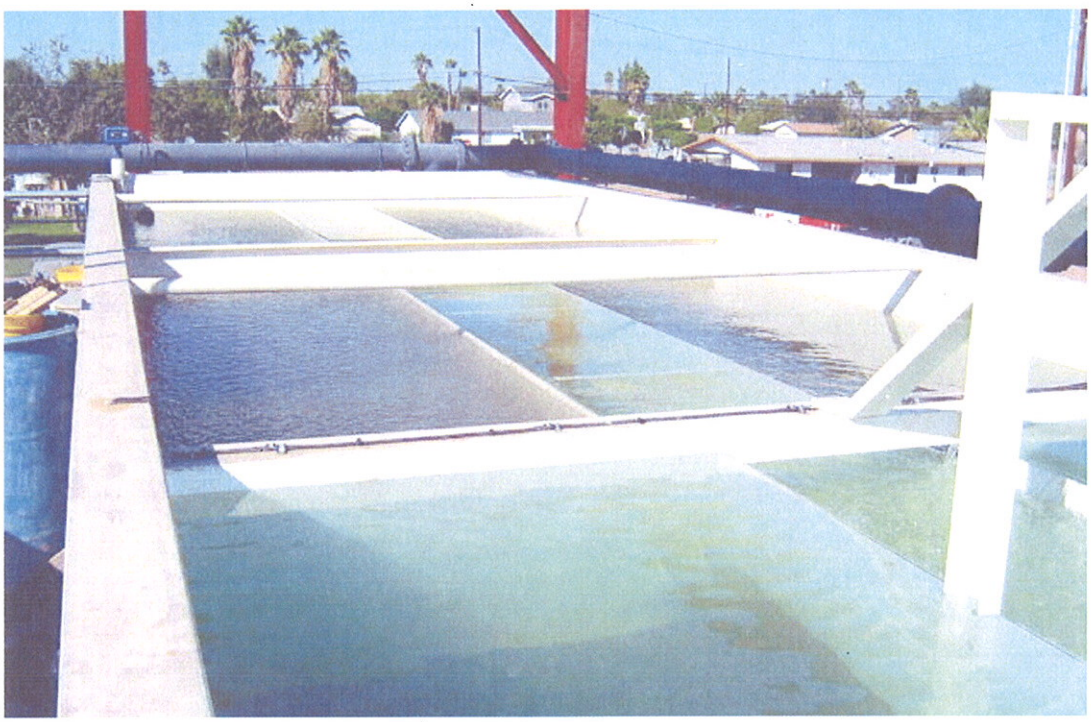
Heber Public Utility District
Water Treatment Plant Expansion



Preliminary Engineering Report
January 28, 2008
THG Job No. 744.032E

Prepared by

THE HOLT GROUP, INC.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Heber Public Utility District Water Treatment Plant was expanded in 2005. The existing Heber Public Utility District Water Treatment Plant is capable of producing 2.0 million gallons per day. The average day demand for the Heber Public Utility District in 2006 was 1.103 MGD. The maximum day demand for 2006 was 2.246 MGD, exceeding the capacity of the plant, and therefore the Water Treatment Plant is now considered "under capacity".

The Heber Public Utility District service area growth from 1990 to 2000 was 1.6 percent per year. The Heber Public Utility District has experienced rapid and significant residential growth over the last several years. The population of the Heber Public Utility District increased 66 percent (from a population of 3,508 persons to a population of 5,834 persons) between the years 2005 through 2006. The population is expected to increase 56.9% during the next ten (10) year period from a population of 5,834 at year end 2006 to a population of 9,151 in the year 2017. Table 5-2 on page 5-5 of this document illustrates the population projections for the years 2007 through 2030.

Several factors have contributed to the rapid and significant residential growth. The Townsite of Heber is immediately south of the premier development in Imperial Valley region – the Imperial Valley Mall. Additional high end commercial and business development are planned in the immediate vicinity of the Imperial Valley Mall. Coupled with commercial development is the sprawl of the neighboring municipality's residential development, reaching toward the southern boundary of the City of El Centro where El Centro meets Heber. The Heber Public Utility District service area is comprised of relatively large tracts of vacant, low-priced farmland that has captured the market interest of residential home builders. The Heber Public Utility District is either near, or intersected by several major arterial roadways, including Highway 86, Highway 111, Interstate 8 and Dogwood Road. The major highway access makes Heber an attractive

location for residential, commercial and industrial development. Heber has been viewed and continues to be an ideal location for growth.

The recommended expansion of the HPUD Water Treatment Plant is based upon continuing the use of the TR840A Microfloc Trident Water Treatment Units. The use of the 2.0 MGD Water Treatment Units will result in a Water Treatment Plant expansion that will increase the water capacity in 2.0 million gallon per day multiples.

It is recommeded that the Heber Public Utility District expand the existing Water Treatment Plant from a 2.0 MGD Plant to a 6.0 MGD Plant. Table 5-2 illustrates that a 4.0 MGD Plant would reach its capacity in the year 2020. A 6.0 MGD Plant would reach its capacity in the year 2030. Assuming funding is for a 15-20 year growth, expanding the existing 2.0 MGD Water Treatment Plant to a 6.0 MGD Water Treatment Plant is the optimal and reasonable alternative.

The Department of Health Services has indicated that HPUD will be required to maintain a minimum of 6 days of raw water storage. One way to create the raw water storage capacity is to construct new Raw Water Basins. However, the construction of new Raw Water Basins will necessitate the acquisition of land. The acquisition of land is both time-intensive and cost prohibitive.

An alternative to constructing additional Raw Water Basins is the installation of portable pumping units and a 1.8 mile (9,504 foot) long, 36-inch diameter HDPE pipeline from the Imperial Irrigation District Central Main Canal to the HPUD Water Treatment Plant. This alternative has been officially submitted and approved by the Imperial Irrigation District and the State Department of Health Services (See Section 7.3). This option appears to be cost effective and practical in comparison to the Raw Water Storage Basins.

HPUD is currently constructing another major Water Treatment Plant component - a 3.0 million gallon (MG) reservoir. The 3.0 MG reservoir will provide the additional finish

water volume to sustain the Water Treatment Plant through peak demand periods. The 3.0 MG reservoir, in conjunction with the existing reservoirs, are expected to provide a sufficient finished water supply through Water Treatment Plant expansions up to 8.0 MG.

This report evaluates the costs to expand the existing 2.0 MGD HPUD Water Treatment Plant to a 6.0 MGD Water Treatment Plant. A detailed Engineer's Opinion of Probable Cost is included in Section 9. The construction of the 36-inch raw water transmission pipeline consitutes as a large portion of the costs with regard to expanding the HPUD Water Treatment Plant. Once this major capital improvement is constructed, the cost of subsequent expansion significantly declines.

INTRODUCTION

1.0 INTRODUCTION

Heber, California is a rural and unincorporated area located approximately 5 miles north of the Mexican border. The location maps are shown in Figure 1-1. According to the 2000 U.S. Census, the population was listed at 2,988. The 2007 population is estimated at approximately 6,174 persons, over double the 2000 population figure. The Heber Public Utility District (HPUD) boundaries contain an area of approximately 1,100 acres (1.7 Square Miles). The surrounding area consists primarily of large tracts of farmland. The HPUD sphere of influence encompasses approximately 7 square miles. The total HPUD service area consists of 8.7 square miles.

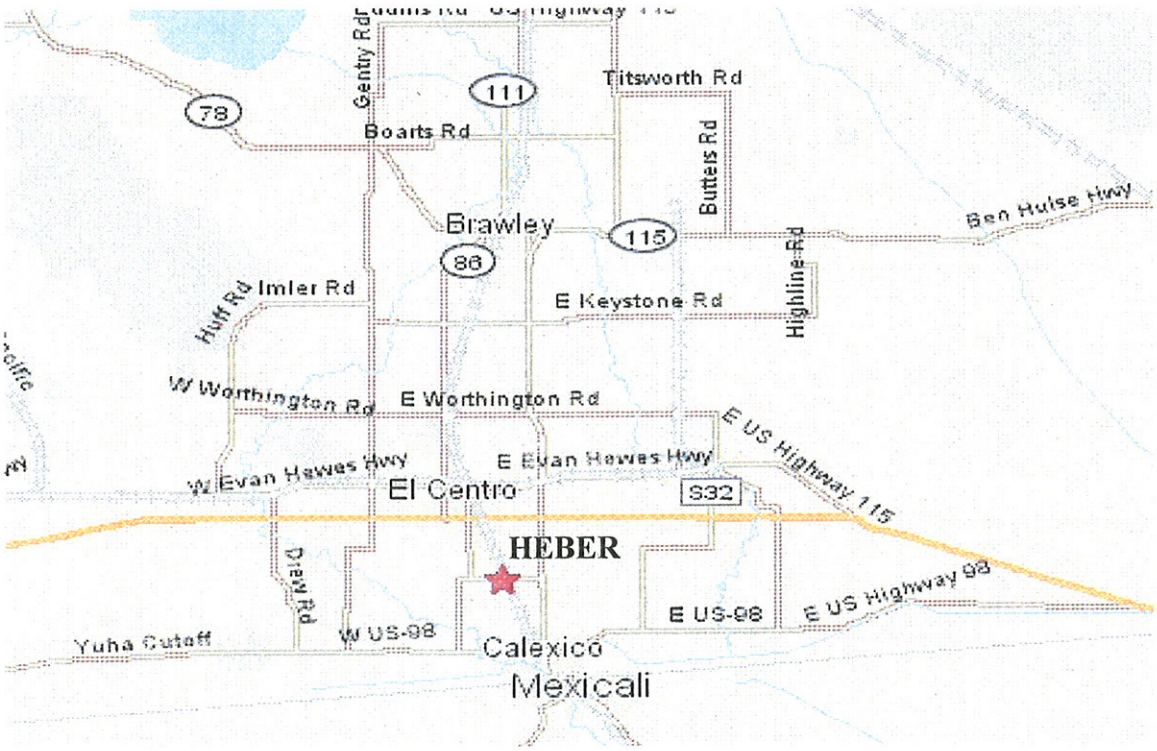


Figure 1-1

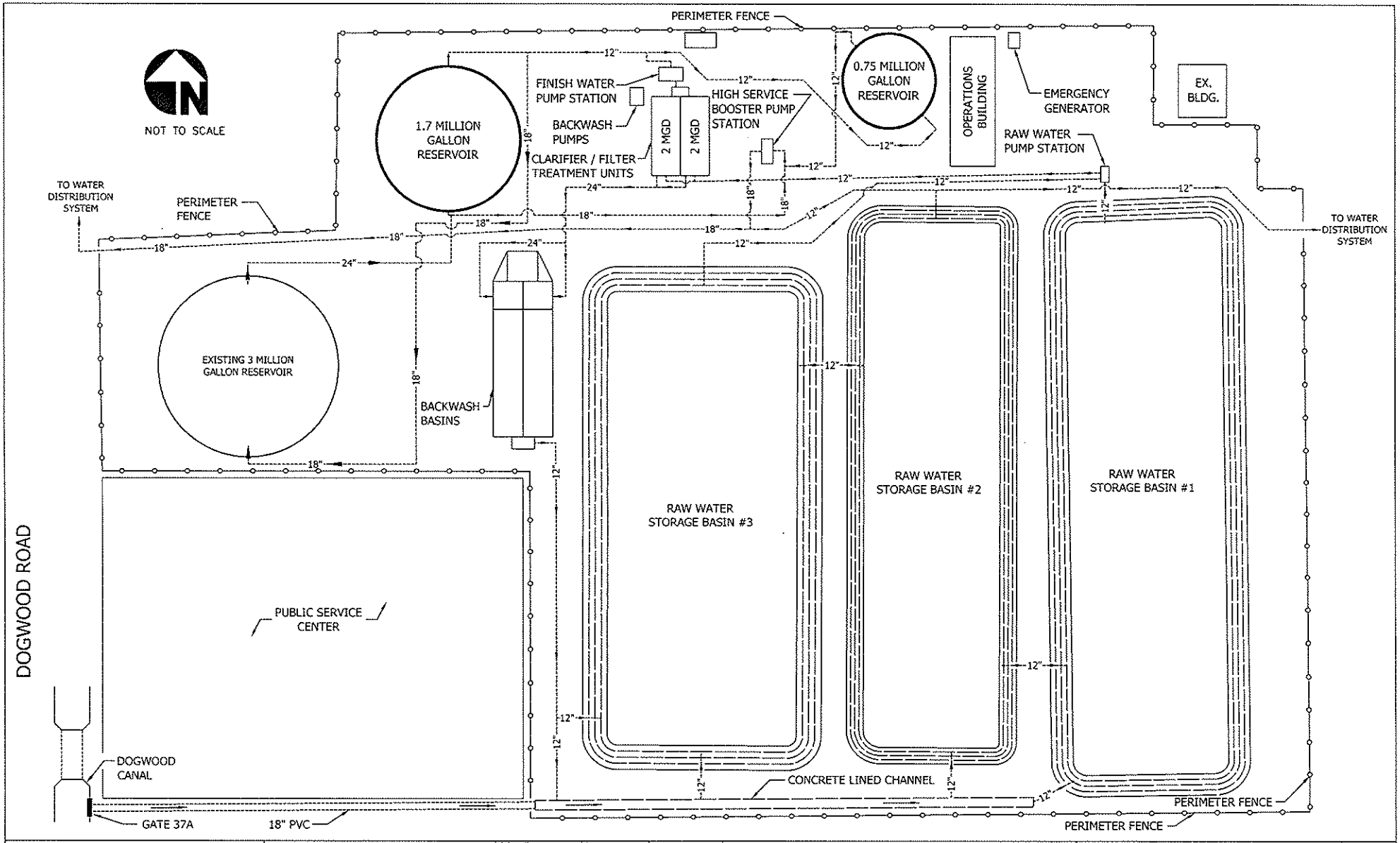
The Heber Public Utility District (HPUD) was formed in 1933 to provide a potable water supply to the Heber Townsite. Since 1933, the Water Treatment Plant has been expanded and upgraded to meet increased demands and remain compliant with water quality standards. The Water Treatment Plant currently consists of three raw water storage

basins, a raw water pump station, a chemical system, combined absorption clarification and media filtration units, a finish water pump station, post chlorination facilities, clear water storage, backwash pumps and backwash basins, an operations building, electrical power facilities, instrumentation and control facilities and a high service booster pump station. The Water Treatment Plant has the capacity to serve 2 million gallons of potable water per day to the Heber Public Utility District. See Figure 1-2 illustrating the existing Heber Public Utility District Water Treatment Plant.

It is recommended by the American Water Works Association (AWWA) that a Preliminary Engineering Report for the expansion of a Water Treatment Plant be prepared when the Water Treatment Plant reaches eighty percent of capacity. The HPUD Water Plant reached 84.5 percent of capacity in the year 2005, and 112.3 percent capacity in 2006. HPUD authorized The Holt Group, Inc. to complete a Preliminary Engineering Report for the expansion of the Heber Public Utility District Water Treatment Plant on January 19, 2006 with the report completed and dated May 2006 using 2005 population figures. With such rapid growth in population, the Heber Public Utility District requested and updated report in September 2007 using 2006 population figures.

Based on information given by HPUD, the current maximum day demand is 2.24 million gallons per day (MGD). The permitted treatment plant capacity of 2.0 MGD was obviously exceeded in 2006. With the number of residential housing units under construction, HPUD anticipates a significant increase in potable water demand during the next four (4) year period. To keep pace with the increased potable water demand, HPUD is exploring the expansion of the Water Treatment Plant from 2.0 MGD to a capacity that will accommodate growth over the next 20 years.

HPUD desires to complete the recommended water treatment plant facility expansion within the existing plant site. The report will evaluate completing the next expansion within the current Water Treatment Plant boundaries.



1601 NO. IMPERIAL AVE PHONE : (760) 337-3883 EL CENTRO, CA 92243 FAX : (760) 337-5997	The Holt Group	SCALE: NOT TO SCALE	DATE: 12-16-2007	PROJECT NO. 744.032E	HEBER PUBLIC UTILITY DISTRICT - WATER TREATMENT PLANT EXPANSION REPORT	DESCRIPTION: EXISTING HPUD WATER TREATMENT PLANT	FIGURE: 1-2

BACKGROUND INFORMATION

2.0 BACKGROUND INFORMATION

2.1 Site Location/Size

The Heber Public Utility District (HPUD) Water Treatment Plant is located southeast of the Dogwood Road and Highway 86 intersection. The HPUD Water Treatment Plant address is 1085 Ingram Road, Heber, California, 92249.

The Water Treatment Plant site is comprised of 8.5 acres of land. There are portions of the Water Treatment Plant site that are used for equipment and material storage. Those portions of land used for storage within the Water Treatment Plant site may be used for the expansion of the Water Treatment Plant.

2.2 Raw Water Supply/Quality

HPUD obtains its raw water from the Imperial Irrigation District (IID) Central Main Canal via the Dogwood Canal and Delivery No. 37-A headgate. The Dogwood Canal is periodically taken out of service by the IID for maintenance. The Dogwood Canal is typically removed from service for a period of four (4) days every three (3) months. During those periods, HPUD relies on the raw water stored in the three water ponds. The raw water ponds contain a combined volume of 7.3 million gallons. At the 2006 Average Daily flow rate of 1,102,600 gallons per day, the raw water storage capacity time duration was 7.3 million gallons/1,102,600 gallons per day = 6.6 days. At the 2006 maximum day demand of 2,246,000 gallons per day, the raw water storage capacity time duration was 7.3 million gallons/2,246,000 gallons per day = 3.3 days. At the rated 2,000,000 gallon per day capacity of the Water Treatment Plant, the raw water storage capacity is 7,300,000 gallons / 2,000,000 gallons / day = 3.65 days. The State of California Department of Health is requiring a raw water storage capacity of six (6) days at the plants rated capacity of 2,000,000 or 6 days x 2,000,000 gallons per day = 12,000,000 gallons. HPUD is 12,000,000 gallons – 7,300,000 gallons = 4,700,000 gallons deficient with respect to the raw water supply.

As with all other Surface Water Supplies, including the HPUD raw water supply, the California Department of Health Services requires the monitoring and treatment of microbiological pathogens, such as bacteria, viruses, Giardia and Cryptosporidium. HPUD is required to monitor its raw water quality source for total coliform, fecal coliform and E. Coli bacteria on a monthly basis.

2.3 Populations- Present and Future

From 1990 to 2000, the Heber Townsite population increased from 2,566 persons to 2,988 persons, for a net increase of 422 persons (per the U.S. Census Bureau). The increase in population from 1990 to 2000 represents a percentage increase in population of 422 persons / 2,566 persons x 100% / 10 years = 1.6% overall growth for each year between 1990 and 2000 (exponential growth rate of 1.52%).

By year end 2005, HPUD had a total of 818 single-family and 59 multi-family residential water services (per Heber Public Utility District document, dated January 10, 2006 as illustrated in Appendix A), creating a total of 877 residential water service connections and a population of 3508 persons. Therefore, from 2000 to 2005, the Heber Townsite population increased from 2,988 persons to 3,508 persons for a net increase of 520 persons representing an exponential growth rate of 3.21 percent.

By year end 2006, HPUD had a total of 1,357 residential water services and a population of 5,834 persons. This represents a 66.3% growth rate in just one year. This growth is attributed to the following residential developments:

Table 2-1: Residential Developments for Heber Townsite by 2006/2007

Name	Residential Units Letter of Commitment by HPUD	Residential Units Occupied in 2006	Residential Units Released in 2007
McCabe Ranch	304	195	42
Heberwood Estates	299	120	115
Desert Sunrise Apts	24	24	0
Heber Meadows	219	121	55
Heber Family Apts	162	81	81
TOTAL	1008	541	293

Per Table 2-1, 541 residential units were constructed and occupied within the HPUD service area by the end of 2006. Based upon an average person per dwelling unit figure of 4.3 persons per unit, the population increase was 541 residential units x 4.3 persons per residential unit = 2,326 persons. This resulted in a population of 3,508 persons + 2,326 persons = 5,834 persons by the end of 2006. This increase in population represents a growth of 2,324 persons / 3,508 persons x 100% = 66.3% growth for the year 2006.

Per Table 2-1, 293 residential units were constructed within the HPUD service area as of end of 2007 (December 3, 2007 data), although not all units are occupied at this time. Based upon HPUD records, a total of 1,436 residential service connections exist. Using an average person per dwelling unit figure of 4.3 persons per unit, 1,436 residential units x 4.3 persons per residential unit = 6,174 persons by the end of 2007. This represents an increase in population of 6,174-5,834=340 persons, or 340 persons / 5,834 persons x 100% = 5.83% growth for the year 2007.

Table 2-2: Anticipated Residential Developments for Heber Townsite by 2010

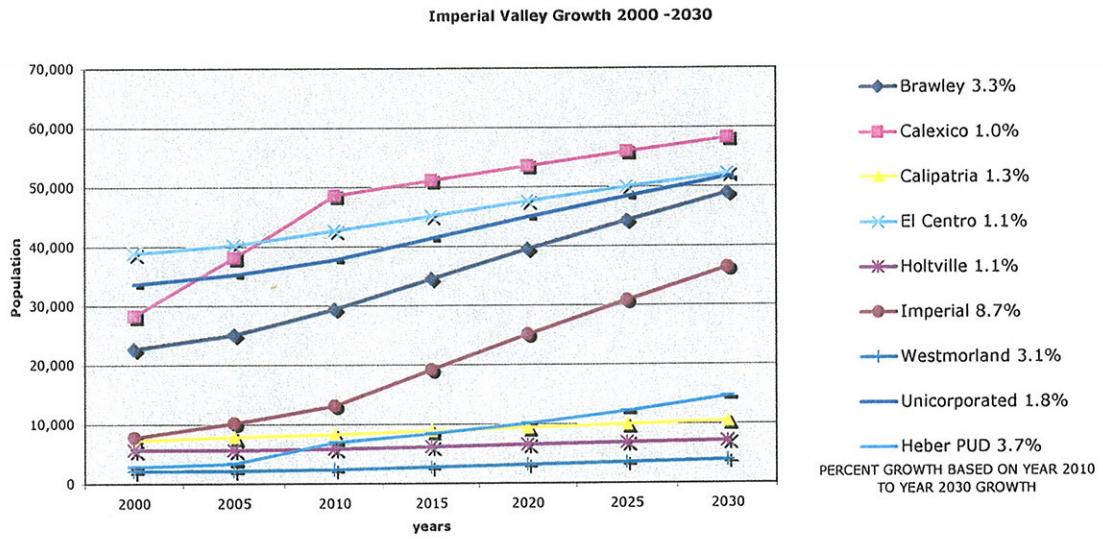
Name	Residential Units Letter of Commitment by HPUD	Residential Units
McCabe Ranch	**127**	**85**
Heberwood Estates	**612**	**273**
Heber Meadows	**107**	**52**
Appaloosa Estates Subdivision	**8**	**8**
TOTAL	**854**	**418**

Per table 2-2, it is anticipated that 418 residential units will be constructed within the HPUD service area between 2008 and 2010. Assuming half of these are actually built, and based upon an average person per dwelling unit figure of 4.3 persons per unit, the projected increased population will be 418 residential units x 4.3 persons per residential unit x 1/2 = 899 persons. This projection will result in a population of 6,174 persons + 899 persons = 7,073 persons by the end of 2010. This increase in population will represent an exponential growth rate of 4.15 percent for the years between 2007 and 2010.

The population growth based upon the number of residential housing units to be constructed within the next three (3) years is predictable within an acceptable degree of accuracy given the new subdivisions currently under construction. Predicting the population growth beyond 2010 based upon the known subdivisions or a known commercial, industrial or institutional development is not possible. In order to predict population growth beyond 2010, a different population growth forecast method is required. The growth rate for 2006 is considered an anomaly and will not be included in the long term growth projection analysis.

Predicting the future population growth within the HPUD Service area beyond 2010 was completed by analyzing the past trends as well as growth predictions developed by the

Southern California Association of Governments (SCAG). SCAG provides the most current population growth trends within Imperial County. The population projection developed by SCAG is presented in Figure 2-1.



*Note: HPUD Growth Curve was superimposed on the Growth Chart

Figure 2-1

The population projection was graphed beyond the year 2010 for Heber based on past and present HPUD growth projections. The tabulated and graphed population projections are illustrated in Figure 2-2 and Table 2-3. The population growth projections for the purposes of this document will be 3.68 percent. The 3.68 percent growth is derived from the average of 3.21 percent (achieved between the years 2000 to 2005) and 4.15 percent (forecast between the years 2007 and 2010). See Table 2-3. The HPUD growth curve of 3.68 percent has been super imposed upon the SCAG growth chart as illustrated by Figure 2-1. An additional method of determining population growth in Heber is to compare the overall growth from 1980-2007 with the calculated average of 3.68% described above. In 1980, the population was 2,221 persons and in 2007 the population is estimated to be 6,174 persons. This calculates to an exponential growth rate of 3.79% which compares very closely to 3.68% used as the basis for this report. The more conservative of the two numbers were used.

