Duration		1.2	MONTHS
	Contingency		25	%
	Final Duration		1.5	MONTHS
	Final Duration		6.3	WEEKS

EQUIPMENT/TRUCKING			
DUMP TRUCKS		13,900	TOTAL VOLUME, CY
		30	CY/TRUCK
		463	# OF TRUCKS FOR TASK
		75	LOADS/DAY (MAX.)
		0.50	CYCLE TIME (HRS)
		4	REQUIRED # OF TRUCKS
OFFSITE TRUCKS		179	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;		20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete		9	# OF TRUCKS
SEMIS		20	CY/TRUCK
		139	# OF TRUCKS FOR TASK
		20	TRUCKS/DAY
CONCRETE TRUCKS		6,580	TOTAL VOLUME, CY
		8	CY/TRUCK
		823	# OF TRUCKS FOR TASK
		25	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		2	# OF TRUCKS

Assumptions:

Standard Excavation Haul & Dump Onsite

Rock Excavation Haul Offsite

Survey Control

Lower Reservoir I/O Structure:

Process: Excavate, Load, Haul, Dump; Drill, Blast, Excavate, Load, Haul offsite.

Equipment: Track Drill, 1 Excavator, 1 Dozers, 1 FE Loader, Dump Trucks, Semis, CP Trucks, Water Truck, Support Truck, Crane.

Crew: 1 Driller, 2 Blasters, 4 Equip Opr., 8 Laborers, 2 survey, 4 DT Drivers, 1 Foreman, 1 Water Truck Driver, 2 CPT Drivers, 1 Support Driver.

Schedule: Activities are additive.

40 Construct IO Struc. Upper

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	1
Dozer, D5	
Dozer, D6	
Dozer, D8	1
Dozer, D10	
Drill, Tracked	1
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	5
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	1
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	2
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	25
Daily Semi Trailer Truck	20

Crew	**Quantity**
Blaster	2
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	4
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	9
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	8
Welder	

Total Crew Size	27
Monthly Labor Cost	$308,300

Duration:	**3.9**	Months	**16.8**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

CONSTRUCT UPPER I/O STRUCTURE					
SCHEDULE					
4.3.1	Intake Structure Excavation			12,000	CY
		Excavator Hourly Production Rate		299	CY/HR
		Assume: cycle time = 30 sec, 3.0 cy bucket, 83% eff.			
		# of Excavators		1	
		Production Rate		2,990	CY/DAY
		Duration		0.2	MONTHS
		Contingency		25	%
	Final Duration			0.2	MONTHS
	Final Duration			1.0	WEEKS
NA	Intake Structure Rock Excavation (D&B) (20%)			2,400	CY
		Production Rate	(1 crew)	400	CY/DAY
		Duration		0.3	MONTHS
		Contingency		25	%
	Final Duration			0.3	MONTHS
	Final Duration			1.5	WEEKS
4.3.2	Intake Structure Concrete			6,400	CY
		Production Rate	(1 crew)	200	CY/DAY
		Duration		1.5	MONTHS
		Contingency		25	%
	Final Duration			1.8	MONTHS
	Final Duration			8.0	WEEKS
16.5	Trashracks, Misc. Metals			100	TONS
		Assumed Unit Weight of Steel		475	LBS/CF
		Area		5,040	SQ FT
		Thickness		6	INCHES
		Percent Openings		85	%
		Unit Weight		35.6	LBS/SQ FT
		Production Rate		200	SQ FT/DAY
		Duration		1.2	MONTHS
		Contingency		25	%
	Final Duration			1.5	MONTHS
	Final Duration			6.3	WEEKS
EQUIPMENT/TRUCKING					
DUMP TRUCKS				12,000	TOTAL VOLUME, CY
				30	CY/TRUCK
				400	# OF TRUCKS FOR TASK
				100	LOADS/DAY (MAX.)
				0.50	CYCLE TIME (HRS)
				5	REQUIRED # OF TRUCKS
OFFSITE TRUCKS				177	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;				20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete				9	# OF TRUCKS
SEMIS				20	CY/TRUCK
				120	# OF TRUCKS FOR TASK
				20	TRUCKS/DAY
CONCRETE TRUCKS				6,400	TOTAL VOLUME, CY
				8	CY/TRUCK
				800	# OF TRUCKS FOR TASK
				25	TRUCKS/DAY
CONCRETE PUMP TRUCKS			(15 TRUCKS)-->	120	CY/DAY
				2	# OF TRUCKS

Assumptions:

Standard Excavation Haul & Dump Onsite

Rock Excavation Haul Offsite

Survey Control

Upper Reservoir I/O Structure:

Process: Excavate, Load, Haul, Dump; Drill, Blast, Excavate, Load, Haul offsite.

Equipment: Track Drill, 1 Excavator, 1 Dozers, 1 FE Loader, Dump Trucks, Semis, CP Trucks, Water Truck, Support Truck, Crane.

Crew: 1 Driller, 2 Blasters, 4 Equip Opr., 8 Laborers, 2 survey, 5 DT Drivers, 1 Foreman, 1 Water Truck Driver, 2 CPT Drivers, 1 Support Driver.

Schedule: Activities are additive.

41 Switchyard Exc.

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	1
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	5
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	1
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	3
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	3
Welder	

Total Crew Size	10
Monthly Labor Cost	$118,500

Duration:	**3.1**	Months	**13.3**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

SWITCHYARD EXCAVATION SCHEDULE				
NA	Switchyard Excavation		107,860	CY
		Excavation Depth	5	FT
		Excavator Hourly Production Rate	299	CY/HR
		Assume: cycle time = 30 sec, 3.0 cy bucket, 83% eff.		
		# of Excavators	1	
		Production Rate	2,988	CY/DAY
		Duration	1.7	MONTHS
		Contingency	25	%
	Final Duration		2.1	MONTHS
	Final Duration		9.0	WEEKS
NA	Transfer Station Grading		20,370	CY
		Production Rate	1,200	CY/DAY
		Duration	0.8	MONTHS
		Contingency	25	%
	Final Duration		1.0	MONTHS
	Final Duration		4.2	WEEKS

EQUIPMENT/TRUCKING		
DUMP TRUCKS	107,860	TOTAL VOLUME, CY
(Assume haul and dump onsite)	30	CY/TRUCK
	3,595	# OF TRUCKS FOR TASK
	100	LOADS/DAY (MAX.)
	0.50	CYCLE TIME (HRS)
	5	REQUIRED # OF TRUCKS

Assumptions:

Standard Excavation Haul & Dump Onsite

Upper Reservoir I/O Structure:

Process: Excavate, Load, Haul, Dump, Grading.

Equipment: 1 Excavator, 1 Dozers, 1 FE Loader, Dump Trucks, Water Truck, Support Truck.

Crew: 3 Equip Opr., 2 Laborers, 5 DT Drivers, 1 Foreman, 1 Water Truck Driver, 1 Support Driver.

Schedule: Activities are additive.

42 Switchyard Foundations

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	1
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	1
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	1
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	5
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	1
Pile Driver	
Pump Truck - Concrete	1
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	1
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	1
Daily Concrete Mixer Truck - 8 CY	2
Daily Semi Trailer Truck	

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	3
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	3
Welder	

Total Crew Size	11
Monthly Labor Cost	$129,100

Duration:	**4.1**	Months	**17.6**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

SWITCHYARD FOUNDATIONS
SCHEDULE

NA	Switchyard Foundations (assume peirs)		
	Foundations Area (assume 5% of area)	27,500	SQ FT
	Area per peir	50	SQ FT
	Peir Depth	30	FT
	Peir Diameter	1	FT
	Number of Peirs	552	#
	Production Rate	10	PEIRS/DAY
	Duration	2.6	MONTHS
	Contingency	25	%
	Final Duration	3.2	MONTHS
	Final Duration	13.8	WEEKS
NA	Gravel Base Placement	10,185	CY
	Production Rate	1,500	CY/DAY
	Duration	0.3	MONTHS
	Contingency	25	%
	Final Duration	0.4	MONTHS
	Final Duration	1.7	WEEKS
NA	Compaction of Gravel Base (assume 3' thick)	10,185	CY
	Compactor Hourly Production Rate	120	CY/HR
	Assume: Drum Width = 50", Lift = 4", Passes = 6, V = 4mph		
	# of Compactors	1	
	Production Rate	1,204	CY/DAY
	Duration	0.4	MONTHS
	Contingency	25	%
	Final Duration	0.5	MONTHS
	Final Duration	2.1	WEEKS

EQUIPMENT/TRUCKING

DUMP TRUCKS (gravel base)	10,185	TOTAL VOLUME, CY
	30	CY/TRUCK
	340	# OF TRUCKS FOR TASK
	50	LOADS/DAY (MAX.)
	1.0	CYCLE TIME (HRS)
	5	REQUIRED # OF TRUCKS
OFFSITE TRUCKS	6	TOTAL WEIGHT, TONS
Assume 2lbs/ft of rebar/rockbolts; 12ft of rebar/c.y. of conc;	20	TONS/TRUCK
1lbs of reinforcment/s.y. of shotcrete	1	# OF TRUCKS
CONCRETE TRUCKS	482	TOTAL VOLUME, CY
	8	CY/TRUCK
	60	# OF TRUCKS FOR TASK
	2	TRUCKS/DAY
CONCRETE PUMP TRUCKS (15 TRUCKS)-->	120	CY/DAY
	1	# OF TRUCKS

Assumptions:

Process: Drill and Pour Peirs, Place Gravel Base, Compact Gravel Base.

Equipment: 1 Track Drill, 1 Dozer, 1 Grader, 1 Vibro. Compactor, Dump Trucks, Conc. Pump Truck, Water Truck, Support Truck.

Crew: 1 Driller, 3 Equip Opr., 2 Laborers, 5 DT Driver, 1 Foreman, 1 Water Truck Driver, 2 CPT Driver, 1 Support Driver.

Schedule: Activities are additive.

43 Switchyard Structures

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EQUIPMENT	Quantity
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	1
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	1
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	2
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	1
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	1
Total Offsite Flatbed/Semi Trucks	10
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Duration:	**1.5**	Months	**6.4**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

SWITCHYARD STRUCTURES SCHEDULE

NA	Switchyard Large Structures			
		Number of Structures	6	#
		Assumed Structure Height	100	FT
		Production Rate	50	FT/DAY
		Duration	0.6	MONTHS
		Contingency	25	%
	Final Duration		0.7	MONTHS
	Final Duration		3.0	WEEKS
NA	Switchyard Small Structures			
		Number of Structures	6	#
		Assumed Structure Height	30	FT
		Production Rate	50	FT/DAY
		Duration	0.2	MONTHS
		Contingency	25	%
	Final Duration		0.2	MONTHS
	Final Duration		0.9	WEEKS
15.5-C	Switchyard Fencing		3,200	LF
		Production Rate	300	LF/DAY
		Duration	0.5	MONTHS
		Contingency	15	%
	Final Duration		0.6	MONTHS
	Final Duration		2.5	WEEKS

Assumptions:

Equipment: 1 Crane, 1 Flatbed Truck, 2 Support Trucks, 1 Forklift, Generator, Welder.
Crew: 1 Crane Opr., 1 Equip. Opr., 2 Laborers, 2 Steel Workers, 1 Foreman, 2 Welders.
Schedule: Activities are additive.

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	2
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	2
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	2
Steel Worker Foreman	
Truck Drivers	
Welder	2

Total Crew Size	9
Monthly Labor Cost	$131,500

44 Trans. Line Foundations

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	1
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	1
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	1
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	1
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	24
Daily Concrete Mixer Truck - 8 CY	7
Daily Semi Trailer Truck	

Duration:	**4.6**	Months	**20.0**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

TRANSMISSION LINE FOUNDATIONS SCHEDULE

NA	Transmission Line Foundations - Concrete		
	Line Length	10	MILES
	Assumed Structures/Mile	8	#/MILE
	Peirs Per Structure	4	#/STRUCTURE
	Total # of Peirs	320	#
	Estimated Length of Peirs	50	FT
	Peir Diameter	3	FT
	Total Volume	4,189	CY
	Production Rate	4	PEIRS/DAY
	Duration	3.7	MONTHS
	Contingency	25	%
	Final Duration	4.6	MONTHS
	Final Duration	20.0	WEEKS
NA	Transmission Line Foundations - Steel		
	Total # of Peirs	320	#
	Estimated Length of Peirs	50	FT
	Peir Diameter	3	FT
	# of Bars/Sq. ft	5	#/SQ FT
	Bar Size	6	#
	Bar Weight Per Foot	1.5	LBS/FT
	Shear Reinforcement Bar Size	4	#
	Shear Reinforcement Weight Per Foot	0.67	LBS/FT
	Total Weight	475	TONS

EQUIPMENT/TRUCKING

CONCRETE TRUCKS		4,189	TOTAL VOLUME, CY
		8	CY/TRUCK
		524	# OF TRUCKS FOR TASK
		7	TRUCKS/DAY
CONCRETE PUMP TRUCKS	(15 TRUCKS)-->	120	CY/DAY
		1	# OF TRUCKS
OFFSITE FLATBED SEMIS (reinforcement)		20	TONS/TRUCK
		24	# OF TRUCKS FOR TASK
		1	TRUCKS/DAY

Assumptions:

Process: Drill Peirs, Place Steel, Pour Concrete, Finish Work.

Equipment: 1 Tracked Drill, 1 Front End Loader, 1 Crane, 1 Flatbed Truck, 1 Support Truck, 1 Conc. Pump Truck.

Crew: 3 Equip. Opr., 2 Laborers, 2 Steel Workers, 1 Foreman, 1 CPT Driver.

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	1
Electricians	
Equipment Operators	3
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	2
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	2
Steel Worker Foreman	
Truck Drivers	1
Welder	

Total Crew Size	10
Monthly Labor Cost	$131,700

45 Trans. line stringing

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EQUIPMENT	Quantity
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	2
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	1
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	2
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	1
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Duration:	**4.0**	Months	**17.2**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

TRANSMISSION LINE STRINGING SCHEDULE

NA Transmission Line Stringing			
	Transmission Line Length	10	MILES
	# of Lines	8	#
	Sag Factor	1.30	
	Total Line Length	549,200	FT
	Production Rate	8,000	FT/DAY
	Duration	3.2	MONTHS
	Contingency	25	%
Final Duration		4.0	MONTHS
Final Duration		17.2	WEEKS

Assumptions:

Equipment: 2 Cranes, 1 Flatbed Truck, 2 Support Truck, 1 Forklift.
Crew: 3 Equip. Opr., 3 Laborers, 1 Foreman.