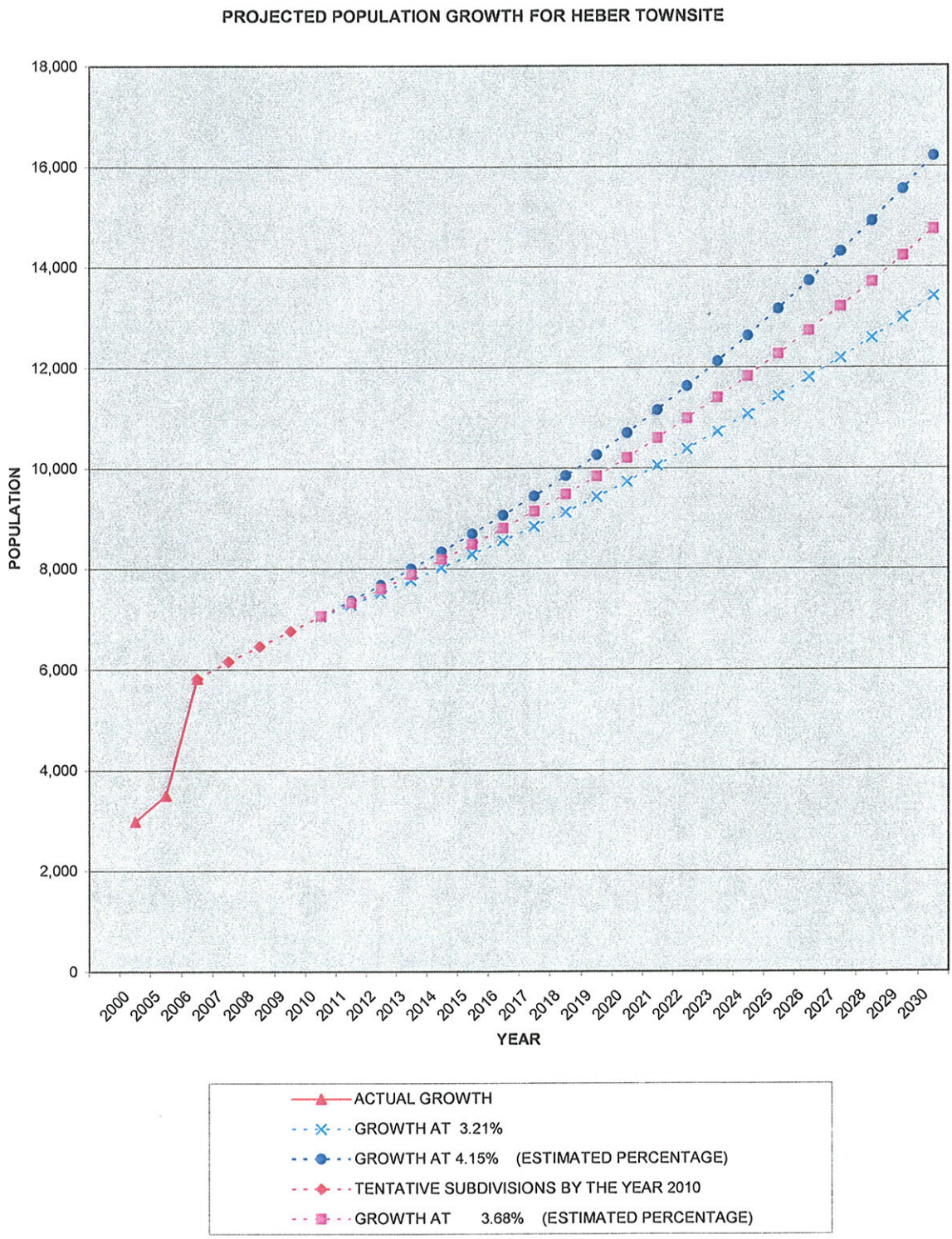

PROJECTED POPULATION GROWTH FOR HEBER TOWNSITE
POPULATION
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2000
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
YEAR
ACTUAL GROWTH
GROWTH AT 3.21%
GROWTH AT 4.15% (ESTIMATED PERCENTAGE)
TENTATIVE SUBDIVISIONS BY THE YEAR 2010
GROWTH AT 3.68% (ESTIMATED PERCENTAGE)

Figure 2-2

PROJECTED POPULATION GROWTH FOR HEBER TOWNSITE

ACTUAL GROWTH		TENTATIVE SUBDIVISIONS BY THE YEAR 2010		GROWTH AT 3.21%		GROWTH AT 4.15% (ESTIMATED PERCENTAGE)		GROWTH AT 3.68% (ESTIMATED PERCENTAGE)	
YEAR	POPULATION	YEAR	POPULATION	YEAR	POPULATION	YEAR	POPULATION	YEAR	POPULATION
2000	2,988								
2005	3,508								
2006	5,834	2006	5,834						
2007	6,174	2007	6,174						
		2008	6,473						
		2009	6,773						
		2010	7,073	2010	7,073	2010	7,073	2010	7,073
				2011	7,304	2011	7,373	2011	7,338
				2012	7,542	2012	7,685	2012	7,613
				2013	7,788	2013	8,011	2013	7,899
				2014	8,042	2014	8,350	2014	8,195
				2015	8,304	2015	8,704	2015	8,502
				2016	8,575	2016	9,073	2016	8,821
				2017	8,854	2017	9,457	2017	9,151
				2018	9,143	2018	9,858	2018	9,494
				2019	9,441	2019	10,276	2019	9,850
				2020	9,749	2020	10,711	2020	10,219
				2021	10,067	2021	11,165	2021	10,602
				2022	10,395	2022	11,638	2022	11,000
				2023	10,734	2023	12,131	2023	11,412
				2024	11,084	2024	12,645	2024	11,840
				2025	11,446	2025	13,181	2025	12,284
				2026	11,819	2026	13,740	2026	12,744
				2027	12,204	2027	14,322	2027	13,222
				2028	12,602	2028	14,929	2028	13,718
				2029	13,013	2029	15,561	2029	14,232
				2030	13,438	2030	16,221	2030	14,765
Column is based on actual growth from 2000 to 2007		Column is based on committed services that are to be served in near future (2008-2010).		Column is based on 3.21 percent growth from 2000 to 2005		Column is based on 4.15 percent growth from 2007 to 2010 projections. 2006 growth rates not used based on anomaly year.		Column is based on average (3.68%) averaging the 4.15 percent and 3.21 percent growth. Also closely matches actual growth rate from 1980-2007 (3.79%).	

Table 2-3

PROJECT DESCRIPTION/OBJECTIVES

3.0 PROJECT DESCRIPTION / OBJECTIVES

The intent of this report is to prepare Heber Public Utility District (HPUD) for the expansion of its District Water Treatment Plant. Rapid residential growth over the last several years has necessitated the expansion of key infrastructure within HPUD. The population of HPUD has increased 95 percent (from a population of 2,988 persons to a population of 5,834 persons) between the years 2000 through 2006. The population is expected to increase 52% during the next ten (10) year period from a population of 5,834 in 2006 to a population of 8,821 in the year 2016.

Several factors have contributed to the rapid residential growth. Heber is immediately south of the premier development in Imperial Valley region – the Imperial Valley Mall. Additional high end commercial and business development are planned in the immediate vicinity of the Imperial Valley Mall. Coupled with commercial development is the sprawl of the neighboring municipality's residential development, reaching toward the southern boundary of the City of El Centro where El Centro meets Heber. The HPUD service area is comprised of relatively large tracts of vacant, low-priced farmland that has captured the market interest of residential home builders. HPUD is either near, or intersected by several major arterial roadways, including Highway 86, Highway 111, Interstate 8 and Dogwood Road. The major highway access makes Heber an attractive location for residential, commercial and industrial development. Heber has been viewed and continues to be an ideal location for growth.

HPUD's maximum day water demand has exceeded the Water Treatment Plant capacity of 2.0 million gallons per day. A maximum day demand of 2,246,000 gallons per day was recorded in the summer of 2006. At this point in time the maximum day demand exceeds the rated capacity of the Water Treatment Plant and therefore the Water

Treatment Plant is considered "over capacity". In order for future growth to occur, it will be necessary to immediately expand the Water Treatment Plant.

The Preliminary Engineering Report will review current and future regulatory issues identified by the governing regulatory agency, The State of California Department of Health Services. The most significant regulatory issues facing HPUD are the required raw water storage for the HPUD Wastewater Treatment Plant and the Chlorine Contact Time (CT) within the ground storage reservoirs. These issues will be reviewed in greater detail within the contents of this report.

The objectives of the report are as follows:

1. To assess the condition and capacity of the existing Water Treatment Plant Facilities, identifying Water Treatment Plant components which are deficient and require rehabilitation or replacement.
2. To explore the expansion of the Water Treatment Plant based upon capacity, considering the integration of the existing treatment units, capital cost, potable water quality, process reliability and ease of operation and maintenance.
3. To recommend the most viable expansion (in terms of capacity), including the capacity of the expanded Water Treatment Plant, excess capacity of the Water Treatment Plant and costs associated with the expansion.

PROJECT REQUIREMENTS

4.0 PROJECT REQUIREMENTS

4.1 Local Flood Levels

The Water Treatment Plant is designated in FEMA Zone C (Areas of Minimal Flooding). The Water Treatment Plant is not located within a 100 year flood plain zone as illustrated on the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps for Imperial County, California.

4.2 Codes and Permits

The Water Treatment Plant is currently permitted under the State of California Department of Health Services (DHS), Drinking Water Program. The Heber Public Utility District (HPUD) Water System DHS designation number is 1310007. The HPUD water treatment system operates under Permit No. 05-14-05-009 (Appendix B).

The Water Treatment Plant is subject to County of Imperial Building Codes and Standards. Any improvements or expansion of the Water Treatment Plant must comply with the 2001 California Building Code which complies with the 1997 UBC, 2000 UPC, 2000 UMC, 1999 NEC and Title 24 Report.

4.3 Soil Reports

A geotechnical (soils) report was prepared for the design, and currently under construction, 3MG Reservoir and proposed Water Treatment Plant Expansion (Included in Appendix C). A separate geotechnical (soils) report was prepared for the design of the raw water transmission pipeline (Included in Appendix D).

4.4 Utilities (power, gas, etc.)

The following utilities service the Water Treatment Plant Site:

- Imperial Irrigation District – Power Division
  1699 West Main Street, Suite A, El Centro, CA 92243
  Alfred Ornelas – (760) 482-3408

- Imperial Irrigation District – Water Division
  333 East Barioni Boulevard, Imperial, CA 92251
  John Kilps – (760) 339-9260

- SBC Telephone
  1029 South Second Street, El Centro, CA 92243
  Mike Ormand – (760) 337-3358

- Southern California Gas Company
  970 North Fourth Street, El Centro, CA 92243
  Jimmie Rodriguez – (760) 352-6100

- Southern California Gas Company
  1981 West Lugonia Avenue, Redlands, CA 92373
  Manny Melendez – (909) 335-7507

- Adelphia
  313 North Eighth Street, El Centro, CA 92243
  Keith Johnson – (760) 352-8835

- Underground Service Alert
  811

- Ogden Geothermal Operations, Inc.
  947 Dogwood Rd, El Centro, CA 92243
  (760) 353-8200

Existing above ground utilities such as telephone lines, power lines, cable lines and junction boxes are visible within and adjacent to the Water Treatment Plant Site. The existing utilities provide service to the adjacent residences, commercial buildings and the HPUD Water Treatment Plant. All utility entities should be contacted regarding the actual location of their respective utility lines and appurtenances during the design and construction phases of the Water Treatment Plant expansion. Prior to construction, Underground Service Alert (Phone Number 811) shall determine the exact location of existing utilities.

4.5 Department of Health Services

HPUD is to comply with the Safe Drinking Water Act and State Laws applicable to public water systems, including, but not limited to, the Health and Safety Code and any regulations, standards or orders adopted thereunder.

HPUD reports to the State of California, Department of Health Services, Division of Drinking Water and Environmental Management, Drinking Water District Office in San Diego, California. On May 11, 2005, the existing 2 MGD Heber Public Utility District Water Treatment Plant was inspected by Mr. Brian Bernardos, San Diego's Branch Engineer and Mr. Bruce Berger, Sanitary Engineer. After the inspection, the Department of Health Services issued HPUD Water Permit (Number 05-14-05-009) dated June 15, 2005. The permit established the requirements to operate the Heber Public Utility District Water Treatment Plant. A provision of the permit limits the capacity of the HPUD Water Treatment Plant to 2 MGD.

The State of California Department of Health Services views the Heber Public Utility District Water Treatment Plant package filter units as alternative technology, equivalent to a conventional filtration treatment. The Heber Public Utility must provide for a combined filter effluent less than 0.25 NTU (nepholometric turbidity units) for 95% of the monthly measurements and less than 1.50 NTU for 100% of the monthly measurements. It shall be necessary to meet a combined filter effluent less than 1.00 NTU from two (2) consecutive turbidity samples. The combined filter effluent samples are to be obtained every four (4) hours. The Water Treatment Plant shall also be capable of achieving at least 99.7% (2.5 log) removal of Giardia cysts and 99% (2 log) removal of viruses in compliance with operation criteria specified in the California Code of Regulations, Title 22, Section 64660 and performance standards specified in Section 64653 (c) or as amended in the future.

WATER PRODUCTION

5.0 WATER PRODUCTION

5.1 Existing Demands

The Water Treatment Plant currently produces a maximum day demand of 2.246 million gallons per day (MGD) of potable water (per Calendar Year 2006 records). As of the end of 2006, Heber Public Utility District (HPUD) served a total of 1,357 single and multi-family residences, and 26 service connections for commercial, institutional and industrial entities. HPUD provides a potable water supply to the Heber Elementary School District site. The school population of the Heber Elementary School consists of 900 persons. HPUD also serves three public parks. Lastly, HPUD has provided construction water to ongoing residential development throughout the last year.

HPUD owns and operates its own Water Treatment Plant. **The average day demand for 2006 was 1.10 MGD, while the maximum day demand for 2006 was 2.246 MGD.** The maximum day peaking factor is 2.246 MGD / 1.10 MGD = 2.04. Figure 5-1 and Table 5-1 illustrate the 2006 Water Demand at the Water Treatment Plant throughout the twelve (12) months of 2006.

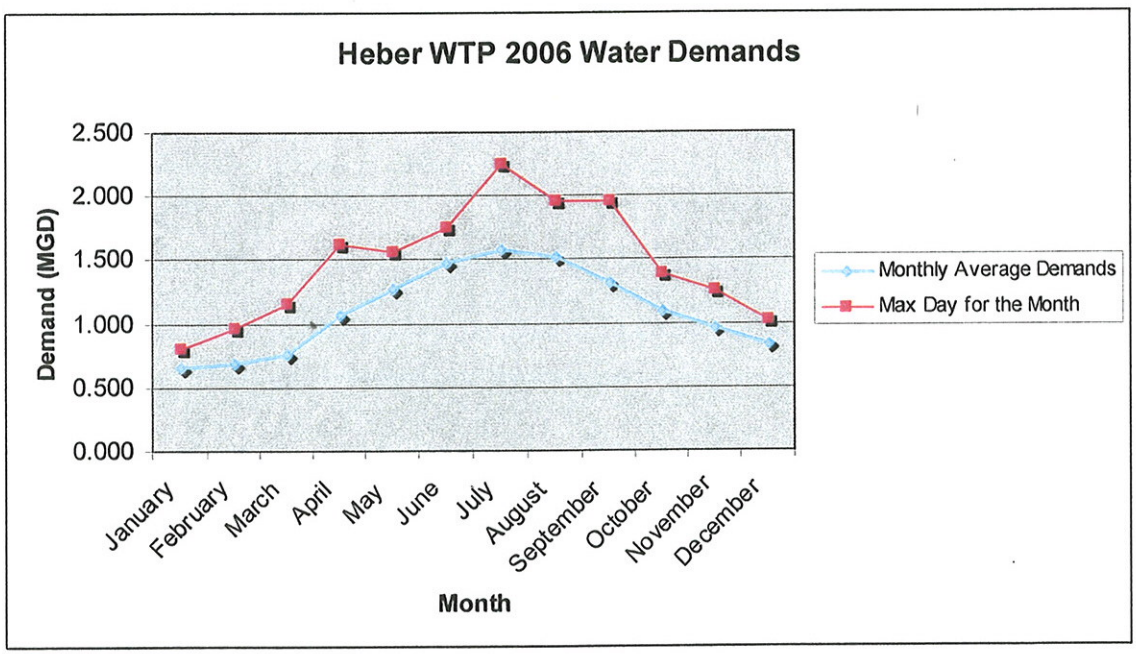


Figure 5-1

HPUD WATER DEMAND FOR YEAR 2006

Month	Total Monthly Flows (MG)	Days per Month	Monthly Avg Demand (MGD)	Max Day Demand for the Month (MGD)
January	20.39	31	0.658	0.81
February	19.358	28	0.691	0.964
March	23.606	31	0.761	1.15
April	32.107	30	1.070	1.616
May	39.504	31	1.274	1.562
June	44.162	30	1.472	1.75
July	48.731	31	1.572	**2.246**
August	47.042	31	1.517	1.961
September	39.655	30	1.322	1.964
October	34.01	31	1.097	1.389
November	29.016	30	0.967	1.251
December	25.675	31	0.828	1.029
Totals	**403.256**		**13.231**	

Annual Avg Demand (MGD) = 13.231 MGD / 12 Months **1.103**

Max Day Demand = 2.246

2006 HPUD Residential Units 1357 Residential Units

(GPUD) 403,256,000 Gallons/365 Days per Yr/1357 Units = 814 GPUD

4.3 persons per Residence per CEQA document **4.3 Persons per Residential Unit**

gallons per capita per day (gpcd) **189 Gallons/Capita/Day**

Max. Day Peaking Factor 2.246 MGD/1.103 MGD **2.04 Max Day Peaking Factor**

Table 5-1

Utilizing the average day demand of 1.10 MGD and assuming a population of 5,834 persons, it is estimated that 189 gallons per capita per day (gpcd) were consumed within the HPUD service area in the year 2006. Water demand for 189 gallons per capita per day can serve a maximum of 1,357 residential units.

5.2 Future Projections for Demand

HPUD is experiencing a noticeable increase in demand for potable water usage. It is anticipated a sustained increase in potable water usage will continue for the next several years. It is necessary to expand the existing 2.0 MGD water capacity immediately in order to accommodate increased demand. Figure 5-2 and Table 5-2 illustrate the anticipated HPUD Future Water Demand.

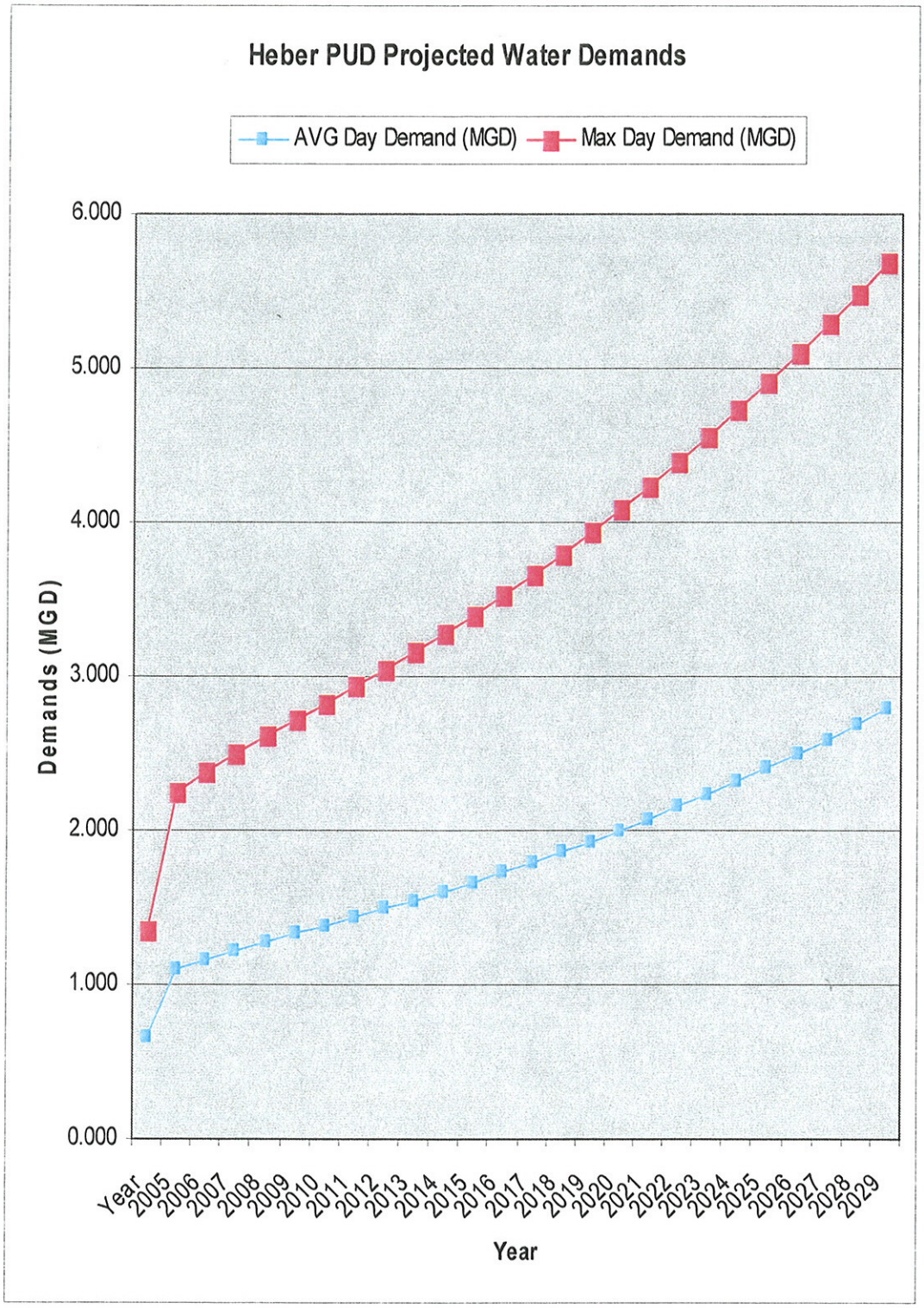

Heber PUD Projected Water Demands
AVG Day Demand (MGD)
Max Day Demand (MGD)
6.000
5.000
4.000
3.000
2.000
1.000
0.000
Demands (MGD)
Year
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
Year