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	3
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	
Welder	

Total Crew Size	7
Monthly Labor Cost	$86,600

46 Trans. line structures

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	2
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	1
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	2
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	1
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	2
Total Offsite Flatbed/Semi Trucks	160
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	2

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	3
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	2
Steel Worker Foreman	1
Truck Drivers	
Welder	2

Total Crew Size	12
Monthly Labor Cost	$173,600

Duration:	**5.8**	Months	**25.0**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

TRANSMISSION LINE STRUCTURES SCHEDULE		
NA Transmission Line Structures		
Line Length	10	MILES
Assumed Structures/Mile	8	#/MILE
Total # of Structures	80	#
Assumed Structure Weight	40	TONS
Total Steel Weight	3,200	TONS
Production Rate	0.8	STRUCTURES/DAY
Duration	4.6	MONTHS
Contingency	25	%
Final Duration	5.8	MONTHS
Final Duration	25.0	WEEKS
EQUIPMENT/TRUCKING		
OFFSITE FLATBED SEMIS	20	TONS/TRUCK
	160	# OF TRUCKS FOR TASK
	2	TRUCKS/DAY

Assumptions:

Process: Deliver Steel, Cut, Bolt, and Erect Steel Structure.
Equipment: 2 Cranes, 1 Flatbed Truck, 2 Support Truck, 1 Forklift, 1 Air compressor, 2 Generator/Welder Set.

Crew: 3 Equip. Opr., 3 Laborers, 2 Steel Workers, 2 Welders, 1 Steel Foreman, 1 Foreman.

47 Inst. H2O Supply Pipe & RO S

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	1
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	1
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	5
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	1
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	1
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	1
Total Offsite Flatbed/Semi Trucks	208
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	4
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	3
Mechanics	
Painter	
Pile Driver	
Pipe Foreman	1
Pipe Layer	2
Plumber	
Rigger	
Survey/Rodmen	2
Steel Worker	
Steel Worker Foreman	
Truck Drivers	6
Welder	

Total Crew Size	19
Monthly Labor Cost	$233,600

Duration:	**6.7**	Months	**29.2**	Weeks
CONSTANTS:	10	HR/DAY	216.25	HRS/MONTH

INSTALL WATER SUPPLY LINE SCHEDULE				
NA	Pipeline Excavation			
		Excavation Length	75,000	FT
		Excavation Unit Volume	1.6	CY/FT
		(assume 30 Steel pipe, 10,000 gpm, 3' Backfill)		
		Excavation Total Volume	120,000	CY
		Excavator Hourly Production Rate	200	LCY/HR
		# of Excavators	1	
		Production Rate	2,000	CY/DAY
		Duration	2.8	MONTHS
		Contingency	25	%
	Final Duration		3.5	MONTHS
	Final Duration		15.0	WEEKS
NA	Pipeline Bedding Material (25% of Backfill)		25,500	CY
		Production Rate	1,000	CY/DAY
		Duration	1.2	MONTHS
		Contingency	25	%
	Final Duration		1.5	MONTHS
	Final Duration		6.4	WEEKS
	Lag from Excavation		2.0	WEEKS
	Maximum Duration		8.4	WEEKS
NA	Pipeline Installation		75,000	FT
		Production Rate	1,000	FT/DAY
		Duration	3.5	MONTHS
		Contingency	25	%
	Final Duration		4.3	MONTHS
	Final Duration		18.8	WEEKS
	Lag from Excavation		4.0	WEEKS
	Maximum Duration		22.8	WEEKS
NA	Compaction Pipeline (85% of Exc.)		102,000	CY
		Compactor Hourly Production Rate	120	CY/HR
		Assume: Drum Width = 50", Lift = 4", Passes = 6, V = 4mph		
		# of Compactors	1	
		Production Rate	1,204	CY/DAY
		Duration	3.9	MONTHS
		Contingency	25	%
	Final Duration		4.9	MONTHS
	Final Duration		21.2	WEEKS
	Lag from Installation		4.0	WEEKS
	Maximum Duration (incl. this lag + install lag)		29.2	WEEKS

EQUIPMENT/TRUCKING		
DUMP TRUCKS (bedding material onsite)	25,500	TOTAL VOLUME, CY
(Assume bedding material is 25% of backfill)	15	CY/TRUCK
	1,700	# OF TRUCKS FOR TASK
	80	LOADS/DAY (MAX.)
	0.50	CYCLE TIME (HRS)
	5	REQUIRED # OF TRUCKS
OFFSITE SEMIS (pipe material)	360	LF/TRUCK
(Assume 40' sticks, 9 per truck)	208	# OF TRUCKS FOR TASK
	3	TRUCKS/DAY

Assumptions:

Upper Reservoir I/O Structure:

Process: Excavate, Place Bedding, Install Pipe, Backfill, Compact.

Equipment: 1 Excavator, 1 Dozers, 1 FE Loader, 1 Sheepsfoot Compactor, Dump Trucks, Water Truck, Support Truck, Welder.

Crew: 4 Equip Opr., 2 Laborers, 5 DT Drivers, 1 Foreman, 1 Water Truck Driver, 1 Support Driver, 1 Pipe Forman, 2 Pipe Layers, 2 Survey.

Schedule: Activities are additive.

48 Reservoir Filling

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	1
Generator - Diesel	
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Duration:	**48.0**	Months	**207.6**	Weeks
CONSTANTS:	20	HR/DAY	216.25	HRS/MONTH

RESERVOIR FILLING SCHEDULE			
NA	Reservoir Filling		
	Reservoirs Active Storage	17,700	AC-FT
	Upper Reservoir Inactive Storage	2,300	AC-FT
	Lower Reservoir Inactive Storage	4,200	AC-FT
	Total Storage	24,200	AC-FT
	Annual Seepage	1,628	AC-FT
	Annual Evaporation	1,763	AC-FT
	Pumping Rate	6,000	GPM
	Final Duration **(From Reservoir Filling Calculations, attached)**	48.0	MONTHS
	Final Duration	207.6	WEEKS

Assumptions:

Equipment: Support Truck.

Crew: 1 Equip Opr., 1 Laborer, 1 Mechanic.

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	
Equipment Operators	1
Grade Setter	
Foreman	
Labor Foreman	
Laborers	1
Mechanics	1
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	
Welder	

Total Crew Size	3
Monthly Labor Cost	$38,000

49 U 1 START

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Duration:	**3.1**	Months	**13.4**	Weeks	
CONSTANTS:	10	HR/DAY		216.25	HRS/MONTH

UNIT 1 START-UP

Assumptions:
Process: Start-up involves inspections and testing of all electrical and mechanical equipment prior to unit initiation.
Equipment: Air Compressor, Generator.
Crew: 3 Electricians, 3 Mechanics, 1 Foreman.

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	3
Equipment Operators	
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	
Mechanics	3
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	
Welder	

Total Crew Size	7
Monthly Labor Cost	$101,500

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EQUIPMENT	**Quantity**
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Duration:	**2.8**	Months	**12.0**	Weeks	
CONSTANTS:	10	HR/DAY		216.25	HRS/MONTH

UNIT 2 START-UP

Assumptions:

Process: Start-up involves inspections and testing of all electrical and mechanical equipment prior to unit initiation.

Equipment: Air Compressor, Generator.

Crew: 3 Electricians, 3 Mechanics, 1 Foreman.

Crew	**Quantity**
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	3
Equipment Operators	
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	
Mechanics	3
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	
Welder	

Total Crew Size	7
Monthly Labor Cost	$101,500

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EQUIPMENT	Quantity
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	3
Equipment Operators	
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	
Mechanics	3
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	
Welder	

Total Crew Size	7
Monthly Labor Cost	$101,500

Duration:	**2.8**	Months	**12.0**	Weeks	
CONSTANTS:	10	HR/DAY		216.25	HRS/MONTH

UNIT 3 START-UP

Assumptions:

Process: Start-up involves inspections and testing of all electrical and mechanical equipment prior to unit initiation.

Equipment: Air Compressor, Generator.

Crew: 3 Electricians, 3 Mechanics, 1 Foreman.

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EQUIPMENT	Quantity
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	3
Equipment Operators	
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	
Mechanics	3
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	
Truck Drivers	
Welder	

Total Crew Size	7
Monthly Labor Cost	$101,500

Duration:	**2.8**	Months	**12.0**	Weeks	
CONSTANTS:	10	HR/DAY		216.25	HRS/MONTH

UNIT 4 START-UP

Assumptions:

Process: Start-up involves inspections and testing of all electrical and mechanical equipment prior to unit initiation.

Equipment: Air Compressor, Generator.

Crew: 3 Electricians, 3 Mechanics, 1 Foreman.

57 FINSIH PROJECT

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Duration: **2.8** Months **12.0** Weeks

CONSTANTS: 10 HR/DAY 216.25 HRS/MONTH

FINISH PROJECT

Assumptions:

Finish Project involves final inspections and testing of all major electrical and mechanical equipment, final tunnel and I/O structures inspections, and all other ancillary structures and equipment inspections and testing.
Equipment: 3 Support Trucks, Air Compressor, Generator.
Crew: 3 Electricians, 3 Mechanics, 1 Steel Worker Foreman, 2 Laborers, 1 Foreman.

EQUIPMENT	Quantity
On Site	
Air Compressor	1
Backhoe / Front End Loader, Wheeled	
Backhoe, Tracked	
Chipper, Wood	
Compactor, Sheepsfoot, Self-Propelled	
Compactor, Vibratory, Self-Propelled	
Concrete Pump	
Crane - 40 Ton	
Crane - 70 Ton	
Dozer, D5	
Dozer, D6	
Dozer, D8	
Dozer, D10	
Drill, Tracked	
Dump Truck, End Dump, 15 Ton	
Dump Truck, Off-Highway, 34 Ton	
Dump Truck, Semi-Trailer	
Excavator, 325	
Forklift, Rough Terrain	
Front End Loader, Tracked	
Front End Loader, Wheeled	
Fuel Truck / Support Truck	3
Generator - Diesel	1
Grout Pump/Plant	
Hydroseed Sprayer, Truck Mounted	
Grader, H14	
Pile Driver	
Pump Truck - Concrete	
Powder Truck	
Scraper, Self-propelled, 21 CY	
Truck, Flatbed	
Tunnel Rig (TBM)	
Water Pump, Diesel	
Water Truck	
Welder and Generator Set	
Total Offsite Flatbed/Semi Trucks	
Daily Concrete Mixer Truck - 8 CY	
Daily Semi Trailer Truck	

Crew	Quantity
Blaster	
Carpenters	
Cement Finisher	
Driller	
Electricians	3
Equipment Operators	
Grade Setter	
Foreman	1
Labor Foreman	
Laborers	2
Mechanics	3
Painter	
Pile Driver	
Pipe Foreman	
Pipe Layer	
Plumber	
Rigger	
Survey/Rodmen	
Steel Worker	
Steel Worker Foreman	1
Truck Drivers	
Welder	

Total Crew Size	10
Monthly Labor Cost	$140,700

GEI Consultants, Inc.
080473 Eagle Mountain Pumped Storage Project
Construction Schedule & Excavation Advancement Rates
1/20/2009
NDM

TBM Advancement Rates - Lookup Table

Type A	120	ft/day
Type B	95	ft/day
Type C	45	ft/day

D&B Advancement Rates - Lookup Table

D&B Rate Reduction Factor (%) =		**25**
Type A	37	ft/day
Type B	32	ft/day
Type C	17	ft/day

Upper Pressure Tunnel

Begin Sta. (ft)	End Sta. (ft)	Length (ft)	Rock Type (A, B, C)	Geologic Rock Description	Excavation Method (TBM, D&B)	Advancement Rate (ft/day)	Duration (days)	Cummulative Duration (days)
0	500	500	B	Granite	TBM	95	5	5
500	1500	1000	C	Quartzite	TBM	45	22	27
1500	2500	1000	C	Schistose meta-arkose	TBM	45	22	50
2500	3000	500	C	Quartzite	TBM	45	11	61
3000	4000	1000	C	Schistose meta-arkose	TBM	45	22	83
	Total =	4000 ft				**Total =**	83	16.7 weeks
						Contingency (%) =	25	
						Estimated Total Construction Duration =	104	20.8 weeks

Original Construction Schedule Estimate
Duration = 22.2 weeks
Length = 4000 ft
Advancement Rate = 36 ft/day

Calc. Advancement Rate = 39 ft/day

Vertical Shaft

Begin Sta. (ft)	End Sta. (ft)	Length (ft)	Rock Type (A, B, C)	Geologic Rock Description	Excavation Method (TBM, D&B)	Advancement Rate (ft/day)	Duration (days)	Cummulative Duration (days)
0	300	300	B	Granite	D&B	32	9	9
300	600	300	B	Granite	D&B	32	9	19
600	900	300	B	Granite	D&B	32	9	28
900	1200	300	C	Schistose meta-arkose	D&B	17	18	46
1200	1398	198	C	Schistose meta-arkose	D&B	17	12	58
	Total =	1398 ft				**Total =**	58	11.6 weeks
						Contingency (%) =	50	
						Estimated Total Construction Duration =	87	17.4 weeks

Original Construction Schedule Estimate
Duration = 39.8 weeks
Length = 1398 ft
Advancement Rate = 7 ft/day

Calc. Advancement Rate = 16 ft/day

Lower Pressure Tunnel

Begin Sta. (ft)	End Sta. (ft)	Length (ft)	Rock Type (A, B, C)	Geologic Rock Description	Excavation Method (TBM, D&B)	Advancement Rate (ft/day)	Duration (days)	Cummulative Duration (days)
0	200	200	C	Granite	TBM	45	4	4
200	500	300	C	Quartz Monzonite	TBM	45	7	11
500	1000	500	C	Granite	TBM	45	11	22
1000	1200	200	C	Schistose meta-arkose	TBM	45	4	27
1200	1560	360	C	Schistose meta-arkose	TBM	45	8	35
	Total =	1560 ft				**Total =**	35	7 weeks
						Contingency (%) =	25	
						Estimated Total Construction Duration =	43	8.7 weeks

Original Construction Schedule Estimate
Duration = 32.6 weeks
Length = 1560 ft
Advancement Rate = 10 ft/day

Calc. Advancement Rate = 36 ft/day

GEI Consultants, Inc.
080473 Eagle Mountain Pumped Storage Project
Construction Schedule & Excavation Advancement Rates
1/20/2009
NDM

Penstocks & Draft Tubes

Begin Sta. (ft)	End Sta. (ft)	Length (ft)	Rock Type (A, B, C)	Geologic Rock Description	Excavation Method (TBM, D&B)	Advancement Rate (ft/day)	Duration (days)	Cummulative Duration (days)
0	350	350	C	Granite	D&B	17	21	21
350	850	500	C	Granite	D&B	17	30	51
850	1200	350	C	Granite	D&B	17	21	72
1200	1200	0	C	-	D&B	17	0	72
1200	1200	0	C	-	D&B	17	0	72
	Total =	1200 ft				**Total =**	72	14.4 weeks
						Contingency (%) =	50	
						Estimated Total Construction Duration =	108	21.6 weeks

Original Construction Schedule Estimate
Duration = 22.6 weeks
Length = 1200 ft
Advancement Rate = 11 ft/day

Calc. Advancement Rate = 11 ft/day

Tailrace Tunnel

Begin Sta. (ft)	End Sta. (ft)	Length (ft)	Rock Type (A, B, C)	Geologic Rock Description	Excavation Method (TBM, D&B)	Advancement Rate (ft/day)	Duration (days)	Cummulative Duration (days)
0	600	600	B	Granite	TBM	95	6	6
600	2500	1900	C	Quartz Monzonite	TBM	45	42	49
2500	4000	1500	B	Granite	TBM	95	16	64
4000	5000	1000	B	Schistose meta-arkose	TBM	95	11	75
5000	6835	1835	C	Schistose meta-arkose	TBM	45	41	116
	Total =	6835 ft				**Total =**	116	23.2 weeks
						Contingency (%) =	25	
						Estimated Total Construction Duration =	145	29 weeks

Original Construction Schedule Estimate
Duration = 31.2 weeks
Length = 6835 ft
Advancement Rate = 44 ft/day

Calc. Advancement Rate = 47 ft/day

Access Tunnel

Begin Sta. (ft)	End Sta. (ft)	Length (ft)	Rock Type (A, B, C)	Geologic Rock Description	Excavation Method (TBM, D&B)	Advancement Rate (ft/day)	Duration (days)	Cummulative Duration (days)
0	500	500	B	Granite	TBM	95	5	5
500	2000	1500	C	Quartz Monzonite	TBM	45	33	39
2000	4000	2000	C	Granite	TBM	45	44	83
4000	4500	500	B	Schistose meta-arkose	TBM	95	5	88
4500	6625	2125	C	Schistose meta-arkose	TBM	45	47	136
	Total =	6625 ft				**Total =**	136	27.2 weeks
						Contingency (%) =	25	
						Estimated Total Construction Duration =	169	33.9 weeks

Original Construction Schedule Estimate
Duration = 48.6 weeks
Length = 6625 ft
Advancement Rate = 27 ft/day

Calc. Advancement Rate = 39 ft/day

Cable Shaft

Begin Sta. (ft)	End Sta. (ft)	Length (ft)	Rock Type (A, B, C)	Geologic Rock Description	Excavation Method (TBM, D&B)	Advancement Rate (ft/day)	Duration (days)	Cummulative Duration (days)
0	500	500	B	Granite	D&B	32	16	16
500	1000	500	B	Quartz Monzonite	D&B	32	16	31
1000	1500	500	B	Granite	D&B	32	16	47
1500	2010	510	C	Schistose meta-arkose	D&B	17	30	77
2010	2010	0	C	-	D&B	17	0	77
	Total =	2010 ft				**Total =**	77	15.5 weeks
						Contingency (%) =	50	
						Estimated Total Construction Duration =	116	23.3 weeks

Original Construction Schedule Estimate
Duration = 26 weeks
Length = 2010 ft
Advancement Rate = 15 ft/day

Calc. Advancement Rate = 17 ft/day

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Tunnel Boring Maching Advancement Rates
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Average Advancment Rate	**120**	**ft/day**	**Equation**
Std. Dev. (rounded) =	**50**	**ft/day**	
Type A (std. TBM Exc.) =	120	ft/day	Average Value
Type B (CIP Liner Req'd) =	95	ft/day	Average Value - (1/2) Std. Dev.
Type C (Diff. Exc w/ Conc. Liner) =	45	ft/day	Average Value - (1.5) Std. Dev.

Assumptions:

Work days/week:	5
Work Hours/Day:	20

Diameter (ft)	Rock Type	Advancement Rate	Units	Advancement Rate (ft/day)	Source
16	A - Std. TBM Exc.	225	m/week	148	Hatch Mott MacDonald Tunnel Estimating Database spreadsheet, Appendix D of VLHC in Northern Illinios, Fermi National Accelerator Labs.
16	B - CIP Liner	195	m/week	128	
16	C - Difficult Exc. Conc Liner	102	m/week	67	
NA	NA	16	m/day	52	http://www-project.slac.stanford.edu/lc/local/documentation/pdf/TBM-
NA	Limestone	8.8	ft/hr	176	Peter J. Tarkoy, Predicting TBM Penetration Rates in Selected Rock Types, Figure 3, Plot of group averages, 1973.
	Shale & Siltstone	9.5	ft/hr	190	
	Sandstone	11.2	ft/hr	224	
	Orthoquartzite	5.2	ft/hr	104	
	Quartzite	3.6	ft/hr	72	
NA	Schist	3.5	ft/hr	70	
					Projects Involving Robbins Equipment reported by TunnelBuilder.com,
11.5	Sandstone	55.0	m/day	180	Bolivia, Misicuni
16.2	Hardrock	28.8	m/day	94	China, Shanxi
13.3	NA	39.1	m/day	128	Ecuador, Manabi
32.8	Hardrock	30.0	m/day	98	New Zealand, Manapouri
18.7	NA	38.0	m/day	125	Peru, Chinango
18.2	Limestone	57.2	m/day	188	United States, Illinios
10.4	Sandstone, shale	58.1	m/day	191	United States, Colorado, Plateau Creek
11	Sandstones	50	ft/day	50	Jacobs Associates. Beatriz Reservoir Intake Tunnel, Tunnel Feasibility
NA	Quartzite	20	m/day	66	EM 1110-2-2901, May 30, 1997, Low values used of Drilling Rate Index range given in Table C-10.
NA	Basalt	30	m/day	98	
NA	Gneiss	30	m/day	98	
NA	Mica Gneiss/Coarse Granite	30	m/day	98	
NA	Schist/Phyllite	35	m/day	115	
NA	Med/Fine Granite	30	m/day	98	
NA	Limestone	50	m/day	164	
NA	Shale	55	m/day	180	
NA	Sandstone	45	m/day	148	
NA	Siltstone	60	m/day	197	

PROJECT FEATURES
& COSTS

Item	Description	Unit	Quantity	Unit Cost	Cost	
1	**CONSTRUCTION AND ACCESS ROADS**					
	1.1 Construction Road to Saddle Dams*	LF	13,800	$95	1,306,800	
	1.2 Road from South Dam to Intake Platform*	LF	1,800	$95	170,500	
	1.3 Road from intake platform down to Channel	LF	2,000	$95	189,400	
	1.4 Road from South Dam to Power Tunnel Portal Const.	LF	10,100	$95	956,400	
	1.5 Extension to Cable, Elevator Shafts & Surge Tank	LF	4,400	$95	416,700	
	1.5 Access road to Lower Inlet Platform	LF	4,000	$95	378,800	
	1.6 Inlet Platform Down to Channel	LF	3,000	$95	284,100	
	* Existing unpaved mining road					**3,702,700**
2	**CONSTRUCTION TUNNELS**					
	2.1 To Machine Hall Roof	CY	2,900	$208	603,200	
	2.2 To Transformer Hall Roof	CY	1,700	$208	353,600	
	2.3 To Power Shaft Construction	CY	8,500	$208	1,768,000	
	2.4 To Tailrace Surge Tank Construction Access	CY	1,900	$208	395,200	
						3,120,000
3	**ACCESS TUNNELS**					
	3.1 Main Access Tunnel (6628')					
	3.1.1 Excavation	CY	192,500	$208	40,040,000	
	3.1.2 Prelining Shotcrete(w/wire-mesh)	SY	20,600	$109	2,245,400	
	3.1.3 Invert concrete	CY	6,900	$500	3,450,000	
	3.1.4 Rock anchors (15' long)	EA	5,000	$300	1,500,000	
	3.2 Drainage Gallery Access Tunnel (L=80')					
	3.2.1 Excavation	CY	800	$208	166,400	
	3.2.2 Invert Concrete	CY	10	$500	5,000	
	3.2.3 Prelining	SY	200	$72	14,400	
	3.3 Tailrace Rock Trap Access Tunnel (L = 100')	LF	100	$780	78,000	
						47,499,200
4	**UPPER RESERVOIR**					
	4.1 South Saddle Dam	CY	218,400	$100	21,840,000	
	4.2 West Saddle dam	CY	72,100	$100	7,210,000	
	4.3 Upper Reservoir Intake Structure					
	4.3.1 Excavation	CY	12,000	$25	300,000	
	4.3.2 Concrete	CY	6,400	$878	5,616,000	
	4.3.3 Trashracks, Gares, miscl. Metals	Tons	100	$10,000	1,000,000	
						35,966,000
5	**UPPER PRESSURE TUNNEL (3963')**					
	5.1 Tunnel Excavation - TBM	CY	133,300	$156	20,794,800	
	5.2 Tunnel Prelining & Support (3")	SY	35,300	$72	2,541,600	
	5.3 Tunnel Lining	CY	36,300	$1,080	39,204,000	
	5.4 Miscellaneous Concrete (bent, plug etc)	CY	5,400	$1,080	5,832,000	
	5.5 Contact Grouting	CF	27,200	$42	1,142,400	
						69,514,800
6	**SURGE TANK**					
	6.1 Shaft Excavation - D/B	CY	8,900	$208	1,851,200	
	6.2 Benching Excavation	CY	35,300	$150	5,295,000	
	6.3 Concrete Works	CY	700	$878	614,300	
						7,760,500
7	**POWER SHAFT (1348')**					
	7.1 Power Shaft Excavation (1208') - D/B	CY	40,600	$208	8,444,800	
	7.2 Shaft Prelining & support	SF	2,200	$72	158,400	
	7.3 Concrete Lining	CY	11,100	$1,080	11,988,000	
	7.4 Contact Grouting	CF	9,300	$42	390,600	
						20,981,800
8	**LOWER PRESSURE TUNNEL (1563')**					
	8.1 Tunnel Excavation - TBM	CY	52,600	$156	8,205,600	
	8.2 Tunnel Prelining & Support (6")	SY	13,900	$109	1,515,100	
	8.3 Tunnel Lining	CY	14,300	$1,080	15,444,000	
	8.4 Miscellaneous Concrete (bent, plug etc)	CY	5,900	$1,080	6,372,000	
	8.5 Contact Grouting	CF	10,700	$42	449,400	
	8.6 Curtain Grouting	CF	5,800	$42	243,600	
						32,229,700
9	**PENSTOCK MANIFOLD (350')**					
	9.1 Manifold Tunnel Excavation - D/B	CY	7,400	$208	1,539,200	
	9.2 Manifold Tunnel Prelining & Support (3", 75%)	SY	2,400	$72	172,800	
	9.3 Concrete Lining	CY	1,800	$1,080	1,944,000	
	9.4 Concrete Plug	CY	10,700	$1,080	11,556,000	
						15,212,000
10	**PENSTOCKS (500')**					
	10.1 Penstock Tunnel Excavation - D/B	CY	18,900	$208	3,931,200	
	10.2 Penstock Tunnel Prelining & Support (3", 30%)	SY	3,800	$72	273,600	
	10.3 Steel liner installation	Tons	3,000	$12,000	36,000,000	
	10.4 Concrete Filling around Liner	CY	5,200	$1,080	5,616,000	
	10.5 Contact Grouting	LF	2,000	$59	118,000	
	10.6 Curtain Grouting	LS	1	$92,000	92,000	
						46,030,800
11	**DRAFT TUBE MANIFOLD (350')**					
	11.1 Manifold Tunnel Excavation - D/B	CY	7,400	$208	1,539,200	
	11.2 Manifold Tunnel Prelining & Support (3", 75%)	SY	2,400	$72	172,800	
	11.3 Concrete Lining	CY	1,600	$1,080	1,728,000	
	11.4 Tube Fingers Excavation (Total L=620')	CY	6,500	$208	1,352,000	
	11.5 Tube Fingers Prelining	SY	4,100	$72	295,200	
	11.6 Tube Fingers Concrete	CY	1,200	$1,080	1,296,000	
						6,383,200
12	**TAILRACE TUNNEL (6635')**					
	12.1 Tailrace Tunnel Excavation - TBM	CY	223,100	$156	34,803,600	
	12.2 Tailrace Tunnel Prelining & Support (3", 100%)	SY	78,700	$109	8,578,300	
	12.3 Plug Concrete Construction	CY	3,400	$1,080	3,672,000	
	12.4 Plug -Radial Grout injection	LS	1	$92,000	92,000	
	12.5 Rock Trap Construction	LS	1	$950,000	950,000	
	12.6 D/S Surge Tank Construction	LS	1	$6,000,000	6,000,000	
						54,095,900