Figure 5-2

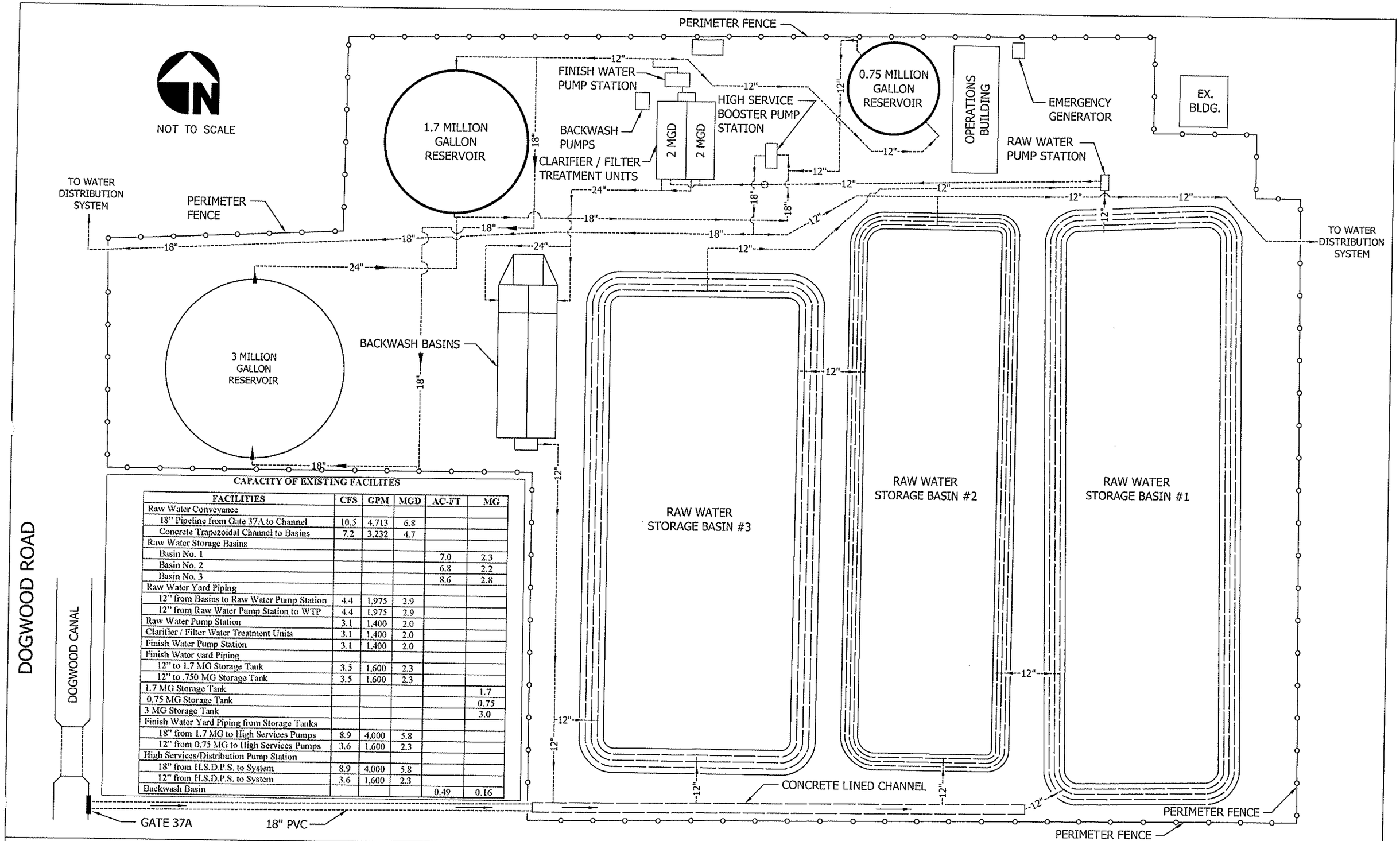
Year	Projected Population	gpcd	AVG Day Demand (MGD)	Peaking Factor	Max Day Demand (MGD)	Capacity used of 2 MGD WTP (%)	Capacity used of 4 MGD WTP (%)	Capacity used of 6 MGD WTP (%)
2005	3,508	189	0.663	2.04	1.353	**67.63%**	33.81%	22.54%
2006	5,834	189	1.103	2.04	2.249	**112.47%**	56.23%	37.49%
2007	6,174	189	1.167	2.04	2.380	**119.02%**	59.51%	39.67%
2008	6,473	189	1.223	2.04	2.496	**124.79%**	62.39%	41.60%
2009	6,773	189	1.280	2.04	2.611	**130.57%**	65.28%	43.52%
2010	7,073	189	1.337	2.04	2.727	**136.35%**	68.18%	45.45%
2011	7,338	189	1.387	2.04	2.829	**141.46%**	70.73%	47.15%
2012	7,613	189	1.439	2.04	2.935	**146.77%**	73.38%	48.92%
2013	7,899	189	1.493	2.04	3.045	**152.27%**	76.13%	50.76%
2014	8,195	189	1.549	2.04	3.160	**157.98%**	78.99%	52.66%
2015	8,502	189	1.607	2.04	3.278	**163.90%**	81.95%	54.63%
2016	8,821	189	1.667	2.04	3.401	**170.04%**	85.02%	56.68%
2017	9,151	189	1.730	2.04	3.528	**176.42%**	88.21%	58.81%
2018	9,494	189	1.794	2.04	3.661	**183.03%**	91.51%	61.01%
2019	9,850	189	1.862	2.04	3.798	**189.89%**	94.95%	63.30%
2020	10,219	189	1.931	2.04	3.940	**197.01%**	98.50%	65.67%
2021	10,602	189	2.004	2.04	4.088	**204.39%**	102.20%	68.13%
2022	11,000	189	2.079	2.04	4.241	**212.06%**	106.03%	70.69%
2023	11,412	189	2.157	2.04	4.400	**220.00%**	110.00%	73.33%
2024	11,840	189	2.238	2.04	4.565	**228.25%**	114.13%	76.08%
2025	12,284	189	2.322	2.04	4.736	**236.81%**	118.40%	78.94%
2026	12,744	189	2.409	2.04	4.914	**245.68%**	122.84%	81.89%
2027	13,222	189	2.499	2.04	5.098	**254.89%**	127.45%	84.96%
2028	13,718	189	2.593	2.04	5.289	**264.45%**	132.22%	88.15%
2029	14,232	189	2.690	2.04	5.487	**274.36%**	137.18%	91.45%
2030	14,765	189	2.791	2.04	5.693	**284.65%**	142.32%	94.88%
					Note:	**Percent Capacity Appr Capacity**		

Table 5-2

EXISTING FACILITIES

6.0 EXISTING FACILITIES

The existing Water Treatment Facilities and capacities are illustrated in Figure 6-0.



CAPACITY OF EXISTING FACILITES

FACILITIES	CFS	GPM	MGD	AC-FT	MG
Raw Water Conveyance					
18" Pipeline from Gate 37A to Channel	10.5	4,713	6.8		
Concrete Trapezoidal Channel to Basins	7.2	3,232	4.7		
Raw Water Storage Basins					
Basin No. 1				7.0	2.3
Basin No. 2				6.8	2.2
Basin No. 3				8.6	2.8
Raw Water Yard Piping					
12" from Basins to Raw Water Pump Station	4.4	1,975	2.9		
12" from Raw Water Pump Station to WTP	4.4	1,975	2.9		
Raw Water Pump Station	3.1	1,400	2.0		
Clarifier / Filter Water Treatment Units	3.1	1,400	2.0		
Finish Water Pump Station	3.1	1,400	2.0		
Finish Water yard Piping					
12" to 1.7 MG Storage Tank	3.5	1,600	2.3		
12" to .750 MG Storage Tank	3.5	1,600	2.3		
1.7 MG Storage Tank					1.7
0.75 MG Storage Tank					0.75
3 MG Storage Tank					3.0
Finish Water Yard Piping from Storage Tanks					
18" from 1.7 MG to High Services Pumps	8.9	4,000	5.8		
12" from 0.75 MG to High Services Pumps	3.6	1,600	2.3		
High Services/Distribution Pump Station					
18" from H.S.D.P.S. to System	8.9	4,000	5.8		
12" from H.S.D.P.S. to System	3.6	1,600	2.3		
Backwash Basin				0.49	0.16

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SCALE:	DATE:	PROJECT NO.		DESCRIPTION:	FIGURE:
NOT TO SCALE	12-16-2007	744.032E	HEBER PUBLIC UTILITY DISTRICT - WATER TREATMENT PLANT EXPANSION REPORT	EXISTING HPUD WATER TREATMENT PLANT	6-0

6.1 Raw Water Conveyance

Raw water is conveyed to the Heber Public Utility District's (HPUD) Water Treatment Plant by gravity flow from the Dogwood Canal Gate 37A. The Dogwood Canal is located along the east side of Dogwood Road. The Dogwood Canal accepts and conveys water from the Imperial Irrigation District Central Main Canal located near the HPUD south service area boundary. The raw water is delivered from Dogwood Canal Gate 37A through an 18-inch diameter, 331-foot long PVC pipeline. The 18-inch diameter PVC pipeline connects to a downstream concrete-lined open channel lateral. The concrete-lined open channel lateral extends 352 feet along the Water Treatment Plant southern property line. The concrete lined channel conveys water to three raw water storage basins. Three (3) separate 12-inch diameter pipelines extend from the concrete channel to each of the three raw water storage basins. The concrete channel is easily overgrown with vegetation, which may impact the current water quality.

The HPUD Water Treatment Plant Operators manually open and close Gate 37A in order to adjust the raw water flow required to fill the raw water storage basins. The capacity of the 18-inch pipeline is limited to approximately 10.5 cubic feet per second (cfs) or 6.8 MGD. The capacity of the concrete-lined open channel is limited to approximately 7.2 cfs or 4.7 MGD. The maximum capacity of the Raw Water Conveyance System is therefore 4.7 MGD.

6.2 Raw Water Storage

The Water Treatment Plant's raw water storage consists of three (3) raw water pre-sedimentation basins. The total raw water storage capacity for all three basins is 22.4 acre-ft (7.3 MG); Basin No. 1 has a capacity of 7.0 acre-ft (2.28 MG); Basin No. 2 has a capacity of 6.78 acre-ft (2.21 MG) and Basin No. 3 has a capacity of 8.56 acre-ft (2.79 MG). Basin No. 1 and Basin No. 3 are concrete-lined. Basin No. 2 is lined with High Density Polyethylene Liner.

At the 2005 maximum day demand of 1,690,000 gallons per day, the raw water storage capacity time duration was 7.3 million gallons/1,690,000 gallons per day = 4.3 days. At the rated 2,000,000 gallon per day capacity of the Water Treatment Plant, the raw water storage capacity is 7,300,000 gallons / 2,000,000 gallons / day = 3.65 days. The State of California Department of Health is requiring a raw water storage capacity of six (6) days at the plant's rated capacity of 2,000,000 or 6 days x 2,000,000 gallons per day = 12,000,000 gallons. HPUD is 12,000,000 gallons – 7,300,000 gallons = 4,700,000 gallons deficient with respect to the raw water supply.

The raw water pre-sedimentation basins are interconnected by 12-inch diameter pipelines. A raw water outlet structure is located at the north end of each basin. The outlet structures are equipped with trash screens and sluice gates with hand wheel operators.. The basins may function in series or parallel in supplying water to the Raw Water Pump Station. Raw water is conveyed from the basins to the Raw Water Pump Station via 12-inch diameter pipelines.

6.3 Raw Water Pumping Station

The raw water pump station is supplied with raw water by gravity from the raw water basins. The raw water pump station's wet well volume is 3,570 gallons. The wet well consists of the following dimensions: length of 10.67 feet, width of 4.67 feet, and depth of 9.58 feet. The inlet piping and outlet piping into and out of the pump station allow for a raw water pumping capacity of 4.4 cfs (1,975 gpm) with two pumps running.

The pumping units consist of two (2) single stage vertical turbine variable frequency drive (VFD) pumps. Each pump is rated at 3.1cfs (1400 gpm) at 35 feet of total dynamic head and is equipped with a 15 Horsepower (Hp), 1,200 revolutions per minute (rpm) electric motor. The pumps operate in a lead and lag mode, and alternate between cycles. The raw water pump station conveys water to the water treatment units via a 12-inch diameter pipeline.

6.4 Water Treatment Units

The existing facilities include two (2) TR840A Microfloc Trident Water Treatment Units manufactured by U.S. Filter (now Siemens). Each unit is composed of a combined absorption clarification and media filtration system which is designed to treat the capacity of 2.0 MGD.

The TR-840A Microfloc Trident Water Treatment Units have three (3) modes of operation. The first mode is Filtration Operation. During the filtration mode, chemicals are introduced to the raw water prior to entering the Absorption Clarifier Unit. Flows are directed to the bottom of the Absorption Clarifier Unit and upward through the absorption media into the filter unit. The finished water from the filter unit is directed to the finished water pump station. The second mode of operation is termed the Absorption Clarifier Flush. This mode of operation cleans the absorption media by flushing raw water through the media absorption unit and exits through the backwash outlet compartment. The cleaning of the media occurs every 360 minutes (6 hours). The third mode is Filter-Cleaning Operation. This mode of operation is completed every 1,000 minutes (16 hours and 40 minutes).

Finished water is backwashed through the filter unit and exits through the backwash outlet compartment to the backwash basins. The second and third modes of operation result in backwash water exiting the treatment units. The backwash water is directed to the backwash basins via a 24-inch diameter gravity pipeline.

6.5 Backwash Basins

There are two (2) concrete backwash basins utilized as equalization basins. The basins receive backwash water from the treatment units via a 24-inch diameter pipeline. The backwash water flows by gravity from the treatment units to the backwash basins. The reclaimed water from the backwash basins is directed to the concrete inlet channel upstream of Raw Water Basins No. 1 through 3 or directly to Raw Water Storage Basin

No. 3 (See Figure 6-0). The backwash basins operate in parallel. One basin may be maintained and/or repaired while the adjacent basin is operational. Each backwash basin measures 21 feet by 108 feet.

6.6 Backwash Pumps

The backwash pumps are located between the clear water reservoirs and the Water Treatment Units. The backwash pumps are supplied with finish water from the 1.7 MG reservoir. The backwash pumps are energized during the water treatment units' third mode of operation. The backwash pump units consist of two (2) Horizontal Split Case pumps manufactured by Aurora. Each pump is rated at 12.5 cfs (5,600 gpm) at 27 feet of total dynamic head with 50 Hp, 690 rpm electric motors. The pumps operate in a lead and lag mode and alternate between cycles.

6.7 Finish Water Pump Station

The finish water pump station is located downstream of the treatment units. 12-inch diameter pipelines convey water from the treatment units to the finished water pump station. The finish water pump station's clearwell volume is 7,058 gallons. The finished water pump station's dimensions are: length of 13.67 ft, width of 7.67 ft, depth of 9.00 ft. The outlet piping for the pumping station conveys approximately 3.1 cfs (1,400 gpm) through 12-inch pipelines extending to the 1.7 MG and 0.75 MG finish water reservoirs. The pump units consist of two (2) single stage vertical turbine pumps. Each pump is rated for 3.1 cfs (1,400 gpm) at 50 feet of total dynamic head with a 25 Hp, 1,800 rpm electric motor. The pumps operate in a lead and lag mode. The pumps alternate between cycles.

6.8 Finish Water Storage

There are two (2) welded steel finish water storage reservoirs which store a total capacity of 2.45 Million Gallons (MG). Finished water is supplied from the finish water storage reservoirs to the high service pump station by 18-inch and 12-inch diameter pipelines. The larger water storage reservoir has a capacity of 1.7 MG. The smaller water storage reservoir has a capacity of 0.75 MG. The 1.7 MG reservoir has a bottom inlet and bottom

outlet located opposite each other and located at the same elevation. The 0.75 MG reservoir has an inlet located on top and an outlet on the opposite bottom side. The interior and exterior of the 0.75 MG reservoir was recently re-coated and a new bottom was installed. It is noted that the 0.75 MG reservoir is not equipped with a cathodic protection system. It is recommended that this improvement be made in the future. The 1.7 MG reservoir is equipped with a cathodic protection system.

Currently under construction is the installation of a new, pre-stressed concrete 3.0 MG finished water reservoir expected to be in service in early 2008. This will provide a total finished water capacity of 5.45MG.

6.9 Chemical Feed Facilities

The Water Treatment Plant was designed to utilize aluminum sulfate (Alum) as the primary coagulant and a non-ionic polymer as a coagulant aid. Alum was injected using an Alldos positive displacement metering pump. The Alum was introduced to the raw water flow upstream of the Chemineer in-line static mixer, prior to entering the treatment units.

Recently, Ferric Sulfate replaced Alum as the primary coagulant. It is now used as the primary coagulant to eliminate the pre-chlorination of the raw water. The Water Treatment Plant has reduced its coagulant dose rate from 24 parts per million (ppm) to 13 ppm since converting from aluminum sulfate to ferric sulfate. Ferric Sulfate is currently stored in a 1,000-gallon plastic chemical storage tank. The 1,000 gallon Ferric Sulfate tank is required to be filled frequently.

The nonionic polymer is presently stored in a 500 gallon storage tank and is injected using an Alldos simplex positive displacement-metering pump. Nonionic polymer is added to each clarifier inlet pipe downstream of the static mixer. Each Water Treatment unit has a dedicated polymer metering pump. The nonionic polymer pump operates automatically according to the water treatment unit operations. Polymer is dosed at a rate of 0.10 – 0.15 ppm.

6.10 Disinfection Facilities

Disinfection is provided by a ClorTec MC 140 Series Sodium Hypochlorite generator, which produces 0.8% Sodium Hypochlorite solution. The Sodium Hypochlorite is injected using Alldos KM 250 Series hydraulic actuated diaphragm metering pumps. The system is designed for both pre- and post-chlorination. Typical dosages range from 3-4 ppm, in order to produce a free chlorine residual between 1-2 ppm. Both combined filter effluent and distribution system chlorine residuals are monitored and recorded by Hach CL 17 continuous monitoring analyzers.

To generate Sodium Hypochlorite, three components are required: brine, water and DC current. These variables react with one another to form a 0.8% Sodium Hypochlorite solution. To produce one pound of chlorine equivalent the ClorTec system requires the following: three (3) pounds of salt, 15 gallons of water and 2 KWH of electrical power. The Water Treatment Plant's existing pound per day of chlorine equivalent for a dosage of 4 ppm at 2 MGD is:

$$\begin{aligned}\text{Lb per day of Chorine equivalent} &= \text{Dosage (ppm)} \times 8.34 \text{ lbs/gal} \times \text{Flow (MGD)} \\ &= 4 \text{ ppm} \times 8.34 \text{ lbs/gal} \times 2 \text{ MGD} \\ &= 66.72 \text{ Lbs per day}\end{aligned}$$

The existing Sodium Hypochlorite system can produce 140 lbs per day of Sodium Hypochlorite. The Sodium Hypochlorite System consists of the following components:

- ClorTec Control Cabinet
- 1- ClorTec MC 140 Stainless Steel Rack Assembly (includes two (2) 70 lb per day DSA Titanium Electrodes)
- 1 - Delta DC Rectifier (27-84-112V 200A)
- 1 - 575 Gallon Brine Tank

- 2 - Alldos – KM 255-332 Metering Pumps
- 2 – 2100 Gallon Hypochlorite Storage Tanks
- 1 - Kinetico K2000 Water Softener

6.11 High Service Pump Station

The high service distribution booster pump station is downstream of the storage reservoirs. The pump station consists of two (2) 3.3 cfs (1,500 gpm) water-lubricated centrifugal VFD operated pumps. The high service pump station conveys potable water to the HPUD Water Distribution System.

6.12 Electrical

The service entrance section for the HPUD Water Treatment Plant is located on the north side of the operation building. The service entrance is rated at 480/277 Volts, 3 Phase, 4 Wire, 2000 Amps. The circuit breaker is current-limited with an adjustable continuous current setting. The service entrance section supplies power to the Automatic Transfer Switch. An Automatic Transfer Switch (ATS) rated at 480V/277V, 3 Phase, 4 Wire, 2,000 Amps is located in a NEMA 1 enclosure. The Automatic Transfer Switch determines whether normal power from the service entrance is provided to the Motor Control Center or whether an Emergency Power Source from the Diesel Generator is supplied to the Motor Control Center.

6.13 SCADA System, Instrumentation and Controls

The Water Treatment Plant's Supervisory Control and Data Acquisition System (SCADA) provides computer system monitoring of the water treatment process and records historical data. The system also provides operator interface for onsite control of the Water Treatment Plant, as well as remote capabilities. The system consists of the following components:

1. Computer workstation designated Human Machine Interface (HMI's)
2. HMI Laptop

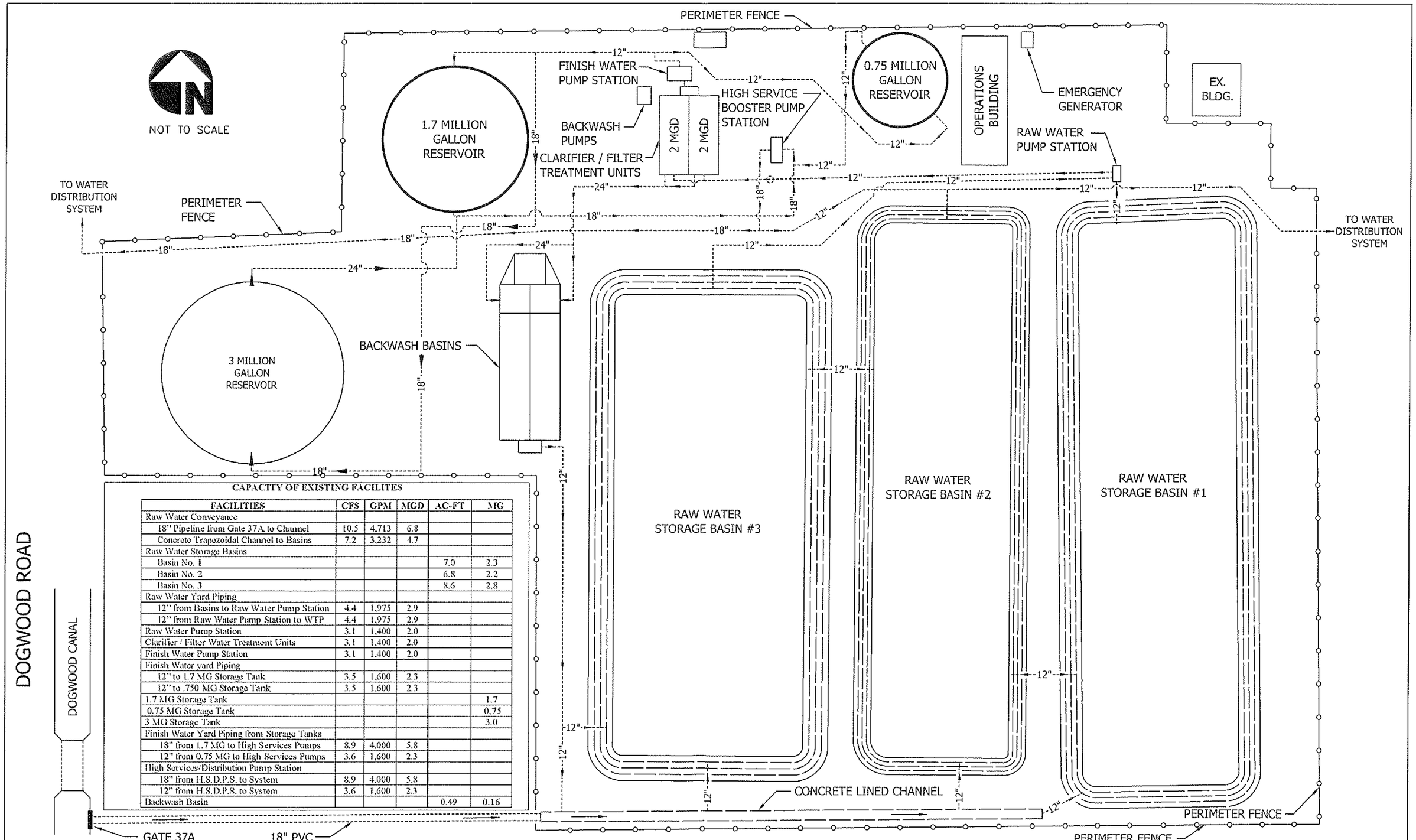
3. Plant Control Network
4. Plant Control Network interface to Programmable Logic Controllers
5. Human Machine Interfaces (HMI's) – The HMI software to produce the water treatment process graphics, alarms and trending information, is illustrated by Figure 6-18 and consists of the following:
   - Rockwell Software RS View
   - Wonderware Intouch
   - Development and Runtime Software

An Automatic Dialing and Voice Annunciation Alarm Management System notifies the Operators of possible plant or equipment malfunctions.

6.14 Emergency Standby Power

An existing 400 kW Standby Generator provides back up power to the existing Water Treatment Plant normal power source. The generator is rated for 480/277 Volt, 3 Phase, 4 Wire, 2,000 Amps power service. The generator is provided with a Main Circuit Breaker. The generator has the capability of providing the power source for the motor loads of the Water Treatment Plant facilities. The generator has a fuel capacity for full load operation for a 24 hour period. It is also equipped with a critical exhaust silencer. The critical exhaust silencer reduces the exhaust noise by 12-18 dB. The generator is housed in a sound-attenuated, weather protective enclosure.

The generator is connected to the automatic transfer switch. The automatic transfer switch automatically selects the power source for the Motor Control Center (either the normal power source or emergency power source).



CAPACITY OF EXISTING FACILITES

FACILITIES	CFS	GPM	MGD	AC-FT	MG
Raw Water Conveyance					
18" Pipeline from Gate 37A to Channel	10.5	4,713	6.8		
Concrete Trapezoidal Channel to Basins	7.2	3,232	4.7		
Raw Water Storage Basins					
Basin No. 1				7.0	2.3
Basin No. 2				6.8	2.2
Basin No. 3				8.6	2.8
Raw Water Yard Piping					
12" from Basins to Raw Water Pump Station	4.4	1,975	2.9		
12" from Raw Water Pump Station to WTP	4.4	1,975	2.9		
Raw Water Pump Station	3.1	1,400	2.0		
Clarifier / Filter Water Treatment Units	3.1	1,400	2.0		
Finish Water Pump Station	3.1	1,400	2.0		
Finish Water yard Piping					
12" to 1.7 MG Storage Tank	3.5	1,600	2.3		
12" to .750 MG Storage Tank	3.5	1,600	2.3		
1.7 MG Storage Tank					1.7
0.75 MG Storage Tank					0.75
3 MG Storage Tank					3.0
Finish Water Yard Piping from Storage Tanks					
18" from 1.7 MG to High Services Pumps	8.9	4,000	5.8		
12" from 0.75 MG to High Services Pumps	3.6	1,600	2.3		
High Services/Distribution Pump Station					
18" from H.S.D.P.S. to System	8.9	4,000	5.8		
12" from H.S.D.P.S. to System	3.6	1,600	2.3		
Backwash Basin				0.49	0.16

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SCALE:	DATE:	PROJECT NO.		DESCRIPTION:	FIGURE:
NOT TO SCALE	12-16-2007	744.032E	HEBER PUBLIC UTILITY DISTRICT - WATER TREATMENT PLANT EXPANSION REPORT	EXISTING HPUD WATER TREATMENT PLANT	6-0

WATER TREATMENT PLANT EXPANSION

7.0 WATER TREATMENT PLANT EXPANSION RECOMMENDATIONS

7.1 Design Rating

Table 5-2 indicates that the average day demand for 2006 was 1.10 MGD, while the maximum day demand for 2006 was 2.246 MGD, exceeding the design limit of the plant. **The recommendation proposes to increase the current Water Treatment Plant capacity from 2.0 MGD to 6.0 MGD.** Table 5-2 indicates the 6.0 MGD plant expansion will serve the Heber Public Utility District (HPUD) until the end of the year 2030.