PROJECT FEATURES
& COSTS

Item	Description	Unit	Quantity	Unit Cost	Cost	
13	**MACHINE HALL**					
	13.1 Excavation Draft Tubes(El.-16,El.-36)	CY	4,600	$208	956,800	
	Benching excavation (El.-16,18)	CY	22,700	$156	3,541,200	
	Hall Benching excavation (El.18,El.85)	CY	64,000	$156	9,984,000	
	Roof excavation (El.85 , 100)	CY	9,900	$208	2,059,200	
	13.2 Roof &Walls Support (W/3" shotcrete)	SF	96,700	$42	4,082,700	
	13.3 Concrete					
	Draft Tubes El.-41, EL.-16	CY	4,500	$1,000	4,500,000	
	Machine Hall El.-16, El.-12	CY	2,700	$800	2,160,000	
	Machine Hall El.-12, El.+9	CY	10,100	$1,000	10,100,000	
	Machine Hall El.9, El. 19	CY	1,100	$1,000	1,100,000	
	Machine Hall El.19, El.21	CY	1,900	$800	1,520,000	
	Machine Hall slab El. 38	CY	1,000	$1,000	1,000,000	
	Machine Hall Walls El. 9, El.18	CY	500	$1,000	500,000	
	Machine Hall Walls El.18, El.85	CY	5,100	$1,000	5,100,000	
	Machine Hall Roof	CY	2,600	$1,000	2,600,000	
	13.4 Draft Tube Liner	Tons	220	$12,000	2,640,000	
	Draft Tube Contact Grouting	LS	1	$340,000	340,000	
	13.5 Elevator Shaft Construction	LS	1	$1,194,647	1,194,600	
	13.6 Miscellaneous Metal works	LS	1	$500,000	500,000	
	13.7 Drainage Gallery Construction	LS	1	$852,013	852,000	
	13.8 96" Dia. Spherical Valve	EA	4	$360,000	1,440,000	
						56,170,500
14	**TURBINES/GENERATORS**					
	14.1 Water to Wire Package	EA	4	$60,000,000	240,000,000	
	14.2 Installation	EA	4	$15,000,000	60,000,000	
						300,000,000
15	**TRANSFORMER HALL**					
	15.1 Excavation					
	Transformer Hall Excavation	CY	30,900	$156	4,820,400	
	Nishe Excavation	CY	2,700	$208	561,600	
	Cable Gallery Excavation	CY	700	$208	145,600	
	A/C Gallery Excavation	CY	100	$208	20,800	
	Cable Shaft Excavation	CY	4,700	$156	733,200	
	15.2 Roof & Wall Support					
	Transformer Hall	SF	44,300	$35	1,566,500	
	Nishe	SF	2,500	$12	30,400	
	Cable Gallery	SF	3,200	$12	38,900	
	A/C Gallery	SF	100	$12	1,200	
	Cable Shaft	SF	56,900	$12	691,200	
	15.3 Concrete works	CY	3,900	$1,000	3,900,000	
	15.4 Miscellaneous Steel	LS	1	$472,764	472,800	
	15.5 Transfer Station					
	Grading	CY	820	$10	8,200	
	Gravel Base	CY	410	$40	16,400	
	Fence	LS	1	$20,000	20,000	
	Towers	Tons	7	$15,000	105,000	
	Footings	LS	1	$18,000	18,000	
	O/H Transmission Lines, (Two pll. each 0.9 mile long)	Mile	1.8	$300,000	540,000	
						13,690,200
16	**LOWER RESERVOIR**	CY				
	16.1 Platform Excavation	CY	661,000	$25	16,525,000	
	16.2 Access tunnel portal concrete	CY	180	$500	90,000	
	16.3 Intake structure excavation	CY	13,900	$40	556,000	
	16.4 Intake structure concrete	CY	6,400	$800	5,120,000	
	16.5 Trashracks, Gares, miscl. Metals	Tons	100	$10,000	1,000,000	**23,291,000**
17	**Unlisted Items (10% of all other items)**	LS	1	$73,564,800	73,564,800	**73,564,800**
				Total	809,213,100	
	Base Construction Subtotal (BCS)				**$809,213,100**	
	Mobilization @ 5% of BSC				$40,460,700	
	Construction Contingencies (15% of BCS+Mob.)				$127,451,100	
	Direct Construction Subtotal (DCS)				**$977,124,900**	
	Design Engineering (4% of DCS)				$39,085,000	
	Permitting (.5% of DCS)				$4,885,600	
	Legal and Administrative Costs (.3% of DCS)				$2,931,400	
	Construction Administration and Engineering (5% of DCS)				$48,856,200	
	Opinion of Probable Construction Costs (OPCC) 2008				**$1,072,880,000**	

GEI Consultants, Inc.
080473 Eagle Mountain Pumped Storage Project
Reservoir Filling Calculations
4/7/2009
NDM

RESERVOIR FILLING CALCULATIONS

Purpose: Estimate the time required to fill the Eagle Mountain Pumped Storage Project Reservoirs to full operating capacity.

Procedure: Calculate inflow, losses, and final reservoir levels based on a monthly time step.

Calculation Steps:

1. Determine volume of groundwater pumped from wells to Lower Reservoir (varies by month).
2. Determine Lower Reservoir storage and water surface elevation after inflow from groundwater wells.
3. Subtract seepage and evaporation losses from Lower Reservoir.
4. If Lower Reservoir level is above 25% active capacity, pump available water up to the Upper Reservoir.
5. Determine the Upper Reservoir storage and water surface elevation after inflow from Lower Reservoir.
6. Subtract seepage and evaporation losses from Upper Reservoir.
7. Repeat steps 1 through 6 until Upper Reservoir is at full capacity.

See attached calculation table and required inputs.

Attached Charts:

1. Eagle Mountain Pumped Storage Project Lower Reservoir Filling:
   This graph shows the Lower Reservoir storage and water surface elevation just before pumping to the Upper Reservoir and the storage and water surface elevation after pumping to the Upper Reservoir, for each monthly time step.

2. Eagle Mountain Pumped Storage Project Upper Reservoir Filling:
   This graph shows the Upper Reservoir storage and water surface elevation just before pumping from the Lower Reservoir and the storage and water surface elevation after pumping From the Lower Reservoir, for each monthly time step.

3. Eagle Mountain Pumped Storage Project Groundwater Supply and Lower Reservoir Pumping:
   This graph shows the volume of water pumped from the groundwater supply wells to Lower Reservoir, and the water pumped from the Lower Reservoir to the Upper Reservoir, for each monthly time step.

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080473 Eagle Mountain Pumped Storage Project
Reservoir Filling
4/7/2009
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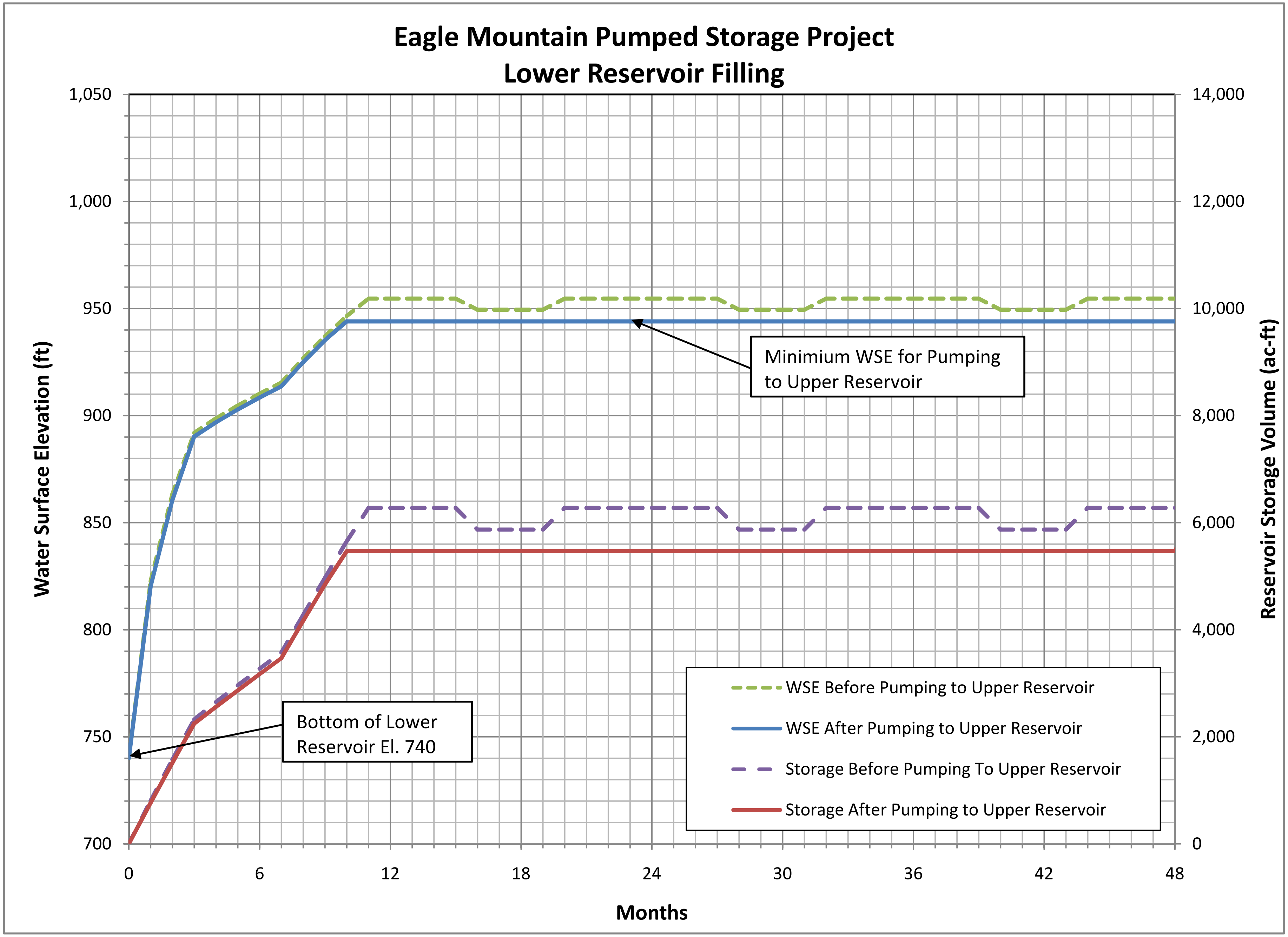
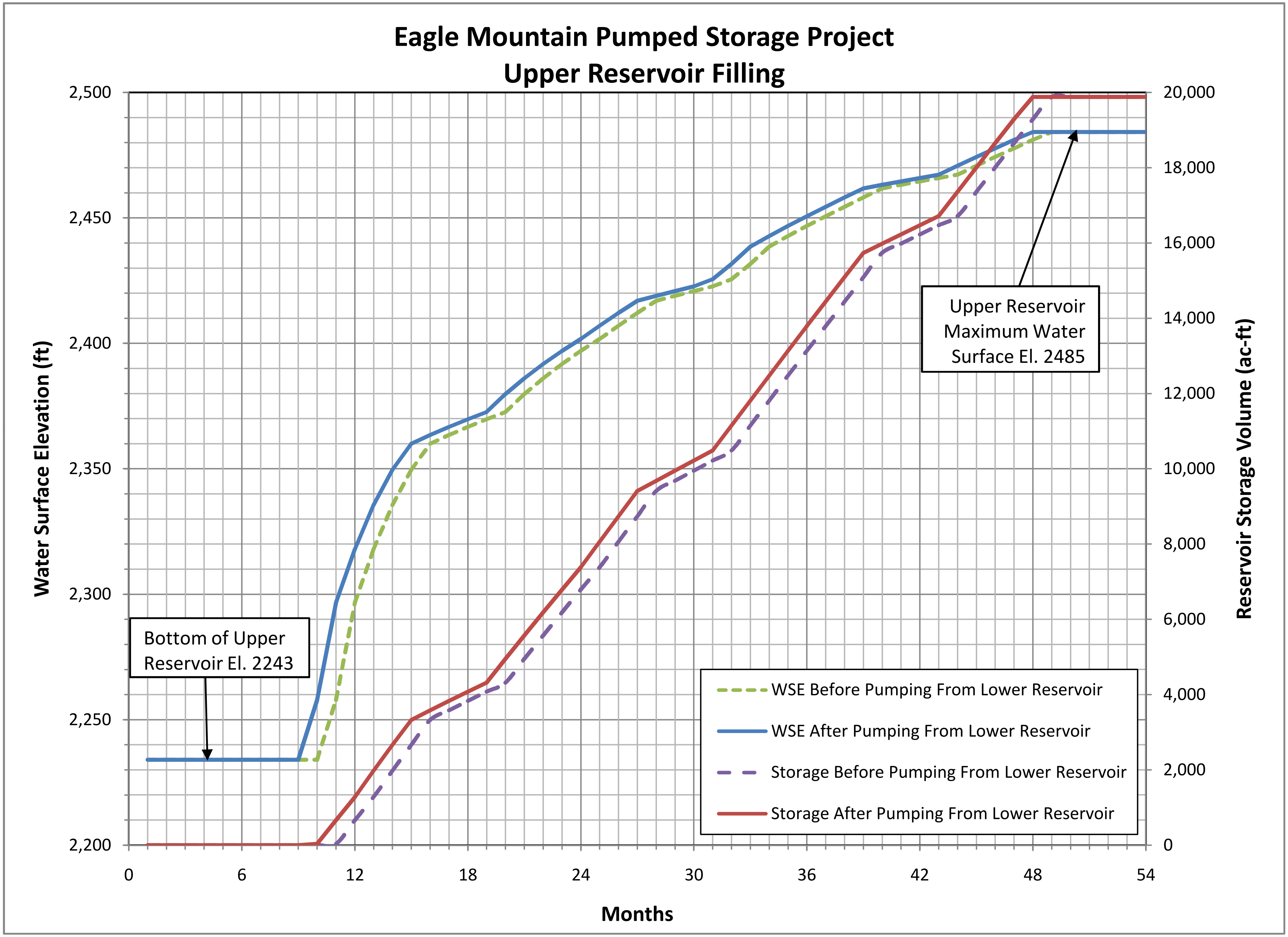
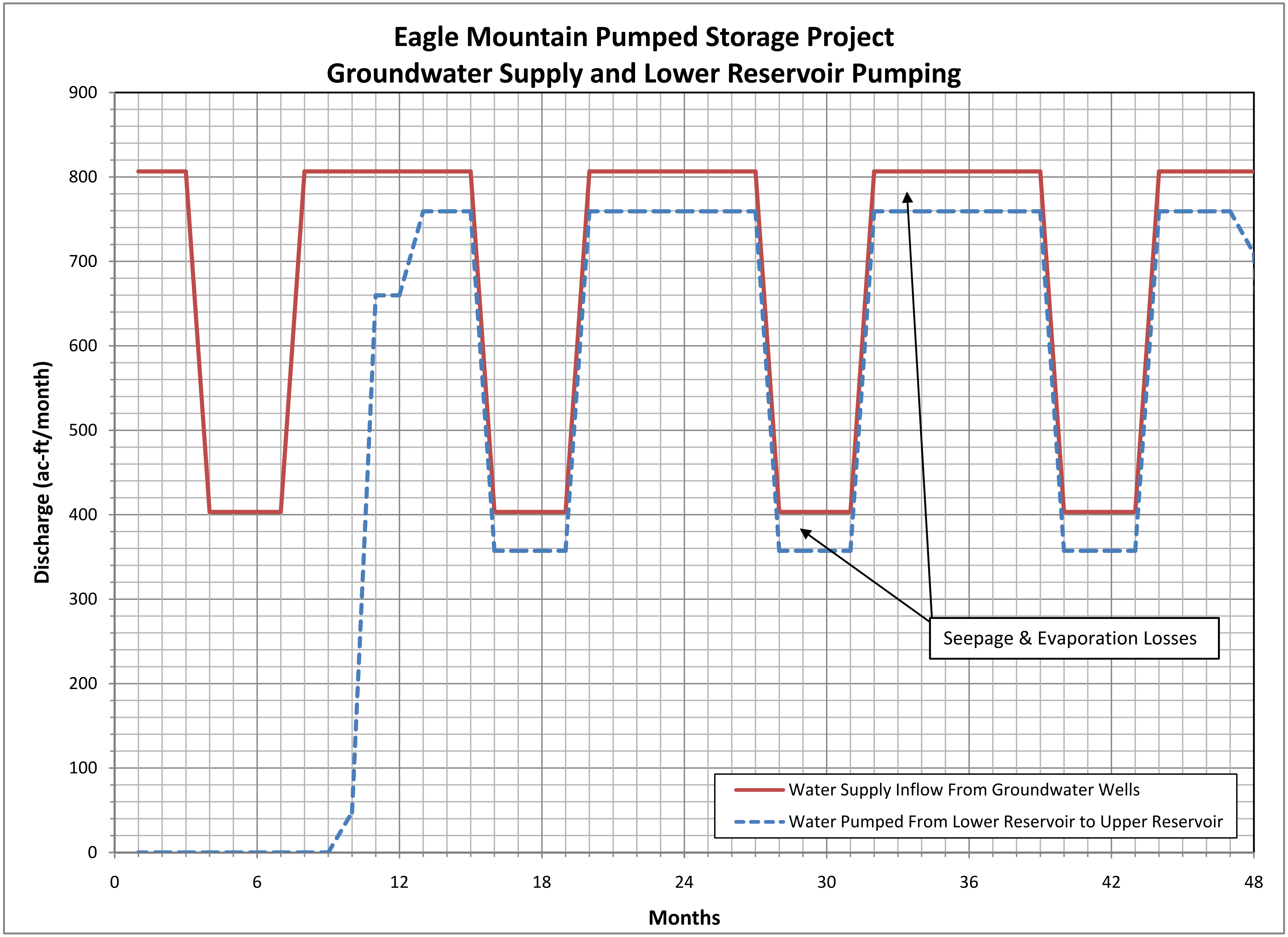
INPUT DATA		
First Filling Month	March	
Pumping Duration Oct-May, t1:	24	hrs
Pumping Duration Jun-Sept, t2:	12	hrs
Pumping Rate, Q:	6,000	gpm
Pumping Rate, Q:	13.37	cfs
Pumping Rate, Q1:	9679	AF/yr
Pumping Rate, Q2:	4839	AF/yr
Evaporation Rate:	7.5	ft/yr