7.2 Filtration Units

The HPUD Water Treatment Plant Primary Water Treatment Units consist of combined absorption clarification and media filtration systems. The two (2) TR840A Microfloc Trident Water Treatment Units as manufactured by U.S. Filter are each capable of treating 2.0 million gallons per day. One of the two (2) TR840A Microfloc Trident Water Treatment Units was installed for redundancy purposes. Filters are periodically removed from service for maintenance purposes. During maintenance periods, only one (1) filter remains operational. Although the current Water Treatment Plant includes two (2) filters capable of treating 2.0 MGD, the Water Treatment Plant is rated for 2.0 MGD as only one (1) filter can be guaranteed to remain operational due to maintenance downtime.

The TR840A Microfloc Trident Water Treatment Units are often referred to as "packaged treatment systems." The packaged treatment systems are pre-assembled prior to delivery to a given water treatment plant. The packaged water treatment systems are purchased and delivered at a designated treatment capacity. The TR840A Microfloc Trident Water Treatment Units are designed to treat 2.0 MGD. The TR840A Microfloc Trident Water Treatment Units were approved by the State of California Department of Health Services for installation during the last Water Treatment Plant expansion completed in 2005.

It is recommended that the TR840A Microfloc Trident Water Treatment Units be used for the next Water Treatment Plant expansion(s) for the following reasons:

1. The State of California Department of Health Services recently approved the TR840A Microfloc Trident Water Treatment Units for the 2005 Water Treatment Expansion completed earlier. It is not necessary to complete a lengthy submittal process approving an alternate process of Water Treatment Unit.
2. The programmable logic controller for the two (2) existing Water Treatment Units can be used or modified to control the TR840A Units which will result in cost savings.
3. Operating different processes of filters will be more difficult for the operation and maintenance of the filter systems. The Plant Operators will be required to operate different treatment units with different operational requirements. The servicing of the units will be required to be completed by different filter system manufacturer representatives. Spare parts would most likely be different.

The expansion of the HPUD Water Treatment Plant is based upon continuing the use of the TR840A Microfloc Trident Water Treatment Units. The use of the 2.0 MGD Water Treatment Units will result in a Water Treatment Plant expansion that will increase the water capacity in 2.0 million gallon per day multiples. The Water Treatment Plant Expansion could therefore occur in 2.0 MGD (current capacity), 4.0 MGD, 6.0 MGD, 8.0 MGD and 10.0 MGD. It is recommended that the use of the packaged Water Treatment Units be evaluated after the Water Treatment Plant reaches a capacity of 10.0 MGD.

7.3 Raw Water Storage

HPUD obtains its raw water from the Imperial Irrigation District (IID) Central Main Canal via the Dogwood Canal and Delivery No. 37-A headgate. The Dogwood Canal is typically removed from service for a period of four (4) days every three (3) months by the IID for maintenance. During those periods, HPUD relies on the raw water stored in the three water ponds. The raw water ponds contain a combined volume of 7.3 million gallons. The State of California Department of Health is requiring a raw water storage

capacity of six (6) days at the plants rated capacity of 2,000,000 or 6 days x 2,000,000 gallons per day = 12,000,000 gallons. HPUD is 12,000,000 gallons – 7,300,000 gallons = 4,700,000 gallons deficient with respect to the raw water supply at the current 2MGD design.

In order to meet the State of California Department of Health requirement for raw water storage, two options exist:

1. Construct additional Raw Water Storage Basins. The construction of new Raw Water Basins will require the acquisition of land. The acquisition of land is both time-intensive and cost prohibitive. In addition, each plant expansion will require the construction of additional Raw Water Basins and the purchase of additional land.

2. Construct a Portable Raw Water Pump Station and transmission pipeline from the Imperial Irrigation District Central Main Canal to the HPUD Water Treatment Plant. The Central Main Canal is almost never taken out of service so it may act as "additional storage" for the HPUD Water Treatment Plant. Although the installation of pumping units and a pipeline from the Central Main Canal to the HPUD Water Treatment Plant will require the completion of a number of difficult tasks, it appears to be more cost effective and practical to construct the pumping units and pipeline than to construct numerous additional Raw Water Storage Basins. Approval for this alternative form the State of California Department of Health Services is shown in Appendix E.

7.4 Existing Components

The recommended Water Treatment Plant expansion is also based upon using the existing Water Treatment Plant facilities as components of future expansions. It is recommended that existing components be duplicated whenever possible to expand the capacity of the Water Treatment Plant. For instance, it may be required to install new Raw Water Storage Basins. If new basins are required, an effort will be made to maintain the

existing basins in service. If it is necessary to construct new backwash basins, an attempt will be made to maintain the existing backwash basin in service. If new reservoirs are required to be constructed, it will be recommended that existing reservoirs remain in service. Alternatives to duplicating existing units will be explored if it is viewed to be more cost effective.

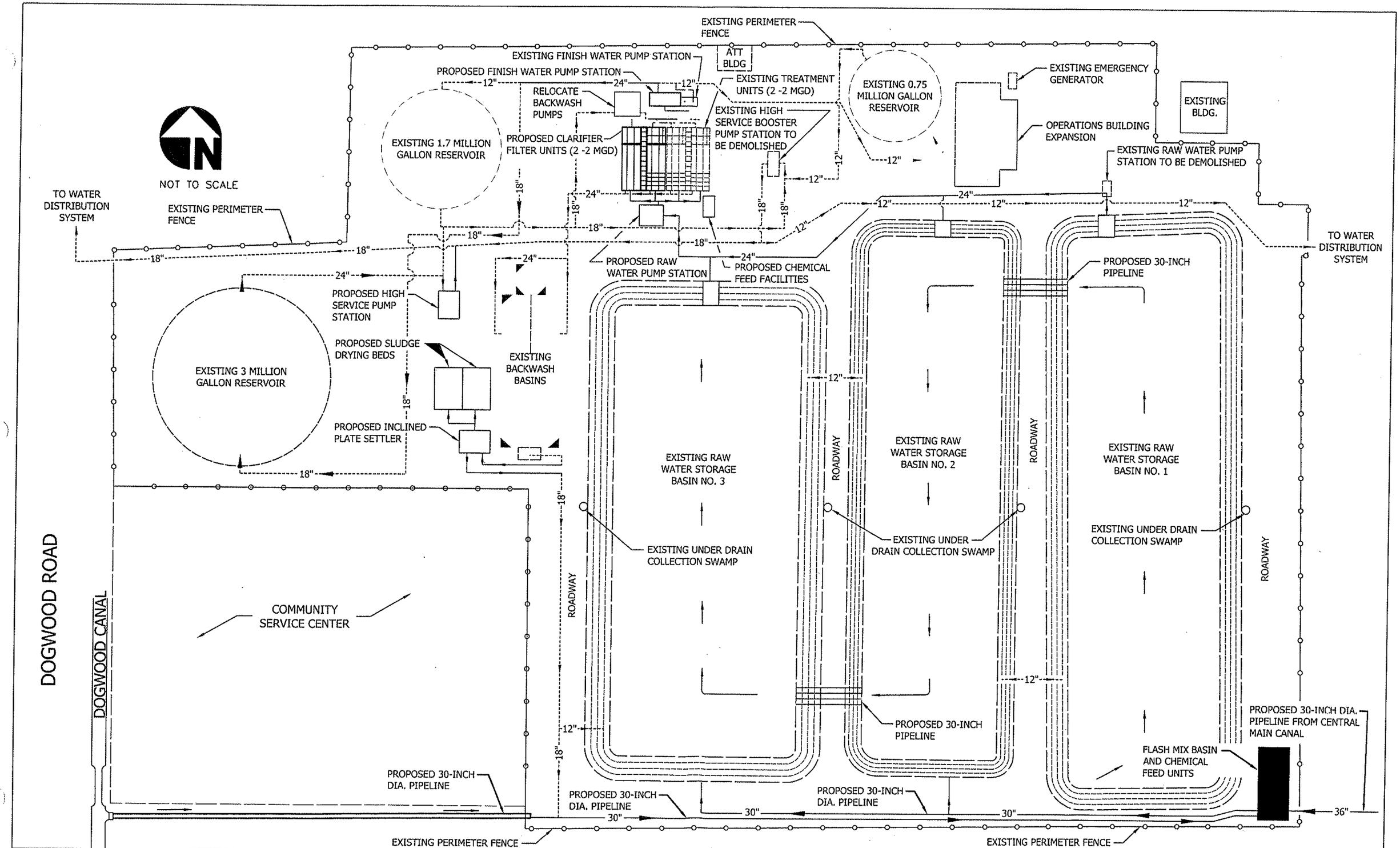
In summary, the proposed expansion of the HPUD Water Treatment Plant shall be based upon using the 2.0 MGD packaged Treatment Units and the duplication of existing Treatment Units whenever possible. The expansion will be completed in multiples of 2.0 MGD. It is recommended that the expanded plant design be 6MGD. The following Section 8.0 of this report has been prepared based upon the above-noted assumptions.

ALTERNATIVE 1 – EXPAND TO A 6MGD WATER TREATMENT PLANT

8.0 EXPAND TO A 6 MILLION GALLON PER DAY (MGD) WATER TREATMENT PLANT

Table 5-2 indicates that the average day demand for 2006 was 1.10 MGD, while the maximum day demand for 2006 was 2.246 MGD, exceeding the design limit of the plant. **The recommendation proposes to increase the current Water Treatment Plant capacity from 2.0 MGD to 6.0 MGD.** Table 5-2 indicates the 6.0 MGD plant expansion will serve the Heber Public Utility District (HPUD) until the end of the year 2030 (note that a 4.0 MGD plant expansion will only serve HPUD until the end of the year 2020).

Please refer to section 6.0, "Existing Facilities" to become familiar with the existing Water Treatment Facility components prior to reviewing the 6 MGD recommendations.



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8.1 Raw Water Conveyance

The existing 18-inch diameter PVC pipeline and concrete lined channel are not adequate to convey 9.3 cfs (6 mgd) of raw water from the Imperial Irrigation District Dogwood Canal to the new Raw Water Basins. It is recommended that a new 30-inch pipeline be installed from the termination point of the 18-inch pipeline to the existing raw water basins. It is recommended a new 30 manifold piping system be installed to connect the existing Raw Water Basins No. 1, 2 and 3.

8.2 Raw Water Source

The State of California Department of Health is requiring the HPUD Water Treatment Plant to maintain a 6 day supply of raw water at the rated capacity of the Water Treatment Plant. The State of California Department of Health has determined that the Dogwood Canal can potentially be removed from service for a period of six (6) days. The Imperial Irrigation District Water Division representatives confirmed the Dogwood Canal is "out of service" four (4) to five (5) days every three (3) months on the average. During these outage periods, the sole source of raw water to operate the HPUD Water Treatment Plant is the Raw Water Storage Basins.

Other raw water sources near the HPUD Water Treatment Plant were investigated. The nearest viable source of raw water is the Imperial Irrigation District Central Main Canal. The Imperial Irrigation District Central Main Canal is located approximately 1.8 miles (9,504 feet) south of the HPUD Water Treatment Plant. The Central Main Canal is one (1) of the three (3) major canals originating from the All American Canal. The Central Main Canal is the water source for all water canals and laterals in the Heber and El Centro area and is rarely removed from service. During the rare instances the Central Main Canal is removed from service, all of the raw water supply canals and laterals in the Heber and El Centro area are without water. According to the Imperial Irrigation District

Water Department, the section of the Central Main Canal south of Heber has been removed from service two (2) times in the last twenty (20) years.

It is recommended to install portable pumping unit (pumping unit) and a 1.8 mile (9,504 foot) long, 36-inch diameter HDPE pipeline from the Central Main Canal to the HPUD Water Treatment Plant, as illustrated in figure 8-2A. HPUD would incur the cost for the turnout (connection to Central Main Canal) and stub-out segment of pipeline design and construction, while Imperial Irrigation District would be responsible for completing the work. The purchase of land is required for the pumping unit and a small portion of the water pipeline. An Encroachment Permit from the County of Imperial would be required for the length of pipeline along the County of Imperial Right-of-Way and Easements. HPUD has obtained approval of the Department of Health Services for the pumping unit and pipeline facilities in lieu of the additional Raw Water Storage Basins as shown in Appendix E.

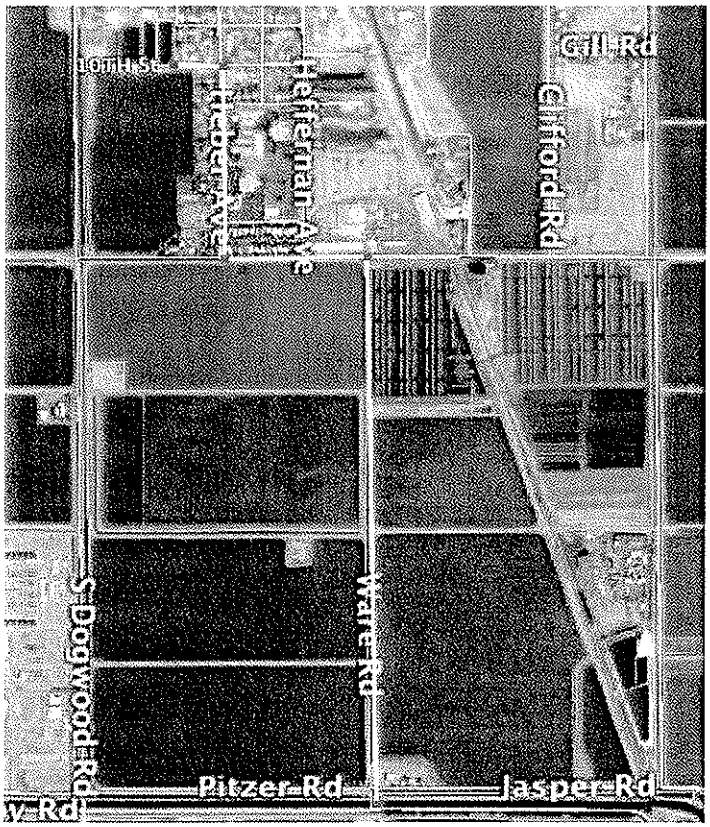


Figure 8-2A

Although the installation of pumping units and a pipeline from the Imperial Irrigation District Central Main Canal to the HPUD Water Treatment Plant will require the completion of a number of difficult tasks, it appears to be more cost effective and practical to construct the facilities for a portable pumping unit and pipeline than to construct numerous additional Raw Water Storage Basins.

8.3 Raw Water Basins

An alternative to the installation of portable pumping unit and a pipeline from the Imperial Irrigation District Central Main Canal to the HPUD Water Treatment Plant is the construction of additional Raw Water Basins.

The Department of Health Services has indicated that HPUD will be required to maintain 6 days of raw water storage. A 6.0 MGD Water Treatment Plant shall require a 6 day x 6 MGD per day = 36 MG storage supply of raw water. The existing raw water storage is 7.3 MG. A minimum of 36 MG – 7.3 MG = 28.7 MG of raw water storage shall be required to be added to the existing 7.3 MG raw water storage supply. It shall be necessary to construct ten (10) - 3 MG Raw Water Basins to provide the additional required storage. The additional required storage will necessitate the purchase of 16.9 acres of land on which to construct the ten (10) new Raw Water Storage Basins as shown in Figure 8-2B. It is recommended that the new basins operate in parallel. It is recommended the raw water flow in the following manner: from the New Raw Water Storage Basins to existing Basin No. 1, from Basin No. 1 to Basin No. 2, and from Basin No. 2 to Basin No. 3.

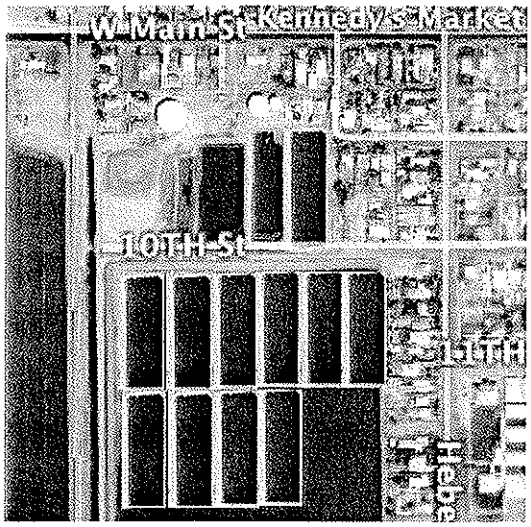


Figure 8-2B

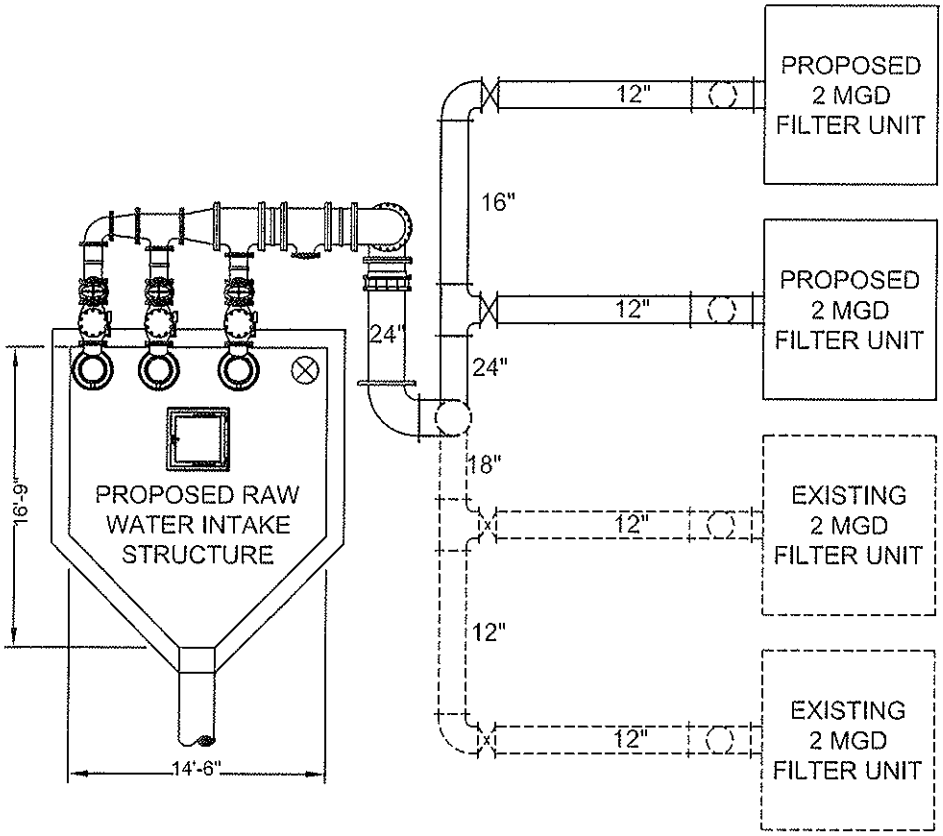
The construction of new Raw Water Basins will require the acquisition of land. The acquisition of land is both time-intensive and cost prohibitive. In addition, each Plant expansion will require the construction of additional Raw Water Basins and the purchase of additional land. Therefore, this option is not recommended.

Regardless of whether new basins are constructed or the Central Main Canal is used as a reliable raw water supply, it is recommended two (2) new 30-inch diameter inter-connecting pipelines be constructed between existing Basin No. 1 and No. 2, and Basin No. 2 and No. 3 to adequately convey the required raw water flow. See Figure 8-1. It is also proposed a coagulant be added prior to the existing Raw Water Basin No. 1 to increase sedimentation removal and improve the raw water quality prior to filtration. This can be accomplished by the installation of a Flash Mix Basin, chemical storage and injection equipment.

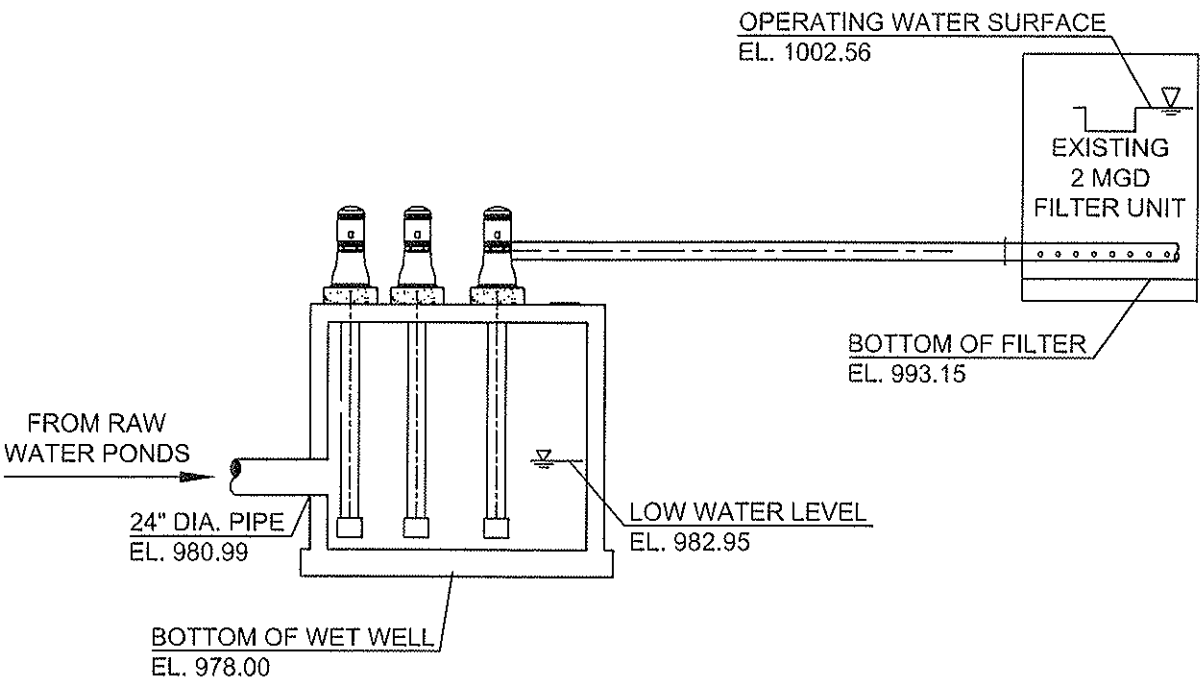
8.4 New Raw Water Pump Station

It is recommended that a new Raw Water Pump Station be constructed to the north of Raw Water Basin No. 3, as shown in Figure 8-1. The existing raw water pump station is undersized. The existing 12-inch diameter pipelines between the raw water pump station and filters are insufficiently sized to transmit the required 6 MGD raw water volume to the Water Treatment Units. It is recommended that larger 24-inch diameter pipelines be installed. The 24-inch diameter discharge piping between the new raw water pump station and Water Treatment Units is illustrated by Figure 8-3. It is recommended, the existing raw water pump station be removed from service and the existing pumps be placed in storage or sold.

The new pump station, as illustrated by Figure 8-3, shall include three (3) new single stage vertical turbine pumps. Each pump shall be capable of delivering a maximum of 2,800 gpm (4 MGD) at 40 feet of total dynamic head (TDH). To provide a range of flow conditions, each pump will operate by means of a variable frequency drive (VFD) unit.



PLAN VIEW



PROFILE VIEW

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HEBER PUBLIC UTILITY DISTRICT - WATER TREATMENT PLANT EXPANSION REPORT	DESCRIPTION:	EXPAND TO A 6 MGD PLANT - RAW WATER PUMP STATION		FIGURE: 8-3

8.5 Water Treatment Units

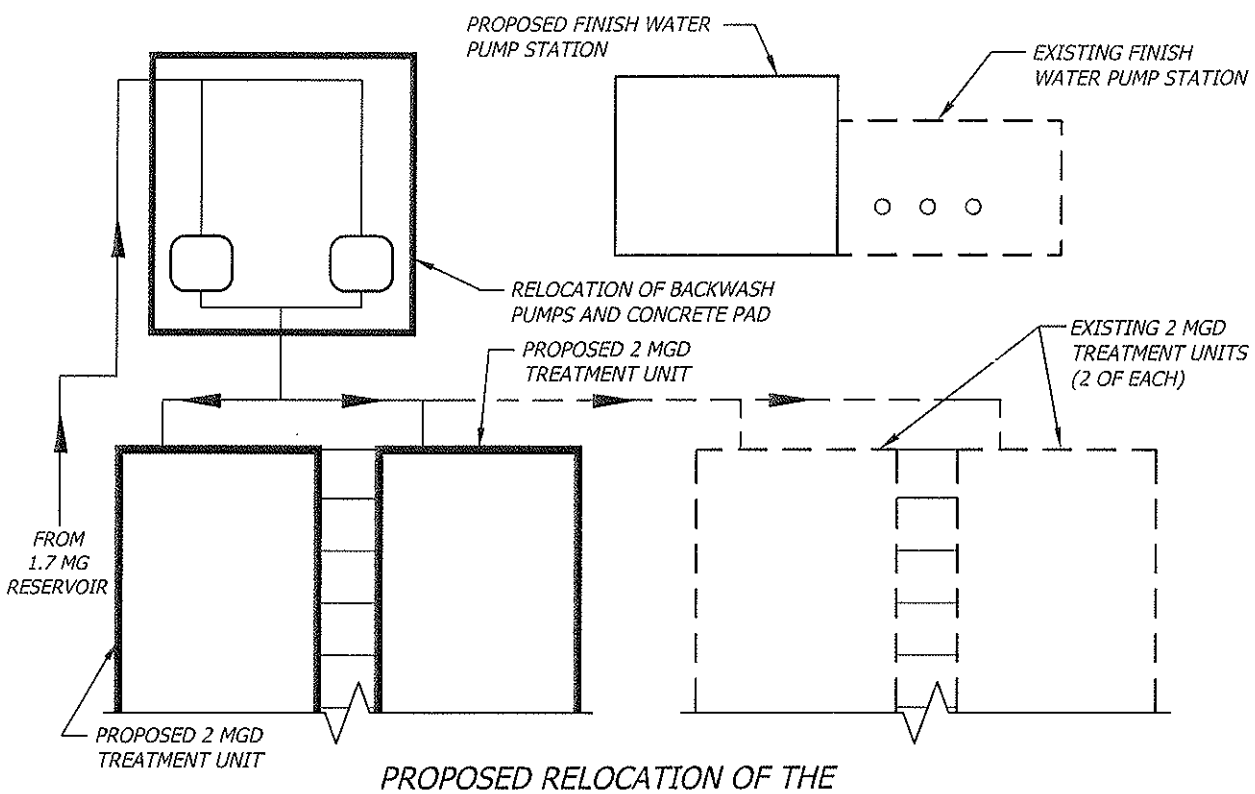
It is recommended two - 2 MGD TR-840A Microfloc Water Treatment Units be installed in parallel with the existing two – 1,400 gpm (2 mgd) TR-840A Microfloc Water Treatment Units. The Water Treatment Units are illustrated on Figure 8-1. The new Water Treatment Units will increase the plant filtering capacity to 4,200 gpm (6 mgd) with an additional 1,400 gpm (2 mgd) redundant filter unit. Under normal operation, three (3) of the Water Treatment Units shall filter water. The fourth Water Treatment Unit shall be allowed to function in the mode of operation appropriate at the time. The fourth filter unit may be removed from service for maintenance purposes. The Water Treatment Units will operate in an alternating sequence.

The new Water Treatment Unit shall be provided with associated Power and Control Panels that shall be interlocked with the existing master control panel. The master control panel shall prohibit two or more Water Treatment Units from engaging in a backwash mode at the same time. A new 18-inch diameter pipeline shall be installed to direct finished water from the Water Treatment Units to the finish water pump station (Refer to Section 8.8). A new metal access stairway, catwalk and shade structure shall be constructed. The shade structure shall be constructed over the Water Treatment Units.

8.6 Backwash Pumps

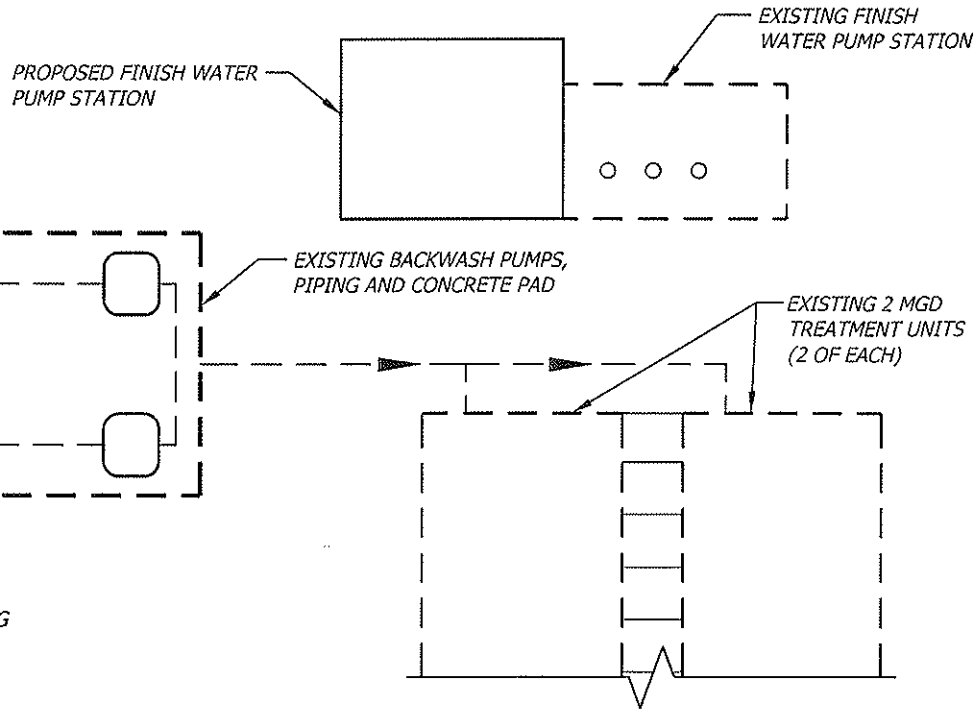
The existing backwash pumps shall be relocated to accommodate the installation of the new Water Treatment Units. The new Water Treatment Units shall be placed in the present location of the backwash pumps. Figure 8-4 illustrates the relocated position of the backwash pumps. It shall be necessary to demolish the existing backwash pump concrete foundation pad. The two (2) existing 5,600 gpm backwash pumps and piping shall be relocated to a new concrete foundation pad. The backwash pumps and piping shall be reconfigured. It shall be necessary to install new backwash pump suction and discharge fittings and piping to relocate and reconfigure the pumps to the new location. The backwash operations for each of the four (4) Water Treatment Units will be

programmed at different cycle times. Only one (1) Water Treatment Unit shall be allowed to be placed in a backwash mode during a particular time period. The existing diameter sizes of the downstream and upstream backwash pump pipelines are adequate for backwashing the filter units on an individual basis.



PROPOSED RELOCATION OF THE BACKWASH PUMPS

NOT TO SCALE



EXISTING LOCATION OF THE BACKWASH PUMPS

601 NO. IMPERIAL AVE PHONE : (760) 337-3883 EL CENTRO, CA 92243 FAX : (760) 337-5997	The Holt Group	SCALE: NOT TO SCALE	DATE: 12-16-2007	PROJECT NO. 744.032E
HEBER PUBLIC UTILITY DISTRICT - WATER TREATMENT PLANT EXPANSION REPORT	DESCRIPTION: EXPAND TO A 6 MGD PLANT - RELOCATE BACKWASH PUMPS			FIGURE: 8-4

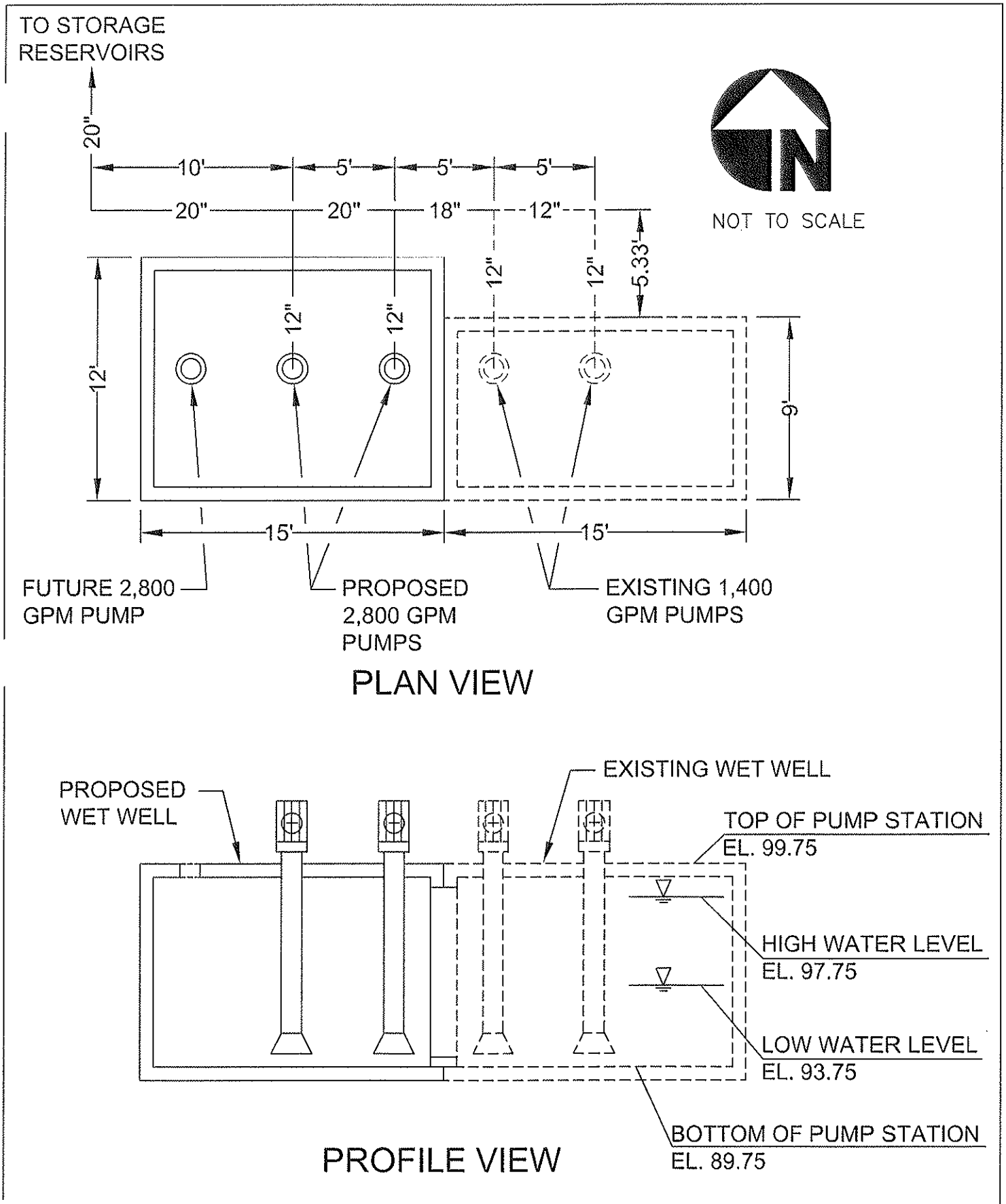
8.7 Inclined Plate Settler System

It shall be necessary to construct a new inclined plate settler system and sludge drying beds to accommodate the increased backwash flow rates. Two (2) pumps will be required to be placed in the existing Backwash Basins to transfer the backwash water to the Inclined Plate Settler System. The Inclined Plate Settler System's filtrate water will be diverted to the existing Raw Water Basins. The Inclined Plate Settler System's reject and sludge will be diverted to the sludge drying beds.

8.8 Finish Water Pump Station

The existing Finish Water Pump Station shall be improved as illustrated by Figure 8-5. An additional clearwell and two (2) new vertical turbine pumps shall be required. The new clearwell and two (2) new pumps will be located adjacent to the existing clearwell and existing constant speed vertical turbine pumps. The new clearwell will be constructed to accommodate an additional pumping capacity of 12 MGD. The new pumping unit shall operate in parallel with the existing pumping units. Two (2) new 2,800 gpm (4 MGD) Variable Frequency Drive Vertical Turbine Pumps shall be installed for the new clear well. The two new 2,800 gpm (4 MGD) Variable Frequency Drive Vertical Turbine Pumps shall be the duty pumps. The existing two (2) 1,400 gallon per minute (2 MGD), 38 foot Total Dynamic Head Pumps shall serve as backup pumps. The total capacity of the four (4) pumps is 8,400 gallons per minute (12 MGD).

A porton of the existing 12-inch diameter pipeline between the the finished water pump station and existing 1.7 MG reservoir shall be replaced with a new 24-inch diameter pipeline. The new 24-inch pipeline segment shall allow additional flow to be conveyed to the newly constructed 3.0 MG finish water storage reservoir and existing 1.7 MG reservoir.



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HEBER PUBLIC UTILITY DISTRICT - WATER TREATMENT PLANT EXPANSION REPORT	DESCRIPTION:	EXPAND TO A 6 MGD PLANT - FINISH WATER PUMP STATION		FIGURE: 8-5

8.9 Chemical Feed Facilities

Two additional simplex coagulant (polymer) positive displacement metering pumps shall be required. The coagulant pumps shall inject polymer into the new Treatment Units for proper operation. The new positive displacement metering pumps shall be either a LMI or Alldos brand pump. The flow rate of each metering pump shall be 8.44 gallons per hour (GPH). It is recommended that the existing 500-gallon polymer storage tank be replaced with a 1,000-gallon polymer storage tank. The 1,000 gallon polymer storage tank will reduce costs by allowing bulk purchase of the polymer. The 1,000 gallon polymer storage tank will also reduce the number of trips necessary to fill the tank, resulting in additional savings.

It is recommended that the existing 1,000 gallon storage tank for the primary coagulant be replaced with a 4,000 gallon storage tank. The existing Water Treatment Plant was designed to use Aluminum Sulfate as a primary coagulant. The HPUD Water Treatment Plant has recently changed the primary coagulant from Aluminum Sulfate to Ferric Sulfate. The 4,000 gallon primary coagulant storage tank will reduce costs by allowing bulk purchase of the chemical. The 4,000 gallon storage tank will also reduce the number of trips necessary to fill the tank, resulting in additional cost savings.

8.10 Disinfection of Facilities

The existing ClorTec MC140 generation system is required to produce 66.72 lbs per day of Sodium Hypochlorite for the existing 2.0 MGD Water Treatment Plant. The existing generation system is capable of generating up to 140 lbs per day of 0.8% Sodium Hypochlorite. The demand of the proposed 6.0 MGD Water Treatment Plant will be 200.16 lbs per day of 0.8% Sodium Hypochlorite. The existing ClorTEC MC140 generation is not capable of producing the Sodium Hypochlorite required for the new 6.0 MGD Water Treatment Plant. It shall be necessary to add one (1) new ClorTEC MC140 generation system to augment the existing system. The two (2) ClorTEC MC140

generation systems shall be capable of producing a combined capacity of 280 lbs per day of 0.8% Sodium Hypochlorite. The two (2) ClorTEC MC140 generation systems will be capable of adequately supplying the Sodium Hypochlorite required for the new 6.0 MGD Water Treatment Plant.

8.11 High Service Pump Station

It shall be necessary to increase the capacity of the High Service Pump Station. It is recommended to replace the existing skid mounted High Service Pump Station with a new skid mounted High Service Pump Station. The new pumps would be sized to more efficiently meet the demand requirements of the distribution system. This option would result in an energy efficient and hydraulically efficient High Service Pump Station.

The new pumps would result in a High Service Pump Station capable of providing the domestic water flow for a 6.0 MGD Water Treatment Plant.

The existing 12-inch and 18-inch diameter distribution pipelines downstream of the High Service Pump Station are adequate to convey the finish water from a 6.0 MGD Water Treatment Plant.

8.12 Electrical

The existing electrical system for the 2 MGD Water Treatment Plant shall require alteration and modification to accommodate the motor requirements of a 6.0 MGD Water Treatment Facility. New Motor Control Starters shall be required for the new motor equipment. The installation of new electrical circuitry for the equipment shall be required. New Variable Frequency Drive Units shall be required for the Raw Water Pumps, Finish Water Pumps and High Service Pumps.

8.13 Instrumentation and Controls

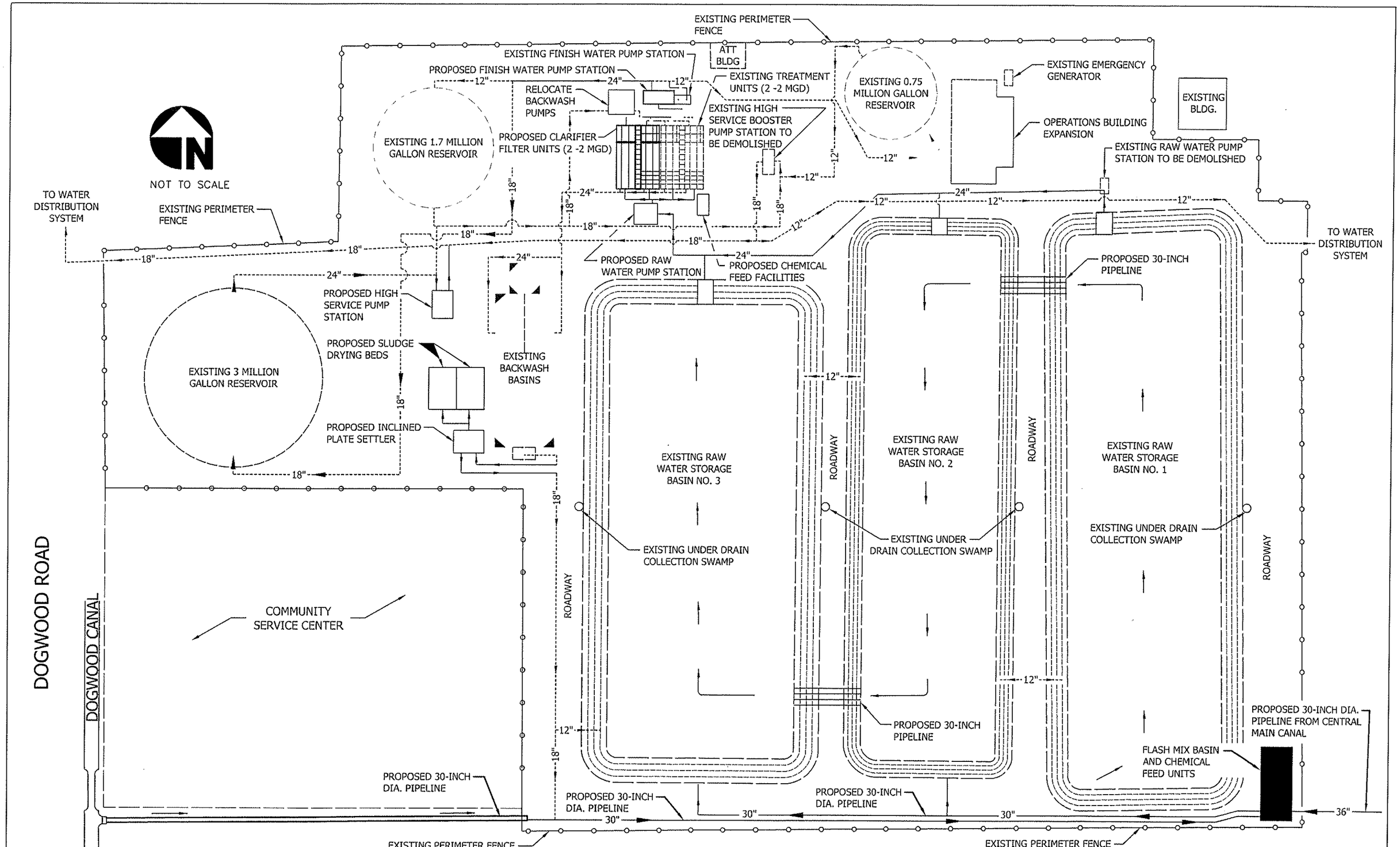
The instrumentation and electrical control equipment shall require alteration, modification or augmentation for the proposed 6.0 MGD expansion. The existing components shall be reviewed in detail during the project design:

- ✓ HMI
- ✓ Computer workstation
- ✓ Plant Control Network
- ✓ Software

It appears the above existing components can be altered, modified or augmented at a minimal expense. Major instrumentation and control modifications are not anticipated to be required for the 6.0 MGD Wastewater Treatment Plant Expansion.

8.14 Emergency Backup Power

The existing 3456 Generator Set shall be supplemented with a second Generator Set Unit to accommodate the 6.0 MGD Water Treatment Plant expansion. It shall be necessary to replace the Automatic Transfer Switch.



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ENGINEER'S OPINION OF PROBABLE COST FOR WATER TREATMENT IMPROVEMENTS

ENGINEERS OPINION OF PROBABLE COST - EXPAND TO A 6.0 MGD WATER TREATMENT PLANT 1/10/08

ITEM	DESCRIPTION	COST	COST
1	**Raw Water Conveyance Pipeline to Raw Water Ponds**		**$161,424.00**
2	**Flash Mix Basin**		**$48,852.00**
	A. Concrete Wet Well Structure	$31,860.00	
	B. Two Metering Pumps	$12,744.00	
	C. Electrical	$2,124.00	
	D. Instrumentation and Controls	$2,124.00	
3	**Basin Nos. 1, 2, and 3 Modifications**		**$38,232.00**
4	**Raw Water Pump Station**		**$209,214.00**
	A Three Raw Water Pumps	$79,650.00	
	B Three VFD Units	$31,860.00	
	C Concrete Wet Well Structure	$44,604.00	
	D Mechanical (Trash Rack and Fish Screen)	$21,240.00	
	E Metal Shade Structure	$10,620.00	
	F Electrical	$15,930.00	
	F Instrumentation and Controls	$5,310.00	
5	**Trident Treatment Unit System**		**$838,980.00**
	A Two - 2 mgd Trident Unit	$557,550.00	
	B Concrete Foundation	$116,820.00	
	C Metal Shade Structure	$31,860.00	
	D Piping	$79,650.00	
	E Electrical	$31,860.00	
	F Instrumentation and Controls	$21,240.00	
6	**Relocate Backwash Pumps**		**$48,852.00**
	A Concrete Foundation	$14,868.00	
	B Demolish Existing Concrete Foundation	$10,620.00	
	C Piping	$19,116.00	
	D Electrical	$2,124.00	
	E Instrumentation and Controls	$2,124.00	
7	**Inclined Plate Settler System**		**$403,560.00**
	A. Concrete Foundation	$14,868.00	
	B. Inclined Plate Settler	$244,260.00	
	C. Two Pumps at Backwash Pump Station	$42,480.00	
	D. Piping	$63,720.00	
	E. Electrical	$6,372.00	
	F. Sludge Drying Bed	$31,860.00	
8	**Finish Water Pump Station**		**$194,346.00**
	A Two Finish Water Pump	$53,100.00	
	B Two VFD Unit	$21,240.00	
	C Concrete Clearwell Structure	$32,922.00	
	D Metal Shade Structure	$10,620.00	
	E Piping	$63,720.00	
	F Electrical	$6,372.00	
	G Instrumentation and Controls	$6,372.00	
9	**Two Sludge Drying Beds**		**$50,000.00**
10	**Chemical Feed Facilities**		**$41,992.00**
	A Two Metering Pumps - Ferric sulfate	$8,496.00	
	B Electrical	$2,124.00	
	C Instrumentation and Controls	$2,124.00	
	D New 1500 gal tank - Ferric Sulfate	$5,000.00	
	E Two Polymer Feed System units - Polymer	$20,000.00	
	F Electrical	$2,124.00	
	G Instrumentation and Controls	$2,124.00	

HPUD - WATER TREATMENT PLANT EXPANSION

ENGINEERS OPINION OF PROBABLE COST - EXPAND TO A 6.0 MGD WATER TREATMENT PLANT 1/10/08

ITEM	DESCRIPTION	COST	COST
11	**Disinfection Facilities**		**$25,488.00**
	A One Cell Unit	$16,992.00	
	B One 4,000 gal. Storage Tank	$4,248.00	
	C Piping	$2,124.00	
	D Electrical	$2,124.00	
12	**High Service Pump Station**		**$191,160.00**
	A Five Booster Pumps	$106,200.00	
	B Five VFD Units	$42,480.00	
	C Concrete Foundation Pad	$6,372.00	
	D Piping	$21,240.00	
	E Electrical	$7,434.00	
	F Instrumentation and Controls	$7,434.00	
13	**Yard Piping**		**$180,540.00**
14	**Electrical**		**$159,300.00**
15	**Instrumentation and Controls**		**$63,720.00**
16	**Emergency Backup Power**		**$79,650.00**
17	**Site Grading**		**$21,240.00**
18	**Operations Building Expansion (916 S.Q. Ft. Expansion)**		**$97,279.20**
	WATER TREATMENT PLANT CONSTRUCTION - ITEMS 1 THROUGH 18		**$2,853,829.20**
19	**36 inch Raw Water Transmission Pipeline from Central Main Canal to Water Treatment Plant**		**$2,280,114.00**
	A 1.8 Miles of 36-inch Pipeline	$2,124,000.00	
	B Ten 36-inch Butterfly Valves	$81,774.00	
	C 12-inch Portable Diesel Pump	$74,340.00	
	CONSTRUCTION SUB-TOTAL		**$5,133,943.20**
	Contingency (15%)		**$770,091.48**
	TOTAL CONSTRUCTION COST		**$5,904,034.68**

20	**Engineering and Design Services**		**$987,535.25**
	A. Engineer Design Fees	$661,238.50	
	B. Geotechnical Report	$76,296.75	
	C. Boundary Survey of Existing and Add'l land, Easements and ROW	$120,000.00	
	D. Legal/Admin	$50,000.00	
	E. Environment Consultant	$30,000.00	
	F. Architectural Design of Operations Building	$40,000.00	
	G. Design of Flash Mix Basin	$10,000.00	

21	**Bidding Phase Services**		**$30,000.00**

22	**Construction Management Services**		**$615,000.00**
	A Construction Management/Resident Engineer	$450,000.00	
	B Geotechnical Material Testing	$80,000.00	
	C Construction Staking	$45,000.00	
	D Legal/Administration	$40,000.00	

	TOTAL PROJECT COST	**$7,536,569.93**

Highlighted items have been added since the PER was completed.