SEEPAGE DATA		
LR Seepage at Max. El.:	2765	AF/yr
LR Seepage at Min. El.:	863	AF/yr
Begin LR Seepage Pumpback Month:	12	
UR Seepage at Max. El.:	1913	AF/yr
UR Seepage at Min. El.:	456	AF/yr
Begin UR Seepage Pumpback Month:	24	

			Lower Reservoir											**Upper Reservoir**										
Month Count	**Month**	**Water Supply Pipeline Discharge (ac-ft)**	**Starting Elevation (ft)**	**Starting Storage (ac-ft)**	**After Filling Storage (ac-ft)**	**After Filling Elevation (ft)**	**Evaporation (ac-ft)**	**Seepage (ac-ft)**	**Intermediate Storage Volume (ac-ft)**	**Intermediate Water Surface Elevation (ft)**	**Percent of Total Capacity (%)**	**Final Storage Volume (ac-ft)**	**Final Water Surface Elevation (ft)**	**Available Pumping Volume to UR (ac-ft)**	**UR Starting Elevation (ft)**	**Starting Storage (ac-ft)**	**Ending Storage (ac-ft)**	**Volume Pumped (ac-ft)**	**Ending Elevation (ft)**	**Evaporation (ac-ft)**	**Seepage (ac-ft)**	**Final Storage Volume (ac-ft)**	**Final Water Surface Elevation (ft)**	**Percent of Total Capacity (%)**
1	March	807	740.0	0	807	822.6	7	32	768	820.2	3.5%	768	820.2	0	2234	0	0.0	0.0	2234.0	0.0	0.0	0.0	2234.0	0.0%
2	April	807	820.2	768	1575	863.3	12	48	1515	860.6	6.9%	1515	860.6	0	2234	0	0.0	0.0	2234.0	0.0	0.0	0.0	2234.0	0.0%
3	May	807	860.6	1515	2322	892.0	15	59	2247	890.2	10.3%	2247	890.2	0	2234	0	0.0	0.0	2234.0	0.0	0.0	0.0	2234.0	0.0%
4	June	403	890.2	2247	2651	898.7	30	62	2559	896.9	11.7%	2559	896.9	0	2234	0	0.0	0.0	2234.0	0.0	0.0	0.0	2234.0	0.0%
5	July	403	896.9	2559	2963	904.7	32	64	2867	902.9	13.1%	2867	902.9	0	2234	0	0.0	0.0	2234.0	0.0	0.0	0.0	2234.0	0.0%
6	August	403	902.9	2867	3270	910.2	34	66	3170	908.4	14.5%	3170	908.4	0	2234	0	0.0	0.0	2234.0	0.0	0.0	0.0	2234.0	0.0%
7	September	403	908.4	3170	3573	915.4	36	68	3469	913.7	15.8%	3469	913.7	0	2234	0	0.0	0.0	2234.0	0.0	0.0	0.0	2234.0	0.0%
8	October	807	913.7	3469	4276	926.7	38	74	4164	925.0	19.0%	4164	925.0	0	2234	0	0.0	0.0	2234.0	0.0	0.0	0.0	2234.0	0.0%
9	November	807	925.0	4164	4971	937.0	42	83	4846	935.2	22.1%	4846	935.2	0	2234	0	0.0	0.0	2234.0	0.0	0.0	0.0	2234.0	0.0%
10	December	807	935.2	4846	5652	946.5	44	92	5516	944.6	25.2%	5469	944.0	47	2234	0	47.4	47.4	2259.0	0.6	8.7	38.1	2257.9	0.2%
11	January	807	944.0	5469	6275	954.7	47	100	6128	952.8	28.0%	5469	944.0	660	2258	38	697.8	659.8	2297.9	10.0	22.3	665.5	2296.6	3.3%
12	February	807	944.0	5469	6275	954.7	47	100	6128	952.8	28.0%	5469	944.0	660	2297	666	1325.3	659.8	2319.2	17.5	29.7	1278.0	2317.9	6.4%
13	March	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2318	1278	2037.4	759.3	2336.9	24.6	35.9	1976.9	2335.5	9.9%
14	April	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2336	1977	2736.2	759.3	2350.9	30.0	44.7	2661.6	2349.6	13.3%
15	May	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2350	2662	3420.9	759.3	2361.3	39.5	53.6	3327.8	2360.0	16.6%
16	June	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2360	3328	3685.0	357.2	2364.8	45.8	56.6	3582.6	2363.5	17.9%
17	July	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2363	3583	3939.8	357.2	2368.1	47.2	59.4	3833.2	2366.7	19.2%
18	August	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2367	3833	4190.4	357.2	2371.1	50.1	62.0	4078.3	2369.8	20.4%
19	September	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2370	4078	4435.5	357.2	2374.0	51.5	64.5	4319.5	2372.6	21.6%
20	October	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2373	4319	5078.8	759.3	2381.1	55.7	70.6	4952.6	2379.7	24.8%
21	November	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2380	4953	5711.9	759.3	2387.4	61.4	75.9	5574.5	2386.1	27.9%
22	December	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2386	5575	6333.8	759.3	2393.1	65.3	80.8	6187.7	2391.8	30.9%
23	January	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2392	6188	6947.0	759.3	2398.3	72.9	85.2	6788.8	2397.0	33.9%
24	February	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2397	6789	7548.2	759.3	2403.0	76.5	89.3	7382.3	2401.7	36.9%
25	March	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2402	7382	8141.6	759.3	2407.6	80.3	0.0	8061.3	2407.0	40.3%
26	April	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2407	8061	8820.6	759.3	2412.7	82.5	0.0	8738.1	2412.1	43.7%
27	May	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2412	8738	9497.4	759.3	2417.6	85.6	0.0	9411.8	2417.0	47.1%
28	June	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2417	9412	9769.1	357.2	2419.5	87.5	0.0	9681.5	2418.9	48.4%
29	July	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2419	9682	10038.8	357.2	2421.4	88.5	0.0	9950.3	2420.8	49.8%
30	August	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2421	9950	10307.5	357.2	2423.3	89.7	0.0	10217.8	2422.7	51.1%
31	September	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2423	10218	10575.1	357.2	2427.4	90.8	0.0	10484.3	2425.6	52.4%
32	October	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2426	10484	11243.6	759.3	2432.2	92.9	0.0	11150.7	2431.6	55.8%
33	November	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2432	11151	11910.0	759.3	2439.2	96.1	0.0	11814.0	2438.6	59.1%
34	December	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2439	11814	12573.3	759.3	2443.3	99.3	0.0	12474.0	2442.7	62.4%
35	January	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2443	12474	13233.3	759.3	2447.4	101.6	0.0	13131.7	2446.7	65.7%
36	February	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2447	13132	13891.0	759.3	2451.3	104.7	0.0	13786.4	2450.6	68.9%
37	March	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2451	13786	14545.7	759.3	2455.0	107.7	0.0	14438.0	2454.4	72.2%
38	April	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2454	14438	15197.3	759.3	2458.8	109.4	0.0	15087.9	2458.1	75.4%
39	May	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2458	15088	15847.2	759.3	2462.4	110.9	0.0	15736.4	2461.8	78.7%
40	June	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2462	15736	16093.6	357.2	2463.8	111.7	0.0	15981.9	2463.2	79.9%
41	July	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2463	15982	16339.2	357.2	2465.1	112.4	0.0	16226.8	2464.5	81.1%
42	August	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2465	16227	16584.0	357.2	2466.5	112.4	0.0	16471.7	2465.9	82.4%
43	September	403	944.0	5469	5872	949.4	46	0	5826	948.8	26.6%	5469	944.0	357	2466	16472	16828.9	357.2	2467.9	113.0	0.0	16715.9	2467.2	83.6%
44	October	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2467	16716	17475.2	759.3	2471.4	113.7	0.0	17361.5	2470.8	86.8%
45	November	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2471	17361	18120.8	759.3	2474.9	115.1	0.0	18005.7	2474.3	90.0%
46	December	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2474	18006	18765.0	759.3	2478.3	116.5	0.0	18648.6	2477.7	93.2%
47	January	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2478	18649	19407.9	759.3	2481.7	117.1	0.0	19290.8	2481.1	96.5%
48	February	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	5469	944.0	759	2481	19291	20000.0	709.2	2484.9	118.5	0.0	19881.5	2484.2	99.4%
49	March	807	944.0	5469	6275	954.7	47	0	6228	954.0	28.4%	6228	954.0	759	2484	19881	20000.0	118.5	2484.9	119.2	0.0	19880.8	2484.2	99.4%
50	April	807	954.0	6228	7035	964.1	50	0	6985	963.5	31.9%	6985	963.5	1516	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
51	May	807	963.5	6985	7791	973.1	52	0	7739	972.5	35.3%	7739	972.5	2270	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
52	June	403	972.5	7739	8142	977.1	54	0	8088	976.5	36.9%	8088	976.5	2620	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
53	July	403	976.5	8088	8492	981.1	55	0	8437	980.4	38.5%	8437	980.4	2968	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
54	August	403	980.4	8437	8840	984.9	56	0	8784	984.3	40.1%	8784	984.3	3315	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
55	September	403	984.3	8784	9187	988.7	57	0	9130	988.0	41.7%	9130	988.0	3661	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
56	October	807	988.0	9130	9936	996.5	59	0	9877	995.9	45.1%	9877	995.9	4409	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
57	November	807	995.9	9877	10684	1004.1	61	0	10623	1003.5	48.5%	10623	1003.5	5154	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
58	December	807	1003.5	10623	11429	1011.5	63	0	11366	1010.8	51.9%	11366	1010.8	5897	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
59	January	807	1010.8	11366	12172	1018.6	65	0	12108	1018.0	55.3%	12108	1018.0	6639	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%
60	February	807	1018.0	12108	12914	1025.5	67	0	12847	1024.8	58.7%	12847	1024.8	7379	2484	19881	20000.0	119.2	2484.9	119.2	0.0	19880.8	2484.2	99.4%


Eagle Mountain Pumped Storage Project
Lower Reservoir Filling
Water Surface Elevation (ft)
Reservoir Storage Volume (ac-ft)
Months
1,050
1,000
950
900
850
800
750
700
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0
6
12
18
24
30
36
42
48
Minimium WSE for Pumping to Upper Reservoir
Bottom of Lower Reservoir El. 740
WSE Before Pumping to Upper Reservoir
WSE After Pumping to Upper Reservoir
Storage Before Pumping To Upper Reservoir
Storage After Pumping to Upper Reservoir


Eagle Mountain Pumped Storage Project
Upper Reservoir Filling
Water Surface Elevation (ft)
2,500
2,450
2,400
2,350
2,300
2,250
2,200
Reservoir Storage Volume (ac-ft)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Months
0
6
12
18
24
30
36
42
48
54
Upper Reservoir Maximum Water Surface El. 2485
Bottom of Upper Reservoir El. 2243
WSE Before Pumping From Lower Reservoir
WSE After Pumping From Lower Reservoir
Storage Before Pumping From Lower Reservoir
Storage After Pumping From Lower Reservoir


Eagle Mountain Pumped Storage Project
Groundwater Supply and Lower Reservoir Pumping
Discharge (ac-ft/month)
900
800
700
600
500
400
300
200
100
0
0
6
12
18
24
30
36
42
48
Months
Seepage & Evaporation Losses
Water Supply Inflow From Groundwater Wells
Water Pumped From Lower Reservoir to Upper Reservoir

Eagle Mountain Pumped Storage Project – Landfill Compatibility

Prepared by: Richard Westmore, P.E., GEI Consultants, Inc. and Ginger Gillin, GEI Consultants, Inc.

April 8, 2009, revised November 24, 2009 and August 13, 2012

The Eagle Mountain Pumped Storage Project will be constructed at the site of the Eagle Mountain Mine, which is no longer operational as an iron mine. Certain features of the pumped storage project will be located on lands that have also been designated for construction of a municipal landfill operation. This memorandum addresses the potential conflicts between the landfill project and the pumped storage project, and provides an assessment of the compatibility of the two projects and how potential conflicts are proposed to be addressed.

Figure 1 presents the pumped storage facilities as they were depicted in the Draft License Application (DLA) dated June 22, 2008. Based on that presentation and comments on the DLA offered by Kaiser Eagle Mountain LLC and Mine Reclamation LLC (the landfill proponents collectively called "Kaiser") and the Los Angeles County Sanitation District No. 2, FERC requested Eagle Crest Energy Company (ECE) to include in its Final License Application (FLA) documentation to support the conclusion that the landfill project and the pumped storage project are compatible (i.e., neither project would interfere with the construction or operation of the other) as stated in the FLA (see FERC letter dated September 15, 2008).

Comments on the DLA provided by Kaiser in a letter dated September 12, 2008, identify a number of perceived conflicts between the pumped storage project and proposed landfill operations and ancillary facilities of the landfill as follows:

- *Pumped storage facilities would hinder or prohibit development of the truck marshalling yard and portions of the rail yards.*
- *The above-ground transmission line from the underground powerhouse to the Eagle Mountain switchyard would reduce Phase 3 landfill disposal capacity.*
- *The pumped storage project tunnels are aligned below the landfill Phases 2, 3 and 4 and could affect landfill liner integrity.*
- *The use of fine tailings from the mine for lining of the proposed reservoirs to control seepage may conflict with use of these fine tailings for the landfill.*
- *The DLA did not indicate how interference and compatibility issues will be addressed and does not credit the advanced design level (estimated to be 70% complete) for the landfill project relative to re-securing approvals if the landfill designs are changed to accommodate the pumped storage project.*

- *Implementation of the landfill project is part of the overall plan for reclamation of the Eagle Mountain mine site. Implementation of the pumped storage project would not be consistent with the plan of reclamation.*

Based upon the analysis undertaken in response to these comments, design of the pumped storage project has been adjusted to avoid or better manage potential conflicts. This memorandum documents these design changes and presents the supporting analysis to demonstrate compatibility of the two projects. This technical memorandum was initially prepared using landfill design drawings dated December 1993. The 2011 update of this TM was prepared using a landfill design drawing dated October 27, 1997.