APPENDIX A

Heber Public Utility District

Proposed development within HPUD Service area:
HPUD can treat 2.02 M gal. per day (Sept. 2004).

1 single family residence = 450 gallons per day
1 multi-family unit = 80 gallons per day
School = 20 gallons per day per person (students & employees)
Parks = ? Usage per acre, Gallons per day

Commercial/Industrial Usage = gallons?

Project Name	Single Family Residential	Multi Family (Units)	Industrial, Commercial	Open Space (acres)	Schools Total Persons	Other Information
Heber Township (current)	818	59	26			*There are 10 Commercial 14 Industrial*
Heber Union Elem. School					816	*716 students 100 employees (as of 9 9 04)*
Heberwood Estates	420	162				Need the commercial estimates?
McCabe Ranch - Phase 1	173	127	9			Start 2004 - End 2006
McCabe Ranch - Phase II - V *	410	90	10	28		13 acres school site/400 students
Desert Sunrise Apartments		24				Heber Community Foundation
Correll Estates *	265			15	755	15 acre school site/650 students-105 Employees
Heber Meadows	219	146				
Heber 142 *	700	1131	45.4			
Imperial Center *			20			77.64 acres/Streets 8.61 acres
Heber Ranch **			120			600 acres/80% residential & 20% commercial
Magnolia Estates ***	23					
McCabe Cove ***	5					
Huerta & Childrens Parks			12.54			Huerta = 10 39 acres & Childrens = 2 15 acres
Totals: --->	**3,033**	**1,739**	**243**	**43**	**1,571**	

Total Single Family/Multi-Family/School: ---> 6,343

Total of all "Other Acreage": ---> 286

Total Gallons Required on Dailey Basis: ---> 1,565,720 *<--- Need to add in Commercial/Industrial & Parks.*

(This total is projected from above figures)

Heberwood Estates has already build 82 single family units, and these are counted in "Heber Township (current)".
*NOTE: *** These will eventually be serviced by El Centro.*
How many bedrooms per home? Calculation of estimated population with completed projects? Calculation of expected population w/proposed development?
What is the current population of Heber? The 2000 Census = 2,988, 1990 = 2,566 (a difference of 422 residents).
*NOTE: * As of this date it is unknown when proposed for development.*
*NOTE: ** As of this date it is proposed that 384 acres be single residence & 96 acres multi-family residence (total of 480 acres).*
How many single family residential can be placed on 384 acres (allow for streets, retention basin, etc)? And how many multi-family homes can be placed on 96 acres (also allowing for any public improvements)?.
NOTE: The impact of Industrial, Commercial, Public, Open Space and all other zoned properties can't be determined until plans for the development are submitted.
Tito Huerta Park = (6 93 - 4.36) 10 39 acres and Childrens Park = 2.15 acres.

APPENDIX B

CALIFORNIA DEPARTMENT OF HEALTH SERVICES
DRINKING WATER FIELD OPERATIONS BRANCH
IMPERIAL DISTRICT

HEBER PUBLIC UTILITY DISTRICT

Water Permit No. 05-14-02P-009

System No.: 1310007
Imperial County

June 15, 2005

STATE OF CALIFORNIA

DOMESTIC WATER SUPPLY PERMIT

Issued To

HEBER PUBLIC UTILITY DISTRICT

1310007

By The

California Department of Health Services,

Division of Drinking Water & Environmental Management Branch

PERMIT NUMBER **05-14-05P-009** **DATE:** **June 15, 2005**

WHEREAS:

1. The Heber Public Utility District was inspected on January 27 and May 11, 2005, by the California Department of Health Services to issue a new public water system and perform an annual inspection.

2. This public water system is known as the Heber Public Utility District whose headquarters is located on Dogwood Road in Heber, CA 92249.

3. The legal owner of the Heber water system is the Heber Public Utility District. The Heber Public Utility District (hereafter Heber), therefore, is responsible for compliance with all statutory and regulatory drinking water requirements and the conditions set forth in this permit.

4. The public water system is as described briefly below:

   The water system is a small community water system that supplies water for domestic purposes to approximately 3,400 through a total of about 853 service connections. The Water system operates 24 hours daily based on system demand. Heber receives raw water from the Imperial Irrigation District (IID), from the Central Main Canal through the Dogwood Canal to Gate 101. The raw water is allowed to settle in three lined settling basins (total capacity of 5.8 MG). Water is pumped from the third settling basin and alum and polymer is added and is mixed via static mixer. The water then flows through two U.S. Filter Co. Micro Floc Water Treatment System units. The filtered water exits the treatment plant and is chlorinated prior to being pumped to one of the two clearwell reservoirs that together store 2.45 MG. Water from the reservoirs is pressurized to 40 psi to feed the one pressure zone distribution system.

5. The Heber treatment plant is located on Dogwood Road in Heber, an area of Imperial County, and serves Heber only. Heber is located in Imperial County with a desert climate.

And WHEREAS:

1. Heber has submitted all of the required information relating to the proposed operation of the water system.

2. The California Department of Health Services has evaluated all of the information submitted by the Heber.

3. The California Department of Health Services has the authority to issue domestic water supply permits pursuant to Health and Safety Code Section 116540.

THEREFORE: The California Department of Health Services has determined the following:

1. The Heber water system meets the criteria for and is hereby classified as a community water system.

2. Heber has demonstrated that the water system has sufficient source capacity to serve the anticipated water demand for at least 5 years.

3. The design of the water system complies with the Water Works Standards and all applicable regulations.

4. Provided the following conditions are complied with, the Heber water system should be capable of providing water to consumers that is pure, wholesome, and potable and in compliance with statutory and regulatory drinking water requirements at all times.

THE HEBER PUBLIC UTILITY DISTRICT IS HEREBY ISSUED THIS DOMESTIC WATER SUPPLY PERMIT TO OPERATE THE HEBER WATER SYSTEM.

The Heber Public Utility District (Heber) shall comply with the following permit conditions:

Safe Drinking Water Act

1. Heber shall comply with all State laws applicable to public water systems, including, but not limited to the Health and Safety Code and any regulations, standards, or orders adopted there under.

Approved Sources & Treatment

2. This permit authorizes Heber to use the following sources:

Source	Status	Capacity	PS Code
Dogwood Canal Gate 37A	Active	N/A	1310007-001 and 1310014-002 (Central Main Canal)

3. The only approved treatment includes the following process:

Facility	P.S. Code	Treatment	Remark
Heber Treatment Plant	1310007-002	Contact Clarification Filtration	Microfloc

4. No changes, additions, or modifications shall be made to the sources or treatment in Provisions Nos. 2 and 3 unless an amended water permit has first been obtained from the Department.

Filtration Plant

5. The Heber Treatment Plant shall not be operated above the design capacity of 2.0 MGD during normal operation.

6. There shall be no bypassing of any treatment process, at any time. These processes include coagulant feed and static mix, contact clarification, filtration, and disinfection.

7. Individual filters shall not be operated at a flow rate that exceeds 5.0 gpm/SF unless approval is granted.

8. The new plant must meet a standard of combined filter effluent less than 0.25 NTU in 95% and less than 1.50 NTU in 100% of measurements during the month. It must meet a standard of combined filter effluent less than 1.00 NTU in two (2) consecutive turbidity samples of the combined filter effluent taken every four (4) hours. To determine compliance with the turbidity performance standards, the turbidity of the combined filter effluent, prior to storage, shall be determined at least once every four (4) hours that the plant is in operation. Monitoring shall be conducted in accordance with the approved operations and maintenance plan.

9. The WTP shall be considered alternative technology, equivalent to a conventional filtration treatment plant (provided the turbidity standard in No. 8 above is met), and shall be deemed to be capable of achieving at least 99.7 percent (2.5 log) removal of Giardia cysts and 99 percent (2 log) removal of viruses when in compliance with operation criteria specified in the California Code of Regulations, Title 22, Section 64660 and performance standards specified in Section 64653 (c), or as amended in the future.

   a) Whenever the bacteriological water quality of the influent exceeds 1000 MPN/100L total coliform in a majority of the past month's sample analyses, until there are a majority of the past month's sample analyses that are less than 1000 MPN/100L, the plant shall provide multibarrier treatment that meets the requirements to reliably ensures at least: a total of 99.99 percent (4-log) reduction of Giardia cysts through filtration and disinfection;

b) And a total of 99.999 percent (5-log) reduction of viruses through filtration and disinfection.

10. Heber shall notify DHS within 24 hours by telephone whenever: a) the turbidity of the filter effluent exceeds 1.49 NTU at any time; or b) more than two (2) consecutive turbidity samples of the combined filter effluent taken every four (4) hours exceed 1.0 NTU. The operators shall notify the Department by telephone and fax of any violation of any MCL in the effluent of the treatment plant or failure to meet CT requirements. Notification shall occur within 24 hours of becoming aware of such an incident. If the Department is closed at the time, it shall be notified by telephone before 8:15 a.m. of the next day.

11. The water entering the distribution system shall contain a disinfectant residual of not less than 0.8 mg/L at any time. Furthermore, a disinfectant residual shall be detectable in at least 95 percent of the samples taken from the distribution system based on the samples collected during two consecutive months. The presence of heterotrophic plate count (HPC) of 500 CFU/mL or less may be substituted for a detectable residual. Residual measurements shall be made in conjunction with coliform sampling.

12. Heber shall comply with all treatment optimization criteria of the Cryptosporidium Action Plan. Heber shall use jar tests or other monitoring devices to adjust chemical dosages and other operation parameters to achieve turbidity goal of 1 to 2 NTU in the settled water.

13. Heber shall calibrate turbidimeters. This shall include the proper use and replacement of both the primary and secondary standards, which are used in the calibration. Heber shall maintain turbidity calibration records including date, model, and location of turbidimeter, and procedures used.

14. Heber shall submit a monthly operation report to this office by the 10th day of the following month. The report shall include the daily turbidity measurements for raw water, settled water, and treated water, chlorine residual measurements of the treated water, CT calculations, a log of turbidity calibrations, a list of water quality complaints and reports of water borne illness received from consumers. Treatment plant records shall be maintained for at least three (3) years. Heber shall contact this office by phone concerning any acute violation or occurrence of a hazardous situation.

15. Heber shall request permit approval prior to any physical changes in the treatment processes, expansion of the water treatment plant, or the addition of rechlorination facilities.

16. All plant operators and supervisory personnel involved with the operation or oversight of the treatment facility shall have a copy of and shall be familiar with the conditions of this permit. A copy of the conditions shall be maintained at the treatment facility and the main office for reference.

17. Operations, maintenance, and monitoring of the treatment facility shall be performed in accordance with manufacturers' operations and maintenance manuals and with a Department approved Operation, Maintenance, and Monitoring Plan (OM&M Plan) and the documents and manuals noted therein unless otherwise specified by State regulations or the Department. All additions, deletions, or amendments to the OM&M Plan shall be approved by the Department prior to implementation. Heber and its operators are responsible for ensuring that the OM&M Plan is, at all times, representative of the

operations, maintenance, and monitoring of the facility and that the appropriate changes to the OM&M Plan are submitted to the Department for approval in a timely manner. Within 60 days of receipt of the permit, a revised OM&M Plan shall be submitted to the Department reflecting any modifications necessary to comply with the conditions of this permit.

18. Heber shall take all necessary actions to minimize vandalism and unauthorized entry to the treatment facility.

19. By August 31, 2005, Heber shall install an automatic shutdown feature in case there is a loss of coagulant feed.

Maximum Contaminant Levels

20. All water supplied by Heber for domestic purposes shall meet all Maximum Contaminant Levels (MCLs) established by the State Department of Health Services. If the water quality does not comply with the California Drinking Water Standards, treatment shall be provided to meet standards.

Operator Certification Program

21. The treatment facilities and distribution system shall be operated by personnel who have been certified in accordance with the Regulations Relating to Certification of Water Treatment Facility Operation and Distribution System, California Code of Regulations, Title 22. Heber will need a **D3 and T3** certified operator for the operation of the water system.

Cross-Connection Control Program

22. Heber shall maintain an active cross-connection control program in accordance with the Regulations Relating to Cross-Connections, California Code of Regulations, Title 17. All cross connections shall be abated within 30 days of their identification. Annual surveys shall be conducted thereafter. Backflow prevention devices shall be tested at least yearly. Heber shall submit an annual report to the Drinking Water Field Operations Branch system outlining the cross-connection control program for the previous year including the name and certification of the person assigned to the program, number of inspections made, number of backflow devices installed in the system and the number of devices tested and repaired.

23. By December 31, 2005, Heber must reevaluate each service connection to determine those that have their own connection to the canal or other auxiliary source of water. Such "auxiliary sources" may require the installation of a RP at the meter. A Cal/NV Section AWWA-certified Cross-connection Control Specialist must conduct this survey.

24. By December 31, 2005, the staff person must either obtain certification as a Cal/NV Section AWWA Cross-connection Control Specialist or Heber must contract with a Cal/NV Section AWWA-certified Cross-connection Control Specialist.

25. Heber must maintain records of all cross connection control inspections and testing.

Water Quality Monitoring

26. Heber shall monitor the distribution system for bacteriological water quality according to a Department-approved Coliform Sample Siting Plan. A bacteriological analyses report shall be submitted to this office by the tenth of the month following sampling signed by the Manager, Superintendent, or Chief Operator including a list of water quality complaints and any reports of waterborne illnesses received from consumers.

27. Heber shall monitor raw water sources monthly for total coliform and fecal coliform/E.coli bacteria. The coliform tests shall be performed using a density analytical method and results shall be reported in units of MPN per 100 ml.

28. Heber shall monitor the distribution system every quarter (three months), for total trihalomethanes (TTHMs) and five haloacetic acids (HAA5). Heber must follow the state-approved disinfection by-product monitoring plan.

29. Heber did not monitor for TTHMs or HAA5s during any of 2004. Heber must report this procedural failure in the 2004 Consumer Confidence Report, due to their consumers July 1, 2005.

30. Pursuant to CCR, Title 22, Section 64451, all water quality monitoring results obtained in a calendar month shall be submitted to the Department on paper by the tenth day of the following month.

31. Pursuant to CCR, Title 22, Section 64451, a State-certified laboratory shall perform all chemical analysis. Heber must require their contract laboratory to report water quality results to the Department using Electronic Data Transfer (EDT) using the Primary Station Code (PS_Code). This requirement excludes bacteriological monitoring, which shall be submitted directly to the Department on paper.

32. Heber shall contact this office by phone concerning any acute violation or the occurrence of a hazardous situation. MCL violations will require public notification and corrective action.

Storage Reservoirs Basic Design

33. The storage reservoirs shall comply with the California Waterworks and American Water Works Association (AWWA) design and construction standards. Distribution reservoirs shall be covered. Vents, overflows, drain outlets and other openings shall be located and constructed to protect the water in the reservoir from contamination. Vents and overflows shall be screened and adequately air-gapped to prevent cross-connections. Overflows shall be large enough to dispose of reservoir overflow rates equal to the maximum reservoir-filling rate. Provisions shall be made to facilitate removal of floating material from the free water surface and for dewatering the reservoir. Outlets shall be designed and constructed to minimize movement of sediment from the reservoir floor to the distribution system water mains. Provisions shall be made for isolating the reservoir(s) and appurtenant facilities from the distribution system without causing pressure problems in the distribution system.

34. Distribution reservoir sites shall not be used for non-water works purposes that would either result in unrestricted public access, compromise security, or create a contamination hazard.

35. Reservoirs shall be disinfected and sampled for bacteriological quality in accordance with the AWWA procedures for disinfecting tanks and reservoirs prior to domestic use.

Storage Reservoir Coating/lining

36. Heber shall use only NSF drinking water approved reservoir coatings, linings and their adhesives for its storage reservoirs. Otherwise, a VOC sample shall be collected after the newly coated/lined reservoir is filled and a minimum 5 day soaking period is allowed. In addition to the chemicals on the standard list (Method 524) analyses shall be made for ortho-Xylene, para-Xylene, meta-Xylene, methylethylketone (MEK), methylisobutylketone (MIBK) and any other solvent in the coating/lining adhesive included in the material Safety Data Sheet (MSDS) must also be included in the sample analysis. The results of the VOC analysis must be submitted to the Department.

Distribution System

37. The distribution system shall comply with all applicable California Waterworks and American Water Works Association (AWWA) design and construction standards and in compliance with the SDHS-CDHS Guidelines for the Separation of Water and Sewer Lines. At least 10 feet horizontal and 1-foot vertical separation shall be maintained between the water and sewer lines. Water lines should always cross above sewer lines. Special construction standards and materials shall be provided where the minimum separation cannot be met.

Direct Additives

38. Pursuant to CCR, Title 22, Section 64700, no chemical or product shall be added to the drinking water as part of the treatment process unless it has been certified as meeting the specifications of the American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 60.

Annual Report to DHS

39. Heber shall submit the Annual Report on the status and condition of the domestic water system as directed by the Department.

Emergency Response Plan

40. By December 31, 2005, Heber must prepare an Emergency Response Plan that incorporates the results of the Bioterrorism Vulnerability Assessment.

This permit supersedes all previous domestic water supply permits issued for this public water system and shall remain in effect unless and until it is amended, revised, reissued, or declared to be null and void by the California Department of Health Services. This permit is non-transferable. Should the Heber Public Utility District undergo a change of ownership, the new owner must apply for and receive a new domestic water supply permit.

Any change in the source of water for the water system, any modification of the method of treatment as described in the Permit Report, or any addition of distribution system storage

reservoirs shall not be made unless an application for such change is submitted to the California Department of Health Services.

This permit shall be effective as of the date shown below.

FOR THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES

Brian Bernados

Brian Bernados, PE
District Engineer

Dated: 6-15-05

H:\Systems\Heber Public Utility District\Permits\Heber Permit 2005\docs\20050615 Heber permit 05-14-05P-009.doc

REGISTERED PROFESSIONAL ENGINEER
BRIAN BERNADOS
NO. C48144
EXR 6-30-06
CIVIL
STATE OF CALIFORNIA

Engineering Report
For Consideration of Full Permit 05-14-05P-009
For
Heber Public Utility District, 1310007
Imperial County
June 15, 2005

State Department of Health Services
Division of Drinking Water and Environmental Management
Drinking Water Field Operations Branch
Bruce Berger, Sanitary Engineer

I. INTRODUCTION

1.1 PURPOSE OF REPORT

The purpose of this report is to document the Sanitary Engineering Review and to make recommendations regarding the issuance of a new domestic water permit.

1.2 BACKGROUND INFORMATION

The Heber Public Utility District (hereafter Heber) was inspected by Bruce Berger, a sanitary engineer for the California Department of Health Services (CDHS) on January 27 and May 11, 2005. The Heber Public Utility District was formed in 1933 when the District purchased the system. Treatment consisted of settling ponds and chlorination. The treatment plant installed in the early 1970's, consisted of a 300-gpm clarifier that is now out of service and some pressure filters. This clarifier along with three pressure filters and the existing 250,000-gallon reservoir made up the treatment plant until the early 1980's. At that time the 300-gpm plant was not producing sufficient water for the system and a construction moratorium was placed on Heber. In response to this moratorium the District installed an 1150 gpm clarifier, three new filters, and a 0.75 million gallon (MG) reservoir. When the 1150 gpm clarifier came on line, the 300 gpm was abandoned and has not been used since. In 1997 the District received a grant to build a 1.7 MG reservoir, three new pressure filters (for a total of nine), and a new booster station. This increased the plant's flow capacity to 1.3 million gallons per day (MGD); however, due to a recent increase in growth, it is expected that water consumption will exceed the current plant's production capacity very soon.

1.3 BRIEF DESCRIPTION OF SYSTEM

The Water system is a small community water system that supplies water for domestic purposes to approximately 3,400 through a total of about 853 service connections. The Water system operates 24 hours daily based on system demand. Heber receives raw water from the Imperial Irrigation District (IID), from the Central Main Canal through the Dogwood Canal to Gate 101. The raw water is allowed to settle in three lined settling basins (total capacity of 5.8 MG). Water is pumped from the third settling basin and alum and polymer is added and is mixed via static mixer. The water then flows through two U.S. Filter Co. Micro Floc Water Treatment System units. The filtered water exits the treatment plant and is chlorinated prior to

being pumped to one of the two clearwell reservoirs that together store 2.45 MG. Water from the reservoirs is pressurized to 40 psi to feed the one pressure zone distribution system.

1.4 ENFORCEMENT HISTORY

A notice of violation was issued on May 28, 2002 due to not submitting the Monthly Summary of Distribution System Coliform Monitoring Report for March 2002. This was corrected in June 2002.

Heber did not monitor for TTHM/HAA5 during 2004. Failure to sample for DBPR is a procedural failure, and was reported to the USEPA on February 7, 2005. Public notification was given by Heber March 3, 2005 via mail. Also, Heber will be required to report this procedural failure in the 2004 Consumer Confidence Report.

1.5 AREA SERVED

Heber currently serves a population of about 3,400 through a total of about 853 metered connections. The majority of the connections are to metered residential customers. The water system also serves 14 industries, a school, and a sewage treatment plant. The service area is at approximately sea level. Local climate is characterized by little rainfall, mild, temperate weather in the winter and extremely hot weather in the summer.

Several proposed developments will soon increase the number of service connections to between 1000 and 1200.

1.6 PRODUCTION DATA

Based on the Source and Storage Capacity Assessment and evaluation, Heber meets the peak demand flow rate of 1.3 MGD with a maximum system capacity of 2.0 MGD. Annual Water Usage in 2004 was 311 MG.

1.7 FACILITIES

The updated treatment plant consists of two U.S. Filter Co. Micro Floc Water Treatment Systems. (See attached Filtration Plant Data Sheet).

1.8 SOURCES OF INFORMATION

Information for this Sanitary Engineering Report was obtained from Richard Zaragosa (Engineer) and Ignacio Colunga (Operator), CDHS records, and a field investigation of the system.

II. INVESTIGATION AND FINDINGS

2.1 SOURCES OF SUPPLY

2.1.1 SURFACE WATER

Heber receives all of its water supply from the Imperial Irrigation District (IID), from the Central Main Canal through the Dogwood Canal Gate 37A. When the Dogwood Canal is out of service for maintenance, Heber uses their raw water storage basins, which have an estimated six days of storage at a peak flow of 1.3 MGD. Before the IID takes out the canal, they contact Heber, and Heber has the chance to postpone the work if they need the water.

Imperial Irrigation District completed a watershed sanitary survey for all surface water systems using the All American Canal in 2003. The report included the following recommendations:

- Large water systems should continue monitoring the raw water at their plant intakes at the same frequency and analyze the water for total coliform, fecal coliform and E. Coli. If there is a significant increase in raw water coliform concentrations or turbidity, plants should increase disinfection as a precautionary measure.
- New plants should be designed to achieve a minimum 4-log Giardia reduction and 5-log virus reduction.
- As a precautionary measure, where possible systems should close their intakes and operate off of storage ponds when canals are being maintained. In addition, when maintenance is being performed on ponds, the ponds should be removed from service until the water has had an opportunity to settle.
- Colorado River water is not amenable to enhanced coagulation. Therefore, systems using the IID canal system should be granted a waiver from enhanced coagulation.

2.1.1.1 PURCHASED TREATED SURFACE WATER

There are no purchased treated water connections.

2.1.2 GROUNDWATER SUPPLIES

There are no groundwater supplies for this water system.

2.1.3 OTHER SOURCES

There are no other sources for this water system.

2.1.4 AUXILIARY SOURCES AND INTERCONNECTIONS

There are no interconnections to other water systems.

2.1.5 ADEQUACY OF SUPPLY

This office did a source capacity assessment and evaluation for the water system using the California Waterworks Standards. A summary of the results is as follows:

1. Heber serves a population of 3,400. Service connections are 853.
2. Annual Water Usage in 2004 was 311 MG.
3. Maximum average temperature is approximately 80 deg F.
4. The maximum day average flow rate was 1.3 MGD in July 20th, 2004.

Summary: The Water system treatment plant provides a source capacity of 2.0 MGD that is adequate to meet the minimum supply rate and the maximum day average flow rate. Heber

maintains three storage tanks that provide a total capacity of 2.45 MG and will be adequate to meet the peak demand rate.

2.1.6 RECYCLED AND/OR GRAY WATER

There is no recycled or gray water usage in this water system.

2.2 TREATMENT

2.2.1 SURFACE WATER

A plant schematic is included in the appendices. The treatment plant consists of two U.S. Filter Co. Micro Floc Water Treatment Systems (See attached Filtration Plant Data Sheet). The treatment plant is a CDHS approved "alternative technology" under the "contact clarifier" category, which is credited with 2.5-log Giardia cyst / 2-log viruses removal capability, provided that the combined effluent turbidity can meet a monthly standard of 0.2 NTU 95% of the time.

Coagulation:
Aluminum Sulfate is stored in one 5000-gallon storage tank. Alum is injected using LMI positive displacement chemical feed pumps prior to entering the Upflow Clarifier. Coagulants are flash mixed using a Chemineer in-line static mixer located six inches past the coagulant injection point. Alum is used as the primary coagulant and dosed at approximately 15-20 ppm.
A Nonionic Polymer blend is used as a coagulant aid and injected using LMI positive displacement chemical feed pumps prior to entering the Upflow Clarifier. The polymer storage tank holds 200 gallons, and the normal dosage is 0.10-0.15 ppm.

Clarifier:
Each upflow clarifier has a total area of 140 square feet (10.83 x 12.92 ft), and is operated at a rate of rate of 10 gpm/ft^2. The clarifier media is composed of irregularly shaped particles of chemically inert material. This material is less dense that water, so it floats at the surface. A stainless steel retaining assembly at the top of the clarifier holds back the four-foot deep bed of clarification media.

Plant staff visually inspects the facilities daily. The floc viewed during the inspection ranged from small pin floc to large fluffy floc. No short-circuiting of the flocculation basin was observed.

Filtration:

Water flows from up-flow contact clarifier basins, overflowing into the mixed media sand filters. The filtration system consists of two 1440-gpm package plants. The filters are mixed media (anthracite, #20 silica sand, and garnet). The filters are equipped with a single outlet pressure gauge on filter No. 1.

The typical length of filter runs is ten hours. The clarifiers and the mixed media sand filters are on separate backwash control systems. The filter pump on/off operation is controlled by high and low reservoir set points of 28 and 30 feet respectively. The reservoirs have a low level alarm set at 25 feet that automatically pages an operator.

The filters have 280 square feet of area each (10.83 x 25.83 ft). The filters are operated at a maximum rate of 1440 gpm. The filtration rate at this flow is 5.0 gpm/sq ft. A flow restriction

valve that throttles back the flow from the filter pumps controls the filtration rate, which is measured by a single flow meter.

Filter backwash of both filters is performed when the turbidimeters show the effluent turbidity to exceed 0.28 NTU, or if the filter headloss reaches 7 feet. The procedures for backwash are outlined in 2005 Heber Operations Plan. The filters are backwashed one at a time; with the source of water used for backwashing is filtered water from the other filter. The filter backwash is returned to the settling storage ponds at the head of the treatment plant.

The plant is equipped with three 1720 Hach turbidimeters, which continuously monitor and record both the individual and the combined filter effluent turbidities. Because of this arrangement, the plant will be able to meet the 15-minute monitoring required in the Long Term Stage 1 Enhanced Surface Water Treatment Rule. The High alarm set points are 0.28 NTU. The delay is set at 10 minutes. The alarms are connected to both a beacon/horn enunciator, as well as to an auto dialer system that dials out and pages the operators.

Disinfection:

Disinfection is provided by sodium hypo-chlorite, which is injected using LMI positive displacement chemical feed pumps. The system is designed for both pre and post-chlorination. Typical dosages range from 3-4 ppm, in order to produce a free chlorine residual between 1-2 ppm. Both combined filter effluent and distribution system chlorine residuals are monitored and recorded by Hach CL17 continuous monitoring analyzers.

The treatment plant is credited with 2.5-log removal of Giardia cyst and 2-log removal of viruses, provided that the combined effluent turbidity can meet a monthly standard of 0.2 NTU 95% of the time. Raw water bacteriological testing for coliforms is done once a month. From October 2004 to March 2005 the coliform concentration ranged from 2 to 500 MPN/mL. Because the source water coliform concentration sometimes exceeds 1,000 MPN/mL, Heber PUD needs to have the capacity to provide four-logs Giardia reduction and five-logs virus reduction.

The records for Heber were reviewed and it was determined that the maximum pH has been 8.3 in the past three years. With a 1.5-log inactivation of Giardia cysts at any worse case scenario (10 degrees C and a pH of 8.0), the required CT that must be attained is 89 (at a 0.8 ppm residual and a pH of 8.3), via interpolation of the CT Tables.

Flow proceeds to the above ground clearwell tanks that together store 2.45 MG. They are currently operated in parallel with automatic pump controls to maintain levels at 28 to 30 foot, but the operator is automatically paged at 25 feet. The reservoirs have no baffling, but water is filled from the top and withdrawn from the bottom; thus a T10/T of 0.1 is assumed, to be conservative. The minimum reservoir volume is calculated as approximately 2 MG at a normal low level of 25 feet. The maximum flow rate through the filters is 1440 gpm; however, this may not correspond to the maximum rate water is withdrawn from the tanks. To estimate the maximum flow through the tanks the maximum day demand of 1.3 MGD is converted to 900 gpm. Then a 2.0 peak hour factor is applied to the maximum day, which corresponds to an estimated peak flow through the tanks of 1800 gpm. Thus, the minimum contact time (T10) at maximum hourly flow is approximately 111 minutes (2,000,000 / 1800 * 0.1).

With a CT required of 89, this can be attained with a chlorine residual equal to or greater than 0.8 mg/L. The plant must shut down and operator must be paged when the chlorine residual is less than 0.8 mg/L (at the time of the inspection, the setpoint was 0.80).

There are a number of conservative assumptions that are used to conclude that a 0.8-ppm chlorine residual leaving the clearwells is required. The worst case total coliform count is assumed. The volume of the water at a level of 25 feet is a little bit larger than 2,000,000 gallons. A low of 10 degrees Celsius is assumed, when over the last five years, the minimum temperature reported has been 12 degrees C.

2.2.2 GROUNDWATER

Heber does not have any groundwater sources.

2.3.1 STORAGE AND TRANSMISSION LINES

2.3.1.1 STORAGE

Heber maintains two reservoirs that provide 2.45 MG of storage capacity. The reservoirs are of steel construction. Water is fed at the top of the reservoirs and is discharged near the bottom on the opposite side of the tank. Both reservoirs are normally interconnected to provide a float. Each tank can be isolated for maintenance.

2.3.1.2 TRANSMISSION LINES

This does not apply to Heber.

2.4 DISTRIBUTION SYSTEM

2.4.1 BOOSTER OR PUMP STATIONS

Heber maintains two booster pumps to pressurize the entire distribution system to 40 psi. One pump is always On, one pump is in Auto Standby.

2.4.2 DISTRIBUTION LINES

Most of the distribution network is comprised of 4 inch and 6 inch diameter Transite (asbestos cement) pipelines.

2.5 OPERATION AND MAINTENANCE

2.5.1 ORGANIZATION AND PERSONNEL

Margarita Huerta Jr. is the interim General Manager that controls the Water system and can be contacted at 1078 Dogwood Rd., Heber, CA 92249. Heber requires at least a T3 and a D3 certified operator. According to the 2003 Annual Report, Heber has adequate certified operators.

2.5.2 TMF

Not applicable; because this is an existing water system.

2.5.3 CROSS CONNECTION PROGRAM

Heber' program manager has a tester certification, but is not certified as a Cal/NV Section AWWA-certified Cross-connection Control Specialist. Therefore, the staff person must either obtain certification or Heber must contract with a Cal/NV Section AWWA-certified Cross-connection Control Specialist.

Raw untreated canal water may be used for irrigation, which raises the potential for cross-connections. Heber must re-evaluate each service connection to determine those that have their own connection to the canal or other auxiliary source of water. Such "auxiliary sources" may require the installation of a RP at the meter. A re-survey by a Cal/NV Section AWWA-certified Cross-connection Control Specialist must be conducted.

2.5.4 COMPLAINT PROGRAM

Heber keeps a record of complaints and follows up with corrective actions if required with one week.

2.5.5 DISASTER RESPONSE PLAN

Heber has no Emergency Response Plan on file with the Department. The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 requires all community water systems serving more than 3300 people to prepare an Emergency Response Plan that incorporates the results of the Vulnerability Assessment.

2.5.6 EMERGENCY CHLORINATION PLAN

Heber has an adequate Emergency Disinfection Plán on file with the Department, which is located in the 2005 Heber Operations Plan.

2.5.7 CONSUMER CONFIDENCE REPORT

Heber did not monitor for TTHM/HAA5 during any of 2004. Failure to sample for DBPR is a procedural failure, which Heber will be required to report in the 2004 Consumer Confidence Report.

2.5.8 EMERGENCY NOTIFICATION PLAN

Heber has an Emergency Notification Plan on file with the Department, which is adequate.

2.5.9 OPERATION CONTROLS

The water system operates automatically. The supply to the distribution system is via three booster pumps and maintains a pressure of at least 50 psi.

An auto call system pages the on call operator if:

1. Finished water chlorine concentration < 0.80 ppm

2. Finished water NTU > 0.28
3. Distribution pressure < 40 psi
4. Reservoir level < 25 foot

2.5.10 FLUSHING PROGRAM

Heber flushes their 6 dead ends every three months; however, no records are maintained.

2.5.11 VALVE MAINTENANCE PROGRAM

Heber exercises all distribution system valves twice per year. Records are maintained.

2.5.12 MAIN DISINFECTION PROGRAM

Whenever possible, water main repair and maintenance is completed without depressurizing the water main. A minimum distribution system pressure of 20 psi must be maintained at all times. If, however, the water main must be depressurized, it will then be disinfected in accordance with one of the three AWWA methods described in standard C651-86.

2.6 WATER QUALITY MONITORING

2.6.1 SURFACE WATER

2.6.1.1 VULNERABILITY ASSESSMENT FOR SOURCE

Heber receives raw surface water from the Imperial Irrigation District (IID). IID is responsible for all chemical monitoring requirements.

2.6.1.2 GENERAL MINERALS AND PHYSICALS

The West Main Canal is analyzed annually for the general mineral and physical analysis on October 25, 2004. Hardness was 350 ppm as $CaCO_3$. TDS was 770 ppm. Color was 15 units. PH was 8.3. Alkalinity was 160 ppm.

2.6.1.3 INORGANIC CHEMICALS

The West Main Canal is analyzed annually for inorganics. On October 19, 2004, no results were above the MCL. On October 19, 2004, Arsenic was 3.2 ppb, Hexavalent Chromium (Cr VI) was ND, and Vanadium was 3.5 ppb. On February 1, 2004, perchlorate was ND, Hexavalent Chromium (Cr VI) was ND, and Vanadium was ND.

2.6.1.4 NITRATES/NITRITES

The West Main Canal is analyzed annually for nitrate/nitrite. On October 19, 2004, nitrates and nitrites were ND.

2.6.1.5 VOLATILE AND SEMI VOLATILE

The West Main Canal is analyzed annually for volatile organics. On October 19, 2004, there were no VOC's detected.

2.6.1.6 SYNTHETIC ORGANICS

The West Main Canal is analyzed every three years for synthetic organics. On October 18, 2004, there were no SOCs detected.

2.6.1.7 RADIOCHEMICALS

The West Main Canal is analyzed every four years for gross alpha. In 2004, no results were above the MCL

2.6.1.8 BACTERIOLOGICAL

Raw water bacteriological testing for coliforms is done once a month. From October 2004 to March 2005 the coliform concentration ranged from 2 to 500 MPN/mL.

2.6.2 DISTRIBUTION SYSTEM MONITORING

2.6.2.1 COLIFORMS

Heber has a Site Sampling Plan on file with the Department. The sampling plan includes a water system map with sampling sites identified. Heber serves 3400 people through 853 service connections and will be required to collect four routine coliform samples from the distribution system monthly. Bacteriological results for the past year have all been negative. The system routinely takes 5 samples per month.

2.6.2.2 SURFACE WATER TREATMENT RULE

The new water treatment plant should ensure that the Surface Water Treatment Regulations will be met.

2.6.2.3 TRIHALOMETHANES/DISINFECTION BYPRODUCTS

Heber shall conduct disinfection profiling calculations. One sample, every quarter (three months), of total trihalomethanes (TTHMs) and five haloacetic acids (HAA5) should be collected at the point of maximum residence time. Heber failed to sample for TTHMs during any of 2004. Failure to sample for TTHMs and HAA5s is a procedural failure, and was reported to the USEPA on February 7, 2005. Public notification was given by Heber March 3, 2005 via mail. It is anticipated that the new plant could be optimized to meet the TTHM standard.

2.7 ENVIRONMENTAL REVIEW

The Department of Health Services (DHS) as responsible agency according to CEQA (California Environmental Quality Act) has reviewed the Environmental Report/Environmental Documentation acceptance letter provided by the USDA/RUS staff (Jennifer Failer) from Woodland, CA. The project was jointly funded by a USDA and NAD Bank.

The EPA was lead agency for environmental review. Prior to construction, an Archaeological Survey was prepared for Burkett and Wong by the Imperial Valley College Desert Museum. No Historic or prehistoric sites existed in the project area and no artifacts were discovered during a field survey. A Biological Assessment was prepared on April 23, 1999 and amended on August 5, 1999. An alternatives analysis was conducted as part of the NEPA process. The USDA/RUS staff concluded the project would fall under a Categorical Exclusion. In accordance with Title 14, Section 15225, CDHS will use the federal documents to meet the requirements for CEQA.

The public review period began on August 30, 1999 and concluded on September 29, 1999. A Public Notice was published in the Imperial Valley Press on September 2, 1999. No written comments were received during the review period.

As a responsible agency, DHS has considered the Environmental Statements and hereby makes the following findings for permit amendment:

The project will not result in any significant impacts.
There are no recommended permit conditions.

III. APPRAISAL OF SANITARY HAZARDS & PUBLIC HEALTH SAFEGUARDS

The Heber distribution system and storage reservoirs are constructed in accordance with current California Waterworks Standards. The new plant is designed to meet the 0.1 NTU goal of the DHS Cryptosporidium Action Plan.

The old facilities are being replaced and updated.

IV. CONCLUSIONS AND RECOMMENDATIONS

The State Department of Health Services, Drinking Water Field Operations Branch system finds that the sources, works, and operation, as described in this report are capable of producing a safe, wholesome and reliable quality of water supply under normal circumstances subject to the conditions below. Issuance of a domestic water supply permit to Heber is recommended, subject to the following provisions:

Safe Drinking Water Act

1. Heber shall comply with all State laws applicable to public water systems, including, but not limited to the Health and Safety Code and any regulations, standards, or orders adopted there under.

Approved Sources & Treatment

2. This permit authorizes Heber to use the following sources:

Source	Status	Capacity	PS Code
Dogwood Canal Gate 37A	Active	N/A	1310007-001 and 1310014-002 (Central Main Canal)

3. The only approved treatment includes the following process:

Facility	P.S. Code	Treatment	Remark
Heber Treatment Plant	1310007-002	Contact Clarification Filtration	Microfloc

4. No changes, additions, or modifications shall be made to the sources or treatment in Provisions Nos. 2 and 3 unless an amended water permit has first been obtained from the Department.

Filtration Plant

5. The Heber Treatment Plant shall not be operated above the design capacity of 2.0 MGD during normal operation.

6. There shall be no bypassing of any treatment process, at any time. These processes include coagulant feed and static mix, contact clarification, filtration, and disinfection.

7. Individual filters shall not be operated at a flow rate that exceeds 5.0 gpm/SF unless approval is granted.

8. The new plant must meet a standard of combined filter effluent less than 0.25 NTU in 95% and less than 1.50 NTU in 100% of measurements during the month. It must meet a standard of combined filter effluent less than 1.00 NTU in two (2) consecutive turbidity samples of the combined filter effluent taken every four (4) hours. To determine compliance with the turbidity performance standards, the turbidity of the combined filter effluent, prior to storage, shall be determined at least once every four (4) hours that the plant is in operation. Monitoring shall be conducted in accordance with the approved operations and maintenance plan.

9. The WTP shall be considered alternative technology, equivalent to a conventional filtration treatment plant (provided the turbidity standard in No. 8 above is met), and shall be deemed to be capable of achieving at least 99.7 percent (2.5 log) removal of Giardia cysts and 99 percent (2 log) removal of viruses when in compliance with operation criteria specified in the California Code of Regulations, Title 22, Section 64660 and performance standards specified in Section 64653 (c), or as amended in the future.

   a) Whenever the bacteriological water quality of the influent exceeds 1000 MPN/100L total coliform in a majority of the past month's sample analyses, until there are a majority of the past month's sample analyses that are less than 1000 MPN/100L, the plant shall provide multibarrier treatment that meets the requirements to reliably ensures at least: a total of 99.99 percent (4-log) reduction of Giardia cysts through filtration and disinfection;
   b) And a total of 99.999 percent (5-log) reduction of viruses through filtration and disinfection.

10. Heber shall notify DHS within 24 hours by telephone whenever: a) the turbidity of the filter effluent exceeds 1.49 NTU at any time; or b) more than two (2) consecutive turbidity samples of the combined filter effluent taken every four (4) hours exceed 1.0 NTU. The

operators shall notify the Department by telephone and fax of any violation of any MCL in the effluent of the treatment plant or failure to meet CT requirements. Notification shall occur within 24 hours of becoming aware of such an incident. If the Department is closed at the time, it shall be notified by telephone before 8:15 a.m. of the next day.

11. The water entering the distribution system shall contain a disinfectant residual of not less than 0.8 mg/L at any time. Furthermore, a disinfectant residual shall be detectable in at least 95 percent of the samples taken from the distribution system based on the samples collected during two consecutive months. The presence of heterotrophic plate count (HPC) of 500 CFU/mL or less may be substituted for a detectable residual. Residual measurements shall be made in conjunction with coliform sampling.

12. Heber shall comply with all treatment optimization criteria of the Cryptosporidium Action Plan. Heber shall use jar tests or other monitoring devices to adjust chemical dosages and other operation parameters to achieve turbidity goal of 1 to 2 NTU in the settled water.

13. Heber shall calibrate turbidimeters. This shall include the proper use and replacement of both the primary and secondary standards, which are used in the calibration. Heber shall maintain turbidity calibration records including date, model, and location of turbidimeter, and procedures used.

14. Heber shall submit a monthly operation report to this office by the 10th day of the following month. The report shall include the daily turbidity measurements for raw water, settled water, and treated water, chlorine residual measurements of the treated water, CT calculations, a log of turbidity calibrations, a list of water quality complaints and reports of water borne illness received from consumers. Treatment plant records shall be maintained for at least three (3) years. Heber shall contact this office by phone concerning any acute violation or occurrence of a hazardous situation.

15. Heber shall request permit approval prior to any physical changes in the treatment processes, expansion of the water treatment plant, or the addition of rechlorination facilities.

16. All plant operators and supervisory personnel involved with the operation or oversight of the treatment facility shall have a copy of and shall be familiar with the conditions of this permit. A copy of the conditions shall be maintained at the treatment facility and the main office for reference.

17. Operations, maintenance, and monitoring of the treatment facility shall be performed in accordance with manufacturers' operations and maintenance manuals and with a Department approved Operation, Maintenance, and Monitoring Plan (OM&M Plan) and the documents and manuals noted therein unless otherwise specified by State regulations or the Department. All additions, deletions, or amendments to the OM&M Plan shall be approved by the Department prior to implementation. Heber and its operators are responsible for ensuring that the OM&M Plan is, at all times, representative of the operations, maintenance, and monitoring of the facility and that the appropriate changes to the OM&M Plan are submitted to the Department for approval in a timely manner. Within 60 days of receipt of the permit, a revised OM&M Plan shall be submitted to the

Department reflecting any modifications necessary to comply with the conditions of this permit.

18. Heber shall take all necessary actions to minimize vandalism and unauthorized entry to the treatment facility.

19. By August 31, 2005, Heber shall install an automatic shutdown feature in case there is a loss of coagulant feed.

Maximum Contaminant Levels

20. All water supplied by Heber for domestic purposes shall meet all Maximum Contaminant Levels (MCLs) established by the State Department of Health Services. If the water quality does not comply with the California Drinking Water Standards, treatment shall be provided to meet standards.

Operator Certification Program

21. The treatment facilities and distribution system shall be operated by personnel who have been certified in accordance with the Regulations Relating to Certification of Water Treatment Facility Operation and Distribution System, California Code of Regulations, Title 22. Heber will need a **D3 and T3** certified operator for the operation of the water system.

Cross-Connection Control Program

22. Heber shall maintain an active cross-connection control program in accordance with the Regulations Relating to Cross-Connections, California Code of Regulations, Title 17. All cross connections shall be abated within 30 days of their identification. Annual surveys shall be conducted thereafter. Backflow prevention devices shall be tested at least yearly. Heber shall submit an annual report to the Drinking Water Field Operations Branch system outlining the cross-connection control program for the previous year including the name and certification of the person assigned to the program, number of inspections made, number of backflow devices installed in the system and the number of devices tested and repaired.

23. By December 31, 2005, Heber must reevaluate each service connection to determine those that have their own connection to the canal or other auxiliary source of water. Such "auxiliary sources" may require the installation of a RP at the meter. A Cal/NV Section AWWA-certified Cross-connection Control Specialist must conduct this survey.

24. By December 31, 2005, the staff person must either obtain certification as a Cal/NV Section AWWA Cross-connection Control Specialist or Heber must contract with a Cal/NV Section AWWA-certified Cross-connection Control Specialist.

25. Heber must maintain records of all cross connection control inspections and testing.

Water Quality Monitoring

26. Heber shall monitor the distribution system for bacteriological water quality according to a Department-approved Coliform Sample Siting Plan. A bacteriological analyses report shall be submitted to this office by the tenth of the month following sampling signed by the Manager, Superintendent, or Chief Operator including a list of water quality complaints and any reports of waterborne illnesses received from consumers.

27. Heber shall monitor raw water sources monthly for total coliform and fecal coliform/E.coli bacteria. The coliform tests shall be performed using a density analytical method and results shall be reported in units of MPN per 100 ml.

28. Heber shall monitor the distribution system every quarter (three months), for total trihalomethanes (TTHMs) and five haloacetic acids (HAA5). Heber must follow the state-approved disinfection by-product monitoring plan.

29. Heber did not monitor for TTHMs or HAA5s during any of 2004. Heber must report this procedural failure in the 2004 Consumer Confidence Report, due to their consumers July 1, 2005.

30. Pursuant to CCR, Title 22, Section 64451, all water quality monitoring results obtained in a calendar month shall be submitted to the Department on paper by the tenth day of the following month.

31. Pursuant to CCR, Title 22, Section 64451, a State-certified laboratory shall perform all chemical analysis. Heber must require their contract laboratory to report water quality results to the Department using Electronic Data Transfer (EDT) using the Primary Station Code (PS_Code). This requirement excludes bacteriological monitoring, which shall be submitted directly to the Department on paper.

32. Heber shall contact this office by phone concerning any acute violation or the occurrence of a hazardous situation. MCL violations will require public notification and corrective action.

Storage Reservoirs Basic Design

33. The storage reservoirs shall comply with the California Waterworks and American Water Works Association (AWWA) design and construction standards. Distribution reservoirs shall be covered. Vents, overflows, drain outlets and other openings shall be located and constructed to protect the water in the reservoir from contamination. Vents and overflows shall be screened and adequately air-gapped to prevent cross-connections. Overflows shall be large enough to dispose of reservoir overflow rates equal to the maximum reservoir-filling rate. Provisions shall be made to facilitate removal of floating material from the free water surface and for dewatering the reservoir. Outlets shall be designed and constructed to minimize movement of sediment from the reservoir floor to the distribution system water mains. Provisions shall be made for isolating the reservoir(s) and appurtenant facilities from the distribution system without causing pressure problems in the distribution system.

34. Distribution reservoir sites shall not be used for non-water works purposes that would either result in unrestricted public access, compromise security, or create a contamination hazard.

35. Reservoirs shall be disinfected and sampled for bacteriological quality in accordance with the AWWA procedures for disinfecting tanks and reservoirs prior to domestic use.

Storage Reservoir Coating/lining

36. Heber shall use only NSF drinking water approved reservoir coatings, linings and their adhesives for its storage reservoirs. Otherwise, a VOC sample shall be collected after the newly coated/lined reservoir is filled and a minimum 5 day soaking period is allowed. In addition to the chemicals on the standard list (Method 524) analyses shall be made for ortho-Xylene, para-Xylene, meta-Xylene, methylethylketone (MEK), methylisobutylketone (MIBK) and any other solvent in the coating/lining adhesive included in the material Safety Data Sheet (MSDS) must also be included in the sample analysis. The results of the VOC analysis must be submitted to the Department.

Distribution System

37. The distribution system shall comply with all applicable California Waterworks and American Water Works Association (AWWA) design and construction standards and in compliance with the SDHS-CDHS Guidelines for the Separation of Water and Sewer Lines. At least 10 feet horizontal and 1-foot vertical separation shall be maintained between the water and sewer lines. Water lines should always cross above sewer lines. Special construction standards and materials shall be provided where the minimum separation cannot be met.

Direct Additives

38. Pursuant to CCR, Title 22, Section 64700, no chemical or product shall be added to the drinking water as part of the treatment process unless it has been certified as meeting the specifications of the American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 60.

Annual Report to DHS

39. Heber shall submit the Annual Report on the status and condition of the domestic water system as directed by the Department.

Emergency Response Plan

40. By December 31, 2005, Heber must prepare an Emergency Response Plan that incorporates the results of the Bioterrorism Vulnerability Assessment.