Conflicts at Truck Marshalling and Rail Yard

The truck marshalling and rail yard facilities for the landfill are located on the east end of the mine site, as shown on Figures 2 and 4. In the DLA, ECE had indicated that construction staging and lay-down areas required for pumped storage project construction would be located close to the truck marshalling and rail yard. These areas have been relocated to a parcel southwest of the lower reservoir and outside of the proposed landfill, as shown on Figure 2.

Transmission from Powerhouse to Eagle Mountain Switchyard

The DLA showed the low-voltage cable connection from the powerhouse to the Eagle Mountain switchyard as an above-ground line. The transmission lines connecting the transfer station and the switchyard were originally placed above ground through the Phase 3 portion of the landfill project. This layout (from the DLA) is shown in Figure 1. The line would have extended from the top through a vertical cable shaft, above ground to the switchyard. ECE now intends to route the low-voltage cables from the underground powerhouse through the underground powerhouse access tunnel (Figure 2). The transmission cables would only be located above ground from the access tunnel portal near the lower reservoir, along the north rim of the reservoir and adjacent to the proposed water pipeline from the reverse osmosis treatment plant to the lower reservoir. The water treatment facilities have also been relocated from the location shown in the DLA to address concerns raised by the Metropolitan Water District (MWD) of Southern California.

The proposed FLA pumped storage layout, shown on Figure 2 (with proposed finished landfill contours), aligns transmission lines within the access tunnel where they will be protected from moisture, down to near the lower reservoir inlet structure. Here, the lines will run up through a shaft to the ground surface and then continue on to the Eagle Mountain switchyard as overhead transmission lines. Cables will run from each of the four 500/18 kV, 135 MVA transformers through the access tunnel and then above ground on towers to the switchyard. The total length of each cable will be approximately 10,000 feet and each will be rated as indicated for the transformers. The cable runs in the tunnel will be approximately 6,000 feet long and above ground the length will be approximately 4,000 feet. A profile view of this alignment is shown in Figure 3, FLA Layout – Cross Section.

Pumped Storage Tunnel Located Beneath the Landfill

The pumped storage facilities are located primarily underground at depths ranging from 100 to 1,500 feet below the existing ground surface and the proposed bottom liner for the landfill. This relationship is shown on Figure 3, which presents cross-sections showing the relationship between the tunnels and the landfill.

For project planning and to assure conservative estimates of project cost, we have assumed that the water conveyance tunnels for the Pumped Storage Project will be concrete-lined throughout, except for the steel-lined penstock and draft-tube tunnels. Depending on actual rock conditions and hydraulic requirements determined during final design and construction, it may be feasible to only line the tunnels at certain locations where seepage potentials are high. Much of the deeper portions of the pumped storage project will be located above the current water table, which is at El. 700 throughout most of the project area.

Kaiser's concerns with the water conveyance tunnels relate to the potential for seepage from the tunnels to impact the landfill liner system. The lower pressure tunnel and tailrace tunnel will be located generally 1,000 – 1,500 ft below ground, far beneath the landfill liner. Maximum operating pressure within the main conveyance tunnel will be approximately 700 psi. Final tunnel design will need to carefully consider water pressures acting on the tunnels in both directions when the tunnels are fully pressurized for hydroelectric operations and when they are dewatered for inspection. The final designs for the tunnels and associated tunnel linings will assure that no potential will exist for water from the project to cause uplift loads on the landfill liner system.

Concerns were expressed by LA Sanitation regarding possible buildup of methane gas in the water conveyance tunnels. This is not expected to be an issue due to the continuous "flushing" operations of the tunnel that will not allow for methane gas buildup. Security concerns were also brought up by LA Sanitation. All of the hydroelectric facilities will be below ground, with the exception of the overhead transmission line southwest of the lower reservoir to the Eagle Mountain switchyard. Access to shafts, access tunnels and pressure tunnels will be secured. Above ground facilities will follow the same security requirements as the landfill project for their construction activities and operations.

Potential for Reservoir Seepage to Impact the Landfill

Concerns have been expressed that seepage from the upper reservoir and from the water conveyance tunnels could potentially impact the landfill. Studies by GeoSyntec (1996) indicate that the natural groundwater flow is initially to the south from the area of the central pit. Those studies also indicated that because of fractures in the bedrock, seepage will occur, particularly if the reservoir is not treated to control the rate of seepage. Therefore, the proposed pumped-storage operations may artificially raise groundwater levels in this local area. In the case of consistently high reservoir levels and efficient interconnectivity of bedrock fractures to the south, there is potential that this groundwater could exit on the hillside south of the upper reservoir, rather than staying beneath the existing ground surface and the landfill. With the landfill proposed to be constructed south (down-gradient) of the upper reservoir, this groundwater could potentially encounter the lining of the landfill.

The potential and timing for groundwater to migrate to the southern slope is dependent on the local hydraulic conductivity of the rock and project operations. The fact that the reservoir will be filled and drained on a weekly basis will have a dampening effect on the rate of seepage, however, assuming a hydraulic conductivity of 650 feet per year as suggested by GeoSyntec's work, it appears that seepage could intersect the southern slope under long-term steady-state assumptions.

The following engineering investigation will be undertaken to determine the actual potential for seepage and to control its rate from the upper reservoir:

- The upper reservoir (east pit) will be thoroughly investigated during final design of the pumped-storage project to identify a program for seepage control. This investigation will include geologic mapping to identify the locations and extent of faults, cracks, fractures, and discontinuities in the rock formations and subsurface explorations to characterize the hydraulic conductivity of the rock formations. The mapping will identify locations that will tend to be the areas where seepage into the bedrock will be most pronounced. A seepage model will then be developed to characterize the flow patterns and potential seepage rates through the bedrock with the upper reservoir at its maximum normal pool (El. 2,485).

Based on the above studies, a seepage control and recovery program will be developed. This program will include:

- Curtain grouting beneath the footprints of the two upper reservoir dams. (Foundation grouting typically is performed for dam safety reasons as a means of uplift control). Grouting and/or shotcrete treatment of the surface features identified in the reservoir as likely locations for seepage to concentrate.

- Installation of monitoring wells and piezometers so that seepage amounts and flow patterns can be understood and addressed as necessary over the long term. (Seepage monitoring wells and recovery wells are described in the technical memorandum on seepage modeling.)

- Installation of seepage recovery well(s) both up-gradient and down-gradient of the landfill prism to maintain groundwater levels below the landfill liner. Seepage recovery wells will be installed at the time of project construction so they will be fully functional if and when seepage from the reservoirs is detected. Phase 1 of the landfill is most proximal to the seepage from the Upper Reservoir. Since the Pumped Storage Project will be constructed before the landfill, the seepage monitoring and recovery wells will be in place before Phase 1 of the landfill is constructed, insuring that the landfill is protected.

- Other measures, such as use of impervious blanketing on portions of the reservoir bottom and sides, may also be used depending on results of detailed studies during final engineering design.

The water surface elevation in the Lower Reservoir will range from elevation 925 and 1,092 feet msl. The landfill is proposed to be constructed in four phases. Phases 1 through 3 will be constructed at elevations above the lower reservoir's maximum water surface elevation and therefore cannot be affected by the seepage from the lower reservoir. Phase 4 is located to the north of the lower reservoir and its foundation finish grade at its lowest point is about 1,040 feet msl (about 800 feet from the reservoir), below the maximum reservoir water surface. This portion of the landfill is being built at least in part over the older alluvium exposed in the eastern portion of the Lower Reservoir, however the area is currently covered by tailing piles so the exact extent of the alluvium is unknown.

The groundwater model covered this area and can approximate the change in the groundwater level beneath this portion of the landfill. Groundwater levels directly beneath the reservoir, if not controlled by seepage recovery wells, would be expected to rise a maximum of 8 feet. Existing monitoring well MW-1 is the closest monitoring well in the alluvium to Phase 4. The groundwater elevation in well MW-1 was 706 feet msl in 1992. The water surface elevation with uncontrolled recharge mounding, projects to be about 714 feet elevation, far below the landfill foundation. With seepage control wells, as shown on Figure 16, groundwater levels are expected to change by about one to four feet.

Use of Fine Tailings for Reservoir Seepage Control

The fine tailings remaining from mine operations may be a good source of lower permeability material for lining the reservoir bottoms to help control seepage. Kaiser intends to use a fairly large quantity of these fine tailings for the landfill. Should a potential shortage develop, reservoir bottom lining for seepage will be accomplished using the portion of the fine tailings that is not needed by the landfill, coupled with imported materials, materials processed on-site that provide sufficiently low permeability, or combinations of all three. During final design, ECE's consultants will work with Kaiser to understand materials availability and to tailor reservoir design to achieve goals without adversely impacting the landfill.

Resolution of Project Compatibility Issues

ECE is committed to successfully resolving all issues of compatibility between the two projects. ECE has attempted to address capability issues with the assumption that the landfill project will be constructed as configured on the most recent set of drawings we have obtained (dated December 1993) with no adjustments to accommodate the pumped storage project.

Based on an overlay of the two projects (Figure 2) and with changes to the pumped storage facility locations described above (DLA to FLA), it appears that the proposed landfill and proposed pumped storage project have insignificant potential conflicts. During final design of the pumped storage project, ECE is committed to meet with Kaiser to review design and construction issues and resolve concerns over conflicts, with the current 70% level design documentation for the landfill serving as the "baseline".

We believe that the existing and proposed roads within the landfill can be utilized by both projects if construction were to occur simultaneously, although simultaneous construction of both projects is unlikely. This will require close coordination and communications between all parties. The landfill haul roads along the perimeter of the project area could be used to move equipment for pumped storage construction and as construction access roads. The existing internal access road running through the northern portion of landfill Phases 2 and 3 may be used to access the pumped storage surge tank and shaft until the north perimeter maintenance road is completed.

The staging, storage, and office/administrative areas for the pumped storage project construction are proposed to be located to the southwest of the lower reservoir, in close proximity to the landfill project's proposed administration buildings. South of this area is the proposed desalination works. The proposed water treatment plant and brine disposal ponds will be accessed using existing roads, and crossing over the Eagle Mountain railroad track system will not be required.

Kaiser's concern with the impacts of the use of rock resources (more specifically within the area of section 36, T14E, R3N) does not appear to be a conflict between the two projects. This area along with other rock pile areas, will not limit access, construction or maintenance for either project. There are no proposed pumped storage project facilities planned to be located on or near this area.

Landfill Use of the East Pit

Landfill Phases 1 through 4 will extend over a period of 85 years, under Kaiser's current projections. In order to operate the landfill for more than 85 years, Phase 5 would be required. The lower reservoir for the pumped storage project (using the East Pit) overlaps with Phase 5. However, the Eagle Mountain landfill was approved by Riverside County for a 50-year operation, and Phase 5 is not a part of the County-approved landfill project. Therefore, there is no conflict between the landfill and the pumped storage project over the use of the East Pit unless and until Phase 5 of the landfill is approved.

The operating license for the pumped storage project from FERC is also proposed to be for a period of 50 years, at which point the project will either be relicensed or retired. Therefore, it is fair to leave the decision of the best use of the east pit to a future generation if relicensing is proposed and a conflict with future landfill operations is encountered.

Landfill Timing Compatibility Issues

The timing of construction of the landfill project is not known at this time. Under present conditions, construction of the pumped storage project is very likely to be completed before the start of the landfill project and construction of facilities required to support landfill operations.

If all approvals for the landfill were resolved in 2012, then construction of support facilities for the landfill could begin when designs were finalized, and commercial landfill operations could theoretically begin as early as 2016. However, we believe this is an unlikely scenario based upon the recent Ninth Circuit Court decision remanding the legal dispute for further review, review of current and projected demand for landfill capacity in southern California, the bankruptcy filing of Mine Reclamation, LLC, and the recent opening of the Mesquite Regional Landfill. Therefore, as discussed in greater depth below, it is highly unlikely that the landfill project and the pumped storage project construction periods will overlap.

One component of the landfill proposal is an exchange of lands between Kaiser and the Bureau of Land Management ("BLM"). Approval of the landfill is contingent upon Kaiser being the fee owner of the property (See Development Agreement No. 64 Section 2.2; California Integrated Waste Management Board resolution 1999-624 (revised); and California Integrated Waste Management Board, Board Meeting Summary December 14-15, 1999). Therefore, until the land exchange is effectuated, the landfill is not a formally approved operation.

On September 25, 1997, BLM issued a Record of Decision approving the land exchange between itself and Kaiser, which was appealed to the Interior Board of Land Appeals ("IBLA"). On September 20, 1999 the IBLA issued an order denying the appeal and affirming the land exchange. This decision was subsequently appealed to the District Court who decided that "*The subject land exchange and grants of rights of way and reversionary interest are set aside and the Defendants are enjoined from engaging in any action that would change the character and use of the exchanged properties…*" until they complied with the changes requested by the decision. *Donna Charpied et al., v. United States Dept. of Interior et al.*, ED CV99-0454 RT (Mcx) (Sept. 20, 2005); *Nat'l Parks and Conservation Assoc., v. Bureau of Land Mgmt, et al.*, ED CV 00-0041 RT (Mcx) (Sept. 20, 2005).

This case was appealed to the Ninth Circuit Court of Appeals, and oral argument was heard on December 6, 2007. A decision on the case was published November 10, 2009, and the case was remanded for further proceedings consistent with the Ninth Circuit opinion. The U.S. Supreme Court declined to hear Kaiser's appeal of the Ninth Circuit decision. According to Kaiser's Quarterly Report to the Securities and Exchange Commission (dated May 2011), "the adverse federal litigation jeopardizes the viability of the current Landfill project. In addition such decision may adversely impact the agreement to sell the Landfill Project to the [Los Angeles County Sanitation] District, including termination of the agreement."

According to the Quarterly Report, "If the land exchange litigation is not ultimately favorably resolved and/or the Company cannot otherwise cure various alleged title and other closing issues in a timely fashion, then the [Los Angeles Sanitation] District's purchase of the Landfill Project would not be completed and the Company might have to abandon the Eagle Mountain Landfill Project and its investment in MRC. The adverse federal litigation materially increases the possibility of such a scenario."

The Quarterly Report additionally states that, “With regard to the Landfill Project, we are evaluating the time and money necessary to pursue a fix through the BLM. This fix process would ultimately include the federal courts reviewing the adequacy of the fix. A fix through BLM and the likely court review would take several years once the fix is formally initiated. Due to the results of the federal litigation and if there is not a successful fix through the BLM, it is a possible [sic] that there ultimately may not be a viable landfill project.”

On October 31, 2011 Mine Reclamation LLC, filed a voluntary petition for relief under Chapter 11 of the United States Bankruptcy Code in the United States Bankruptcy Court for Central District of California, Riverside Division, bankruptcy case number 6:11-bk-43596 . According to Form 8-K filed by Kaiser Ventures with the Security and Exchange Commission, dated October 31, 2011, Mine Reclamation will continue to operate its business as a "debtor in possession" under the jurisdiction of the Bankruptcy Court and in accordance with the applicable provisions of the Bankruptcy Code, Rules and orders of the Bankruptcy Court. Kaiser Ventures LLC owns approximately 84.247% of Mine Reclamation. In a press release issued on October 31, 2011, Mine Reclamation stated that “the future of the [Eagle Mountain] site and its potential for job creation and funding for Riverside County and the future for Kaiser's retired steel workers are all more uncertain than ever.”

Therefore, while it is not possible to predict the length of time needed for future proceedings, it is clear that several years will be needed to resolve the landfill litigation. In the event that the land exchange is confirmed and all the necessary landfill approvals are issued, construction of the landfill could commence. A timeline for the start of construction is unknown, but is unlikely to occur before 2015 under the most optimistic scenario. Based on the experience of the Mesquite Regional Landfill, construction could take three years before the landfill would be ready to accept waste. Therefore, landfill operations are unlikely to commence prior to 2018.

However, the construction and operation of the Eagle Mountain Landfill may be further delayed due to a lack of demand for additional landfill capacity in southern California at this time. The Mesquite Regional Landfill (MRL) opened for business in 2009. The MRL will provide capacity for approximately 600 million tons of solid waste and 100 years of operation at a maximum of 20,000 tons per day. In 2009, when the MRL became operational, the Los Angeles County Sanitation District’s projections show there will be between 10,000 and 16,000 tons per day of excess landfill capacity in Los Angeles County. Although this means there is no immediate need to export trash to the MRL, the Sanitation Districts are proposing to conduct a 300 tons per day operation at the MRL. The projections continue to show excess landfill capacity in Los Angeles County until late 2013, when the Puente Hills Landfill will be closed permanently. According to the projections, there may still be some excess capacity at other landfills in 2013. However, there could be an overall shortfall of 4,500 tons per day in 2013 (Sanitation Districts of Los Angeles County, http://www.mrlf.org/index.php?pid=101, accessed February 18, 2009).

If the entire 4,500 tons per day shortfall from Los Angeles County is transported to the MRL facility, there would still be capacity for an additional 15,500 tons per day from other sources at the MRL facility. Therefore, there is enough capacity at the MRL facility to serve southern California’s waste disposal needs for decades to come. For these reasons, construction of the landfill is unlikely to commence in the foreseeable future. On this basis, we conclude that the Pumped Storage Project is likely to be built and operational prior to initiation of landfill construction at Eagle Mountain.

Post Construction Operations

During normal operations after construction, the pumped storage project will require a relatively small work force for routine operations and maintenance. Daily traffic patterns would likely be as follows:

- Day and night shift small truck traffic on Kaiser Road into and out of the underground powerhouse access tunnel portal at the lower reservoir.
- Day shift traffic on Kaiser Road into and out of the water treatment facility area.
- Once or twice per day daytime small truck traffic on the lower reservoir perimeter road to inspect the inlet/outlet structure
- Once or twice per day daytime small truck traffic on the access road along the landfill to the upper reservoir and the surge shaft location for inspection of the upper reservoir dams inlet/outlet structure, and the surge control facilities.

During major maintenance activities (once per year and possibly less frequently), larger trucks and construction-type equipment will be traveling on the same project area roads as indicated above. These activities, although relatively infrequent, can be readily coordinated in advance with Kaiser so that landfill operations are not impacted.

As part of the design coordination process between ECE and Kaiser, planning for large and small vehicle traffic and road design should be addressed. Operation of the landfill will be large vehicle and equipment intensive and there will be times when large vehicles and equipment must be mobilized. Roads will be wide enough to accommodate simultaneous road use for both projects. Signage and safety management measures will be designed to address both projects.

January 2011 update: Response to Additional Comments from Kaiser and Others in Review of the July 2010 Draft Environmental Impact Report.

In June 2010, the Draft Environmental Impact Report (DEIR) on the Eagle Mountain Pumped Storage Project was issued by the State Water Board under the California Environmental Quality Act (CEQA) process. In a letter dated October 7, 2010, Kaiser provided additional comments on the Project related to the potentials for conflicts between the Project and the Landfill. ECE's position on these conflicts and proposals to address potential conflicts are summarized below:

Kaiser concern: The proposed construction road to the shaft crosses Phases 2 and 3 of the Landfill.
Response: The existing access road will be used to access the pumped storage surge tank and shaft. However, in the event that the landfill is constructed, a north perimeter access road will be constructed by the landfill for landfill access. The proposed Project will then utilize the north perimeter maintenance road for access to the surge tank and shaft to avoid impacts to the landfill Phases 2 and 3.

Kaiser concern: The Project's upper reservoir outlet channel may conflict with Phase 1 of the Landfill.
Response: The existing natural drainage downstream of the existing Central Pit will accept any flood spills or other releases from the upper reservoir. ECE has assumed that this drainage would not be within the "footprint" of the proposed Landfill. At the present time, with the scale and level of design detail available for both projects, it is not possible to clearly

identify conflicts that may potentially exist. As designs for both projects progress, it will be very important to determine the westerly extent of the Phase 1 Landfill toe and to see whether or not it will extend into the existing drainage, which will be improved to handle the very infrequent outflows from the upper reservoir. If the Landfill toe will extend into this drainage channel, it will be necessary to adjust the channel alignment and to assure that the Landfill toe is protected against erosion.

Kaiser concern: It appears that the upper reservoir dam toe extends into Phase 1 of the Landfill.
Response: The selected upper reservoir south dam axis is tentatively located to minimize the amount of material required to construct the dam, based on available topographic mapping. The dam axis can be adjusted during final project planning and design to avoid any potential for conflict. This adjustment would generally be to the north (upstream) of the currently proposed dam axis a distance of 150 to 200 feet. The "footprint" of the upper reservoir area would not be increased.

Kaiser concern: The transmission line from access tunnel portal to the switchyard is above ground and extends through a portion of Landfill Phase 4.
Response: The current alignment of the transmission line from the access tunnel portal to the switchyard can be modified to avoid Phase 4 of the Landfill, with little impact on the Project. This revised alignment will be developed during final project planning and design, and discussed with Kaiser to be sure of compatibility.

Kaiser concern: Certain proposed Project facilities could interfere with the planned Landfill rail yard and RO/Admin facilities for the Project.
Response: ECE developed Figure 4 using the most-current landfill design drawings which are publically available (dated October 1997). Based on this project layout, ECE understands that the railyard and operations center would be located on the east side of the Landfill. However, other, older drawings from the proposed Specific Plan show the railyard to be located south of the East Pit for the early years of landfill development. The ideal location for the proposed Project switchyard and RO facilities and structures is the one currently shown on the Project drawings. Therefore, it appears that further discussions between ECE and landfill interests will be required as final planning and design of both projects proceeds.

August 2012 update: Response to Additional Comments from Kaiser on Draft Water Quality Certification

Kaiser concern: All five phases of the landfill were covered in the Landfill EIR/EIS and received the necessary approvals from Riverside County.
Response: On January 14, 2000, the Local Solid Waste Management Enforcement Agency for Riverside County issued a Solid Waste Facility Permit 33-AA-0228 for the Eagle Mountain Landfill. The California Integrated Water Management Board concurred with the issuance of Solid Waste Facility Permit No. 33-AA-0228 (Resolution 1999-624 Revised). The Solid Waste Facility Permit issued to the Eagle Mountain Landfill specifies a "permitted area" of 4,654 acres, a "disposal area" of 1,864 acres, and a design capacity for Phases 1 – 4 of 559,963,680 cubic yards. These specifications match the area and capacity of landfill Phases 1 – 4, but do not include landfill Phase 5. Therefore, Landfill Phase 5 is not included in the Solid Waste Facility permit.

The Waste Discharge Requirements (WDR) Order 99-061 issued by the Colorado River Regional Water Quality Control Board states that development of the landfill will, "Begin with Phase 1 and end with Phase 4." The WDR further states that, "The 1,868 acre landfill will be constructed in four continguous phases, containing 13 sequences… The approximate total airspace of the site is 660 million cubic yards, which will provide waste capacity of about 561 million cubic yards during the 84 year life of projected landfill life." The WDR specifies the construction sequencing of the landfill (starting with Phase 1 and ending with Phase 4) and requires the written approval of the Executive Director for significant deviations in sequencing. Attachment 8 of the WDR is the Landfill Phasing Plan which shows only Phases 1 – 4 of the landfill. No provision is made in the WDR for construction of Phase 5 of the landfill.

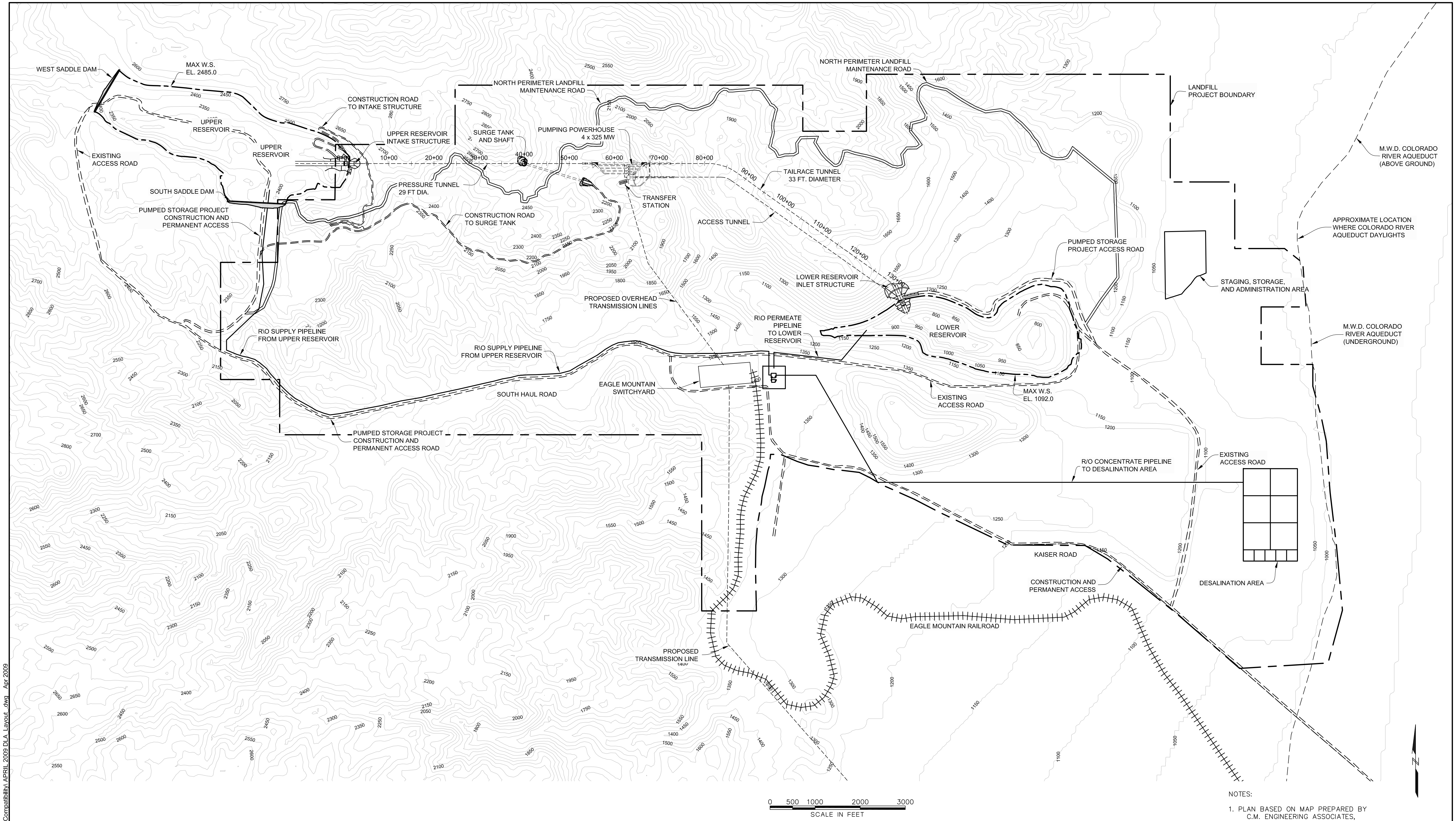
The Report of Disposal Site Information (RDSI) prepared by GeoSyntec in August 1999 and filed with the Regional Water Quality Control Board states that "The proposed landfill operation addressed in this RDSI occurs in four large contiguous phases. A future fill area designated as Phase 5 and evaluated in the EIR/EIS is also indicated in the RDSI for conceptual purposes. The permitting for Phase 5 future fill area will be accomplished at a later date under a separate document from this RDSI… Total estimated capacity of the landfill area (Phases 1 – 4) is approximately 560,700,000 cubic yards which will accommodate the disposal of 462,500,000 cubic yards of waste." The projected life of Phases 1 - 4 is 84 years. No later permitting was accomplished for Phase 5 of the landfill.

The Development Agreement No. 64 between Riverside County and Mine Reclamation Corporation specifies the term of the agreement, "The County has further approved the term of this Agreement for the period beginning on the Effective Date and continuing until November 30, 2088, and the parties have agreed to stage the term. Specifically, the parties have agreed to initial term of fifty (50) years from the Effective Date, although there will be additional landfill capacity available at the expiration of the initial term of this Agreement...**in no event shall the term of this agreement be extended under this Section 2.3.1 beyond November 30, 2088**." (emphasis added). As described above, the projected life of Phases 1 - 4 is 84 years. Therefore, even if the landfill were to begin operation this year, which is not possible for the reasons described above, the Development Agreement will expire prior to the completion of Phase 4.

Therefore, we conclude that Phase 5 of the Eagle Mountain Landfill is not a component of the project as approved by Riverside County and the Regional Water Quality Control Board, and there is not sufficient time remaining in the Development Agreement to allow for construction of any phases beyond Phase 4.

Conclusion

Based on GEI's review of the landfill design, as currently documented, we are of the opinion that both the proposed pumped storage project and the proposed landfill project (Phases 1 – 4) can be constructed and operated without significant conflicts. As final design on both projects progresses, potential conflicts that relate to road use and traffic management will be assessed and planned for.



NOTES:

1. PLAN BASED ON MAP PREPARED BY C.M. ENGINEERING ASSOCIATES, SAN BERNARDINO, CA.

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NO.	DATE	ISSUE/REVISION	DES	DRN	CHK	APP

EAGLE CREST ENERGY COMPANY

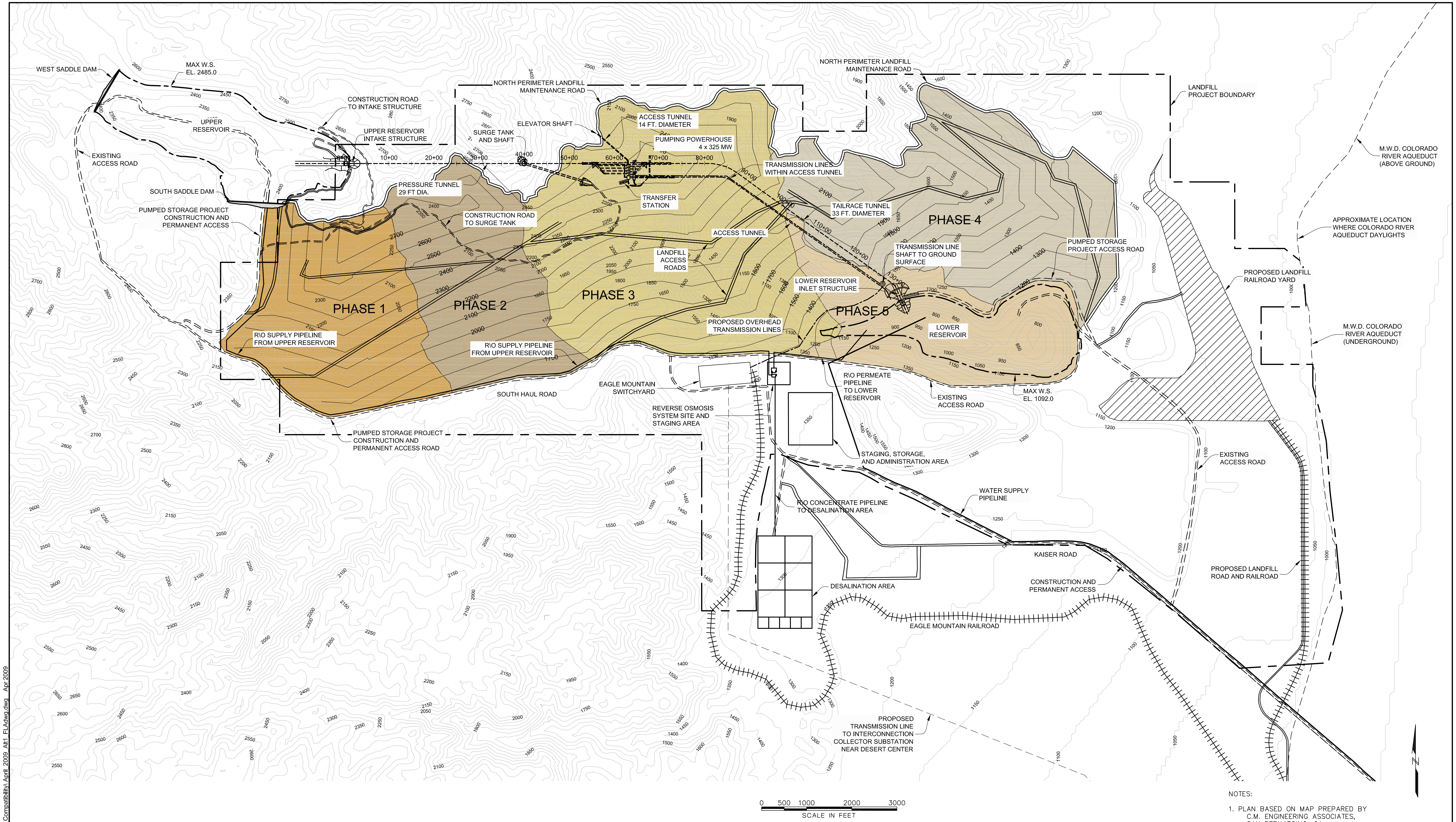
GEI PROJECT 080473

EAGLE MOUNTAIN PUMPED STORAGE PROJECT

LANDFILL COMPATIBILITY PLAN
DLA LAYOUT

FIGURE NO.
1

SHEET NO.
1 of 3



NOTES:

1. PLAN BASED ON MAP PREPARED BY C.M. ENGINEERING ASSOCIATES, SAN BERNARDINO, CA.

NO.	DATE	ISSUE/REVISION	DES	DRN	CHK	APP

Eagle Crest
Energy Company

EAGLE CREST ENERGY
COMPANY

GEI PROJECT 080473

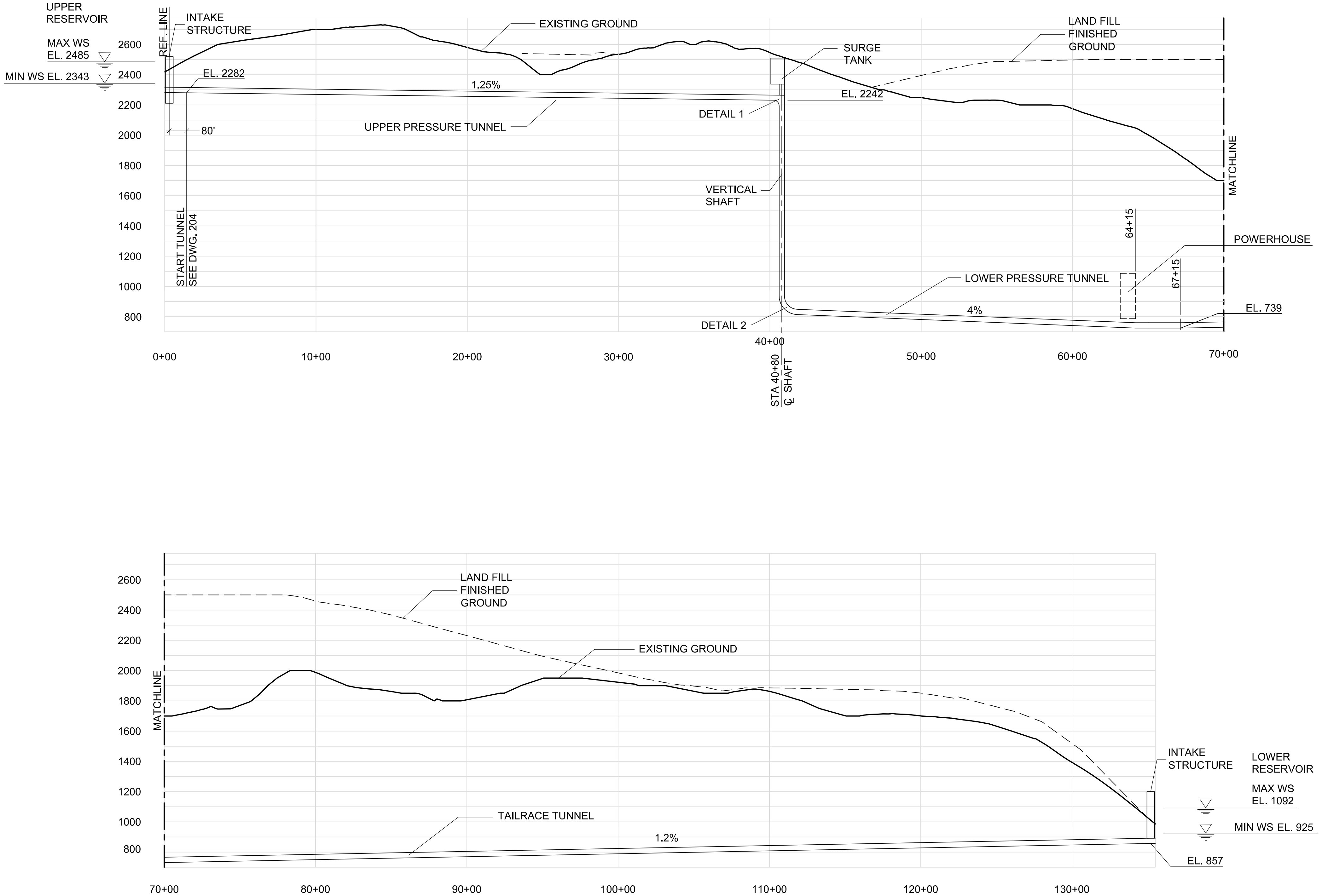
EAGLE MOUNTAIN PUMPED
STORAGE PROJECT

LANDFILL COMPATIBILITY
PLAN
FLA LAYOUT

FIGURE NO.
2

SHEET NO.
2 of 3

P:\080470 Eagle Mt\080472 Landfill Compatibility\ April 2009 Alt1 FLA.dwg Apr 2009



CROSS SECTION ALONG WATER CONDUITS

NOTES:

1. UNDEFINED LANDFILL CONTOURS WERE ASSUMED TO FOLLOW DEFINED CONTOURS AND TO COME INTO ALIGNMENT WITH THE EXISING GROUND SURFACE.

NOTES:

1. PLAN BASED ON MAP PREPARED BY C.M. ENGINEERING ASSOCIATES, SAN BERNARDINO, CA.

PLAN

0 400 800

SCALE, FEET

NO.	DATE	ISSUE/REVISION	DES	DRN	CHK	APP

Eagle Crest
Energy Company

EAGLE CREST ENERGY COMPANY

GEI PROJECT 080473

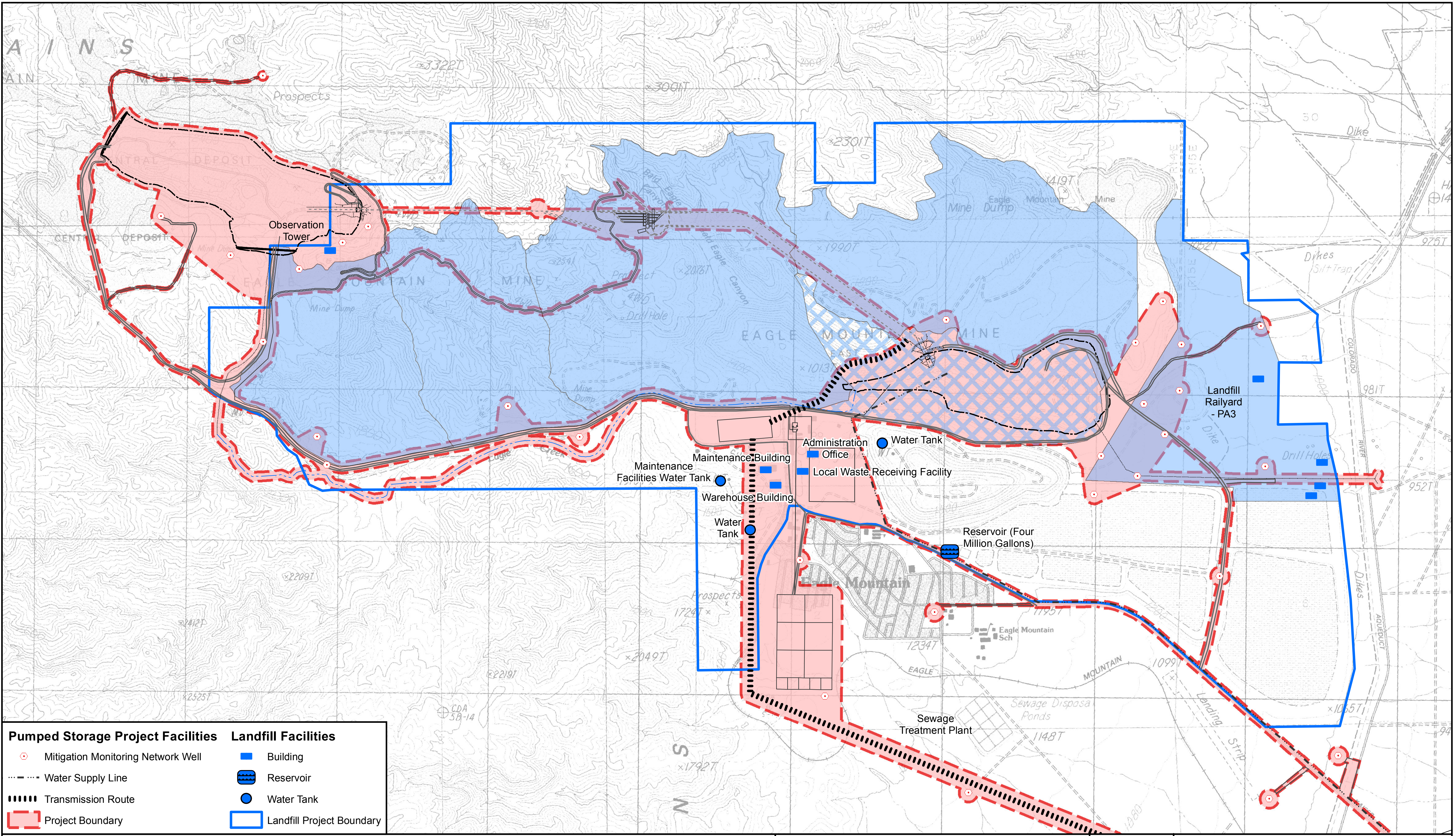
EAGLE MOUNTAIN PUMPED STORAGE PROJECT

LANDFILL COMPATIBILITY
FLA LAYOUT -
CROSS SECTION

FIGURE NO.
3

SHEET NO.
3 of 3

P:\080470 Eagle Mt\080472 Landfill_Compatibility\ PROFILE_FLA.dwg Apr 2009



Pumped Storage Project Facilities

⊙	Mitigation Monitoring Network Well
···-···	Water Supply Line
▮▮▮▮▮▮	Transmission Route
🟥	Project Boundary

Landfill Facilities

🟦	Building
▤	Reservoir
●	Water Tank
☐	Landfill Project Boundary

Source: Landfill Features from Eagle Mountain Landfill and Recycling Center Site, Report of Disposal Site Information, Site Development Plan, Prepared for Mine Reclamation Corporation by C-M Engineering Associates, Drawing 2 of 43, Feb 1994, updated 10/27/97.

Eagle Crest Energy Company

Eastern Riverside County, California

OVERLAY OF LANDFILL PROJECT (1997 UPDATE) AND PUMPED STORAGE PROJECT (DEIS)

June 2011

Figure 4, Sheet 4 of 4

15-Jun-2011 Z:\Projects\080472_EagleMtn_fromDenver\Figure_C_forLF_2.mxd SET