APPENDICES

Data sheets

H:\Systems\Heber Public Utility District\Permits\Heber Permit 2005\docs\Heber Permit Report 050615.doc

STATE OF CALIFORNIA
DEPARTMENT OF HEALTH SERVICES

CHLORINE DISINFECTION DATA

System Name: Heber Public Utility District No: 1310007
Source of Information: O & M Manual
Collected By: Ignacio Colunga Date: 11/11/04

Location:	
Type of Disinfectant Used:	NaCL2
Application:	
Water Treated: (raw, filtered, etc.)	Raw & filtered
Oxidant Demand Character:	
Point of Application:	Pre and post chlorination
Mixing:	
Contact Time: (minutes)	
Minimum Contact Time Before Residual Test:	
How was Contact Time Measured or Determined:	
Water Flow Variation:	
Average Daily:	7,000 gpm
Maximum Daily:	1,300 gpm
Peak Hourly Flow:	2 hrs. peak flow
Machine:	
Make:	Information not available now, waiting on
Type:	O & M Manual from contractor
Capacity:	
Condition:	
Housing: (type)	
Insulation:	
Heating:	
Chemical Added:	
% Available Disinfectant, Form	
Cylinder or Crock Capacity:	
Stock on Hand:	
Safety Features: (Locks, Lighting, Ventilation, Alarms, Etc)	Lock, ventilated, alarms
Operation and Maintenance:	
Spare Parts on Hand:	
Ability to Make Repairs:	Yes
Equipment Inspection Frequency:	
Residual Tests:	
Test Made: (DPD, etc.)	
Type of Instrumentation:	DPD Pocket Chlorimeter
Continuous/Grab:	Hach CL17 / chlorinator
Where Test Made:	Before storage tank/distribution line
Type: (Total, Free, Combined, Other)	Free
Records:	
Frequency of Equipment Calibration:	
Reliability Features:	
Auxiliary Power:	Yes
Automatic Switch-over:	Yes
Condition of Scales: (if any)	None
Alarms: (if any)	Low & High
Defects or Remarks:	

State of California

Department of Health Services

DISTRIBUTION DATA

System Name: Heber Public Utility District **System No:** 1310007

Source of Information: O & M Manual

Collected By: Ignacio Colunga, Chief Operator **Date:** November 11, 2004

Number of Service Connections	858
Pressure Range	45 psi – 50 psi
Type of Pipe Installed (%)	
Steel-Tar Coated & Wrapped	None
Steel-Cemented Lined, Cement Coated	None
Steel-Cement Lined	None
Ductile Iron	None
Asbestos Cement	
Galvanized	None
Cast Iron	None
PVC	
ABS	None
Polyethylene (PE)	
Minimum Size of New Mains	
Amount Less Than 4" Diameter	0
Condition of Mains	
Minimum Depth of Cover (Inches)	18 inches
Service Connections (%)	
Copper	90%
Plastic (Type & %)	10%
Lead	0
Distance of Mains from Sewers	10 feet
Disinfection Method – New Mains (Describe Procedure)	
Disinfection After Repairs (Describe Procedure)	
Infiltration Hazard (Relation to Groundwater Table)	None
Dead Ends	
How Many?	One
Flushing Valves Installed?	None
Flushing Program (Describe)	Every six months
Growth and Sludge in Mains	None
Valves	
Sufficient Number	80%
Valve Maps Maintained	Yes
Valve Exercise Program	Yes
Defects and Remarks	

State of California | Department of Health Services

Filtration Plant Data

System Name:	Heber Public Utility District
System Number:	131-0007
Source of Information:	O & M Manual
Collected By: Ignacio Colunga, Chief Operator	Date: 11/11/04
Name Of Water Treatment Plant:	Micro Floc Trident Water Treatment System
Treatment Classification:	
Plant Capacity:	2.0 mgd
Design Flow (mgd):	2.0
Maximum Flow (mgd):	2.0
How Is The Flow Measured?	Flow meter or phase plates.
Flow Variations:	
Year Operation Began:	
Frequency Plant Checked:	Daily
Raw Water Pumps:	Daily
Type And Method Of Control:	
Capacity Of Each:	
Pump #1 (hp) 20 HP	(gpm) 1,400 (mgd)
Pump #2 (hp) 20 HP	(gpm)1,400 (mgd)
Pump #3 (hp)	(gpm) (mgd)
Influent Turbidity Measured Continuously?	No
Excessive Influent Turbidity Alarm?	No
What Turbidity Level Triggers Alarm?	No
Automatic Shutdown At High Turbidity?	No
Chemical Data	
Type:	Aluminum Sulfate
Purpose:	Coagulant control
Strength of Chemical Injected (%):	90%
Rate Injected Into System:	9 to 10 strokes / min
Dosage (mg/l):	2 mg/l
Is Chemical Added Continuously?	
Feeding and Injection Equipment	
Type:	Diaphragm metering pump
Make:	Allcos
Model:	primus 2211-27
Capacity:	1.2 to 36.4 gph
What Determines Dose Level Used?	NTU's set point
Are Jar Tests Performed?	No
How Often?	
Chemical Storage	
Capacity:	Allume 1,000 gal
Days Of Storage:	60 day
Chemical Form When Added To System?	Liquid
Points Of Application:	Intake pipe to filter unit
Low Level Chemical Alarm Provided?	No

State of California | Department of Health Services

Filtration Plant Data-(cont'd)

Flash Mixing	N/A	
Type:		
Number:		
Mixing Energy (G):		
Nominal (sec^-1):		
Maximum (sec^-1):		
Nominal Mixing Time (sec):		
Flocculation Basins	N/A	
Number Of Basins:	N/A	
Stages Of Flocculation:	N/A	
Inside Dimensions of Each Stage (LxW in feet):	N/A	
Stage 1:	N/A	
Stage 2:	N/A	
Stage 3:	N/A	
Average Water Depth (ft):	N/A	
Volume Of Each Stage (ft^3):	N/A	
Stage 1:	N/A	
Stage 2:	N/A	
Stage 3:	N/A	
Volume Of Each Basin (ft^3):	N/A	
Total Volume (ft^3):	N/A	
Total Flocculation Time (sec):	N/A	
Velocity Gradient (fps/ft):	N/A	
Type Of Flocculators:	N/A	
Number Of Flocculators:	N/A	
Stage 1:	N/A	
Stage 2:	N/A	
Stage 3:	N/A	
Number Per Basin:	N/A	
Total Number:	N/A	
Mixing Energy (G):	N/A	
Stage 1-High:	(sec^-1)	Stage 1-Low:
Stage 2-High:	(sec^-1)	Stage 2-Low:
Stage 3-High:	(sec^-1)	Stage 3-Low:
Total GT For Flocculation Step:		
Flocculator Power (Each):		
Stage 1 (hp):	Stage 2 (hp):	
Stage 3 (hp):		
Flocculator Equipment Failure Alarm?		
Alarm Triggered By What?		

State of California | Department of Health Services

Filtration Plant Data-(cont'd)

Sedimentation	
Number Of Basins:	3 (1) 5.5' H x 406.5 L x 168 w = 2.07 mg
Inside Dimensions Of Each Basin (ft x ft):	(2) 7.5 H x 366 L x 86 W = 2.31 mg & (3) 5.5 H x 345.9 L x 138 W = 6.57 mg
Average Water Depth (ft):	6.1
Volume Of Each Basin (ft^3):	(1) = 2.07 mg; (2) = 2.31 mg & (3) = 2.19 mg Total of 6.57 mg
Total Sedimentation Volume (ft^3):	
Horizontal Velocity (fpm):	
Average:	Maximum:
Detention Time (min):	
Average:	Maximum:
Surface Loading Rate (gpm/ft^2):	
Average:	Maximum:
Weir Overflow Rate (gpm/ft^2):	
Average:	Maximum:
Method Of Sludge Withdrawal:	
Filters	
Type:	Microfloc Trident TR840
Number Of Filters:	2
Filter Inside Dimensions (ft x ft):	L 39' 10" x 11' 11"
Filter Media	
Anthracite Coal	
Depth (in): 18	Effective Size: 1.0 - 1.1 mm
Uniformity Coefficient: 670 or less	Specific Gravity: 1.6 +/- .05
Fine Sand	
Depth (in): 19	Effective Size: .35 - 0.45 mm
Uniformity Coefficient: 1.4 or less	Specific Gravity: 2.6 +/- 0.05
Coarse Sand	
Depth (in): 3	Effective Size: 0.20 - 032 mm
Uniformity Coefficient: 2.2 or less	Specific Gravity: 3.80
Gravel-Number Of Layers: 0	Total Depth: 0
Media Area Per Filter (ft^2): 0	Total Media Area (ft^2): 0
Filtration Rate at Design Flow	
All Filters In Service (gpm/ft^2):	
One Filter Not In Service (gpm/ft^2):	
How Is Filtration Rate Controlled?	Filter Contro Panel
Turbidimeters At Each Filter?	Yes
Do Excessive Turbidities Trigger An Alarm?	Yes
At What Turbidity?	0.45
Continuous Measurement And Recording Of Finished Water Turbidity?	Yes
Location:	After filter unit
Type Of Device:	Hach 17200 Low Range process tubidimeter
Frequency Of Calibration:	once a month
High Turbidity Alarm: Yes	Activated At: .45 N (NTU)
Who Is Alerted?	Chief Operator, Water Plant Operator, on call person

State of California | Department of Health Services

Filtration Plant Data-(cont'd)

Filter Backwash	
What Determines Backwash Interval?	Times, High headloss, high turbidity, manual initiate
Filter To Waste Capability?	yes
Source Of Backwash Water?	Clear well # 2
Can Spent Backwash Water Be Visually Observed?	Yes
Underdrain Type:	Yes
Maximum Backwash Rate (gpm/ft^2):	15 to 17 gal/ft2
Percent Expansion During Backwash:	20%
Backwash Duration (min):	
Can Backwash Time Be Shortened Or Lengthend?	Yes
What Determines Length Of Backwash?	Majual valve adjusting
Quantity Of Backwash Generated Each Day (mgd):	
Supplemental Backwash Tank	
Type:	None
Volume (gal):	None
Number Of Backwashes Per Volume:	
Filter Surface Wash	
Type:	N/A
Surface Wash Rate (gpm/ft):	
Surface Wash Rate (gpm):	
Surface Wash Rate (mgd):	
Surface Wash Duration (min):	
Waste Washwater Basins	
Type:	Storage, pond
Number Of Basins:	1
Total Volume (MG):	2.19 mg
Volume Of Wastewater Per Backwash (gal):	7,000 gal
Washwater Disposal:	land fill
Sludge Disposal:	land fill
Clearwell	
Type:	Storage tank
Capacity (MG):	1.7
Detention Time (Hr):	70,800 gal/hr

Comments

State of California | Department of Health Services

Reservoir Data

(Use For All Distribution Storage, Chlorine Contact Tanks, Etc)

System Name:	Heber Public Utility District	
System Number:	1310007	
Source of Information:	O & M Manual	
Collected By: Ignacio Colunga, Chief Operator		Date: 11/11/04
Reservoir Number Or Name:	**Reservoir 2**	**Reservoir 3**
Location	1085 Ingram Ave.,	
Cross Streets:	Hwy. 86 AKA Main St.	
Neighborhood:	Residential	
Size Of Lot:		
Fencing:	7' Chain-link fencing with 2' barbed wire.	
Construction	1979	
Date Constructed/Refurbished:	Refurbished 2003	1996
Purpose (Storage, Chlorine Contact, Etc.):	Storage	Storage
Design Capacity (MG):	.75 MG	1.7 MG
Operating Capacity (MG):	Steel Plate	Steel Plate
Construction Type:	Steel	
Shape:	Round	Round
Construction Materials:	Steel Plate	Steel Plate
Sides:	Steel Plate	Steel Plate
Floor:	Steel Plate	Steel Plate
Cover Or Roof:	Roof/Steel	Roof/Steel
Interior Coating Type:		
Dimensions		
Dimensions (H x L x W) Or (H & Diameter)(feet):	30 X 65'	30' X 100'
Tank Bottom Elevation (feet):		
Height Of Tank (feet):	30	30
Surface Drainage To Reservoir Possible?	No	No
Ventilation		
Screened (Y/N):	Y	Y
Cathodic Protection:	Y	Y
Inlet Description		
Distance Above Bottom (feet):	23.'	3'
Receives Water From:	Filters	Filters
Outlet Description		
Distance From Inlet (feet):	46.'	100'
Distance Above Bottom (feet):	3.0'	1'
Delivers Water To:	Distribution Pumps	Distribution Pumps
Pressure Zone Served:		
Drain Location		
Distance Above Floor (feet):	.5'	No Drain
Discharge Location:	Pond 2	
Overflow Location		
Overflow Elevation (feet):	27'	29'.3"
Distance Above Bottom (feet):		27.'
Discharge Location:	Pond 2	Pond 3

State of California

Department of Health Services

Reservoir Data (Cont'd)

If Hydropneumatic Tank

Capacity (gal):

Site Glass:

Air Vent:

Pressure Gage:

Comments

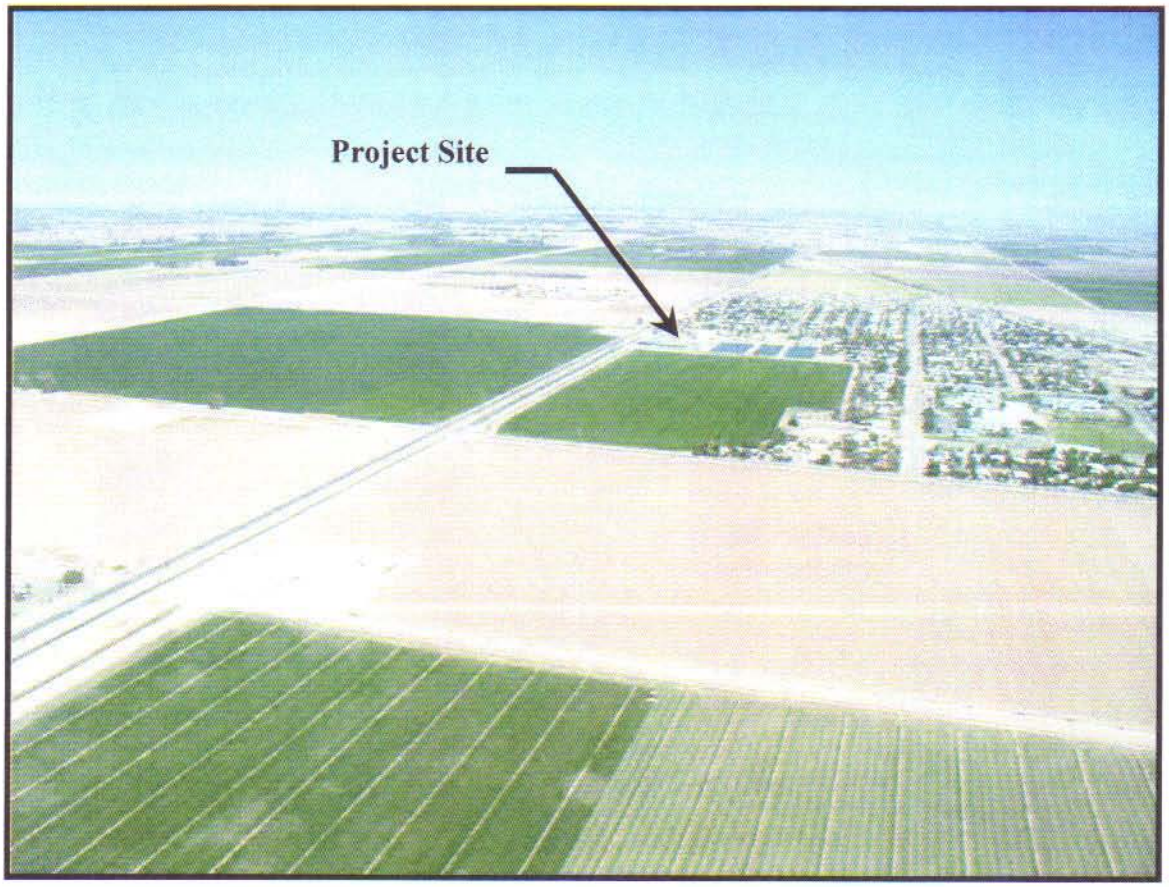
APPENDIX C

Geotechnical Report

Heber Public District Utilities WTP Expansion
1085 Main Street
Heber, California

Prepared for:

The Holt Group
1561 S. 4th Street
El Centro, CA 92243



Prepared by:

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243
(760) 370-3000

September 2006

LANDMARK
Geo-Engineers and Geologists

780 N. 4th Street
El Centro, CA 92243
(760) 370-3000
(760) 337-8900 fax

77-948 Wildcat Drive
Palm Desert, CA 92211
(760) 360-0665
(760) 360-0521 fax

September 12, 2006

Mr. Jack Holt
The Holt Group
1561 S. 4th Street
El Centro, CA 92243

Geotechnical Investigation
Heber Public Utilities District WTP Expansion
1085 Main Street
Heber, California
LCI Report No. LE06278

Dear Mr. Holt:

This geotechnical report is provided for design and construction of the proposed expansion of the Heber Public Utilities District (HPUD) Water Treatment Plant located at 1085 Main Street in Heber, California. Our geotechnical investigation was conducted in response to your request for our services. The enclosed report describes our soil engineering investigation and presents our professional opinions regarding geotechnical conditions at the site to be considered in the design and construction of the project.

This summary presents ***selected*** elements of our findings and recommendations only. It ***does not*** present crucial details needed for the proper application of our findings and recommendations. Our findings, recommendations, and application options are related ***only through reading the full report***, and are best evaluated with the active participation of the engineer of record who developed them.

The findings of this study indicate that the expansion site is, in general, predominantly underlain by stiff to very stiff clays/silty clays of moderate expansion potential to a depth of about 41 feet. Interbedded layers of loose to dense clayey silts, sandy silts and silty sands were encountered between 41 to 84 feet below ground surface. Groundwater was encountered at 8 to 9 feet.

The soil is highly corrosive to metals and may contain sufficient sulfates and chlorides to require special concrete mixes (4,500 psi with a 0.45 maximum water cement ratio and Type V cement) and protection of embedded steel components when concrete is placed in contact with native soil (see Section 4.7).

Evaluation of liquefaction potential at the site indicates that a 4-foot thick, interbedded layer of sandy silt at a depth between 41 to 45 feet may liquefy under seismically induced groundshaking, potentially resulting in an estimated ¼ to ½ inches of deep seated settlement (Section 3.7, page 10). Since the potentially liquefiable silty/sandy soils are overlain by 41 feet of non-liquefiable soils which resist groundwater movement, it is unlikely that liquefaction induced settlements will affect surface structures.

Estimated foundation settlements for the 125-foot diameter pre-stressed concrete water tank are indicated on Plate D-1 in Appendix D of this report. Differential settlement is estimated to be about of 3 to 4 inches between center and edge of tank. A rigid mat foundation is suggested for a concrete storage tank. Section 4.4 provides deep foundation capacities for settlement sensitive plant components.

We did not encounter soil conditions that would preclude implementation of the proposed project provided the recommendations contained in this report are implemented in the design and construction of this project.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. If you have any questions or comments regarding our findings, please call our office at (760) 370-3000.

Respectfully Submitted,
Landmark Consultants, Inc.

PROFESSIONAL GEOLOGIST
STEVEN K. WILLIAMS
CERTIFIED ENGINEERING GEOLOGIST
CEG 2261
STATE OF CALIFORNIA

Steven K. Williams, CEG
Senior Engineering Geologist

Julian R. Avalos
Staff Engineer

REGISTERED PROFESSIONAL ENGINEER
JEFFREY O. LYON
No. 31921
EXPIRES 12-31-06
CIVIL
STATE OF CALIFORNIA

Jeffrey O. Lyon, PE
President

Distribution:
Client (4)

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Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our geotechnical investigation for the proposed expansion of the Heber Public Utilities District (HPUD) Water Treatment Plant located at 1085 Main Street in Heber, California (See Vicinity Map, Plate A-1).

The proposed improvements will consist of the construction of a 125-foot diameter pre-stressed concrete water storage tank, backwash basins, raw water pump station, finish water pump station, and two 2 MGD treatments units. A site plan for the proposed improvements was provided by The Holt Group prior to initiation of the field investigation.

Site development will include building pad preparation, backwash basins excavation and embankment construction, underground utility installation, and excavation of two wet wells with an approximate depth of 10 feet.

1.2 Purpose and Scope of Work

The purpose of this geotechnical study was to investigate the upper 21.5 to 84 feet of subsurface soil at selected locations within the site for evaluation of physical/engineering properties. From the subsequent field and laboratory data, professional opinions were developed and are provided in this report regarding geotechnical conditions at this site and the effect on design and construction. The scope of our services consisted of the following:

- Field exploration and in-situ testing of the site soils at selected locations and depths.
- Laboratory testing for physical and/or chemical properties of selected samples.
- Review of the available literature and publications pertaining to local geology, faulting, and seismicity.
- Engineering analysis and evaluation of the data collected.
- Preparation of this report presenting our findings, professional opinions, and recommendations for the geotechnical aspects of project design and construction.

This report addresses the following geotechnical issues:

- Subsurface soil and groundwater conditions
- Site geology, regional faulting and seismicity, near source factors, and site seismic accelerations
- Liquefaction potential and its mitigation
- Expansive soil and methods of mitigation
- Compressible subsoils, estimated settlements and methods of mitigation
- Aggressive soil conditions to metals and concrete

Professional opinions with regard to the above issues are presented for the following:

- Site grading and earthwork
- Building pad and foundation subgrade preparation
- Allowable soil bearing pressures and expected settlements
- Deep foundation recommendations
- Concrete slabs-on-grade
- Lateral earth pressures
- Excavation conditions and buried utility installations
- Mitigation of the potential effects of salt concentrations in native soil to concrete mixes and steel reinforcement
- Seismic design parameters

Our scope of work for this report did not include an evaluation of the site for the presence of environmentally hazardous materials or conditions.

1.3 Authorization

Mr. James G. "Jack" Holt of The Holt Group provided authorization by written agreement to proceed with our work on July 14, 2006. We conducted our work according to our written proposal dated June 13, 2006.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Subsurface exploration was performed on June 31, 2006 using 2R Drilling of Ontario, California to advance five (4) borings to depths of 21.5 to 51.5 feet below existing ground surface. The borings were advanced with a truck-mounted, CME 55 drill rig using 8-inch diameter, hollow-stem, continuous-flight augers. The approximate boring locations were established in the field and plotted on the site map by sighting to discernable site features. The boring locations are shown on the Site and Exploration Plan (Plate A-2).

A staff engineer observed the drilling operations and maintained a log of the soil encountered and sampling depths, visually classified the soil encountered during drilling in accordance with the Unified Soil Classification System, and obtained drive tube and bulk samples of the subsurface materials at selected intervals. Relatively undisturbed soil samples were retrieved using a 2-inch outside diameter (OD) split-spoon sampler or a 3-inch OD Modified California Split-Barrel (ring) sampler. The samples were obtained by driving the sampler ahead of the auger tip at selected depths. The drill rig was equipped with a 140-pound CME automatic hammer for conducting Standard Penetration Tests (SPT). The number of blows required to drive the samplers 12 inches into the soil is recorded on the boring logs as "blows per foot". Blow counts reported on the boring logs represent the field blow counts. No corrections have been applied for effects of overburden pressure, automatic hammer drive energy, drill rod lengths, liners, and sampler diameter. Pocket penetrometer readings were also obtained to evaluate the stiffness of cohesive soils retrieved from sampler barrels.

After logging and sampling the soil, the exploratory borings were backfilled with the excavated material. The backfill was loosely placed and was not compacted to the requirements specified for engineered fill.

Additional subsurface exploration was performed on August 16, 2006 using Holguin, Fahan, & Associates, Inc. of Cypress, California to advance three (3) electric cone penetrometer (CPT) soundings to approximate depth of 50 to 84 feet below existing ground surface.

The soundings were made at the locations shown on the Site and Exploration Plan (Plate A-2). The approximate sounding locations were established in the field and plotted on the site map by sighting to discernable site features.

CPT soundings provide a continuous profile of the soil stratigraphy with readings every 2.5cm (1 inch) in depth. Direct sampling for visual and physical confirmation of soil properties has been used by our firm to establish direct correlations with CPT exploration in this geographical region.

The CPT exploration was conducted by hydraulically advancing an instrumented Hogentogler $10cm^2$ conical probe into the ground at a rate of 2cm per second using a 23-ton truck as a reaction mass. An electronic data acquisition system recorded a nearly continuous log of the resistance of the soil against the cone tip (Qc) and soil friction against the cone sleeve (Fs) as the probe was advanced. Empirical relationships (Robertson and Campanella, 1989) were then applied to the data to give a continuous profile of the soil stratigraphy. Interpretation of CPT data provides correlations for SPT blow count, phi (ϕ) angle (soil friction angle), undrained shear strength (S_u) of clays and over-consolidation ratio (OCR). These correlations may then be used to evaluate vertical and lateral soil bearing capacities and consolidation characteristics of the subsurface soil.

The subsurface borings logs and interpretive logs of the CPT soundings are presented on Plates B-1 through B-7 in Appendix B. A key to the interpretation of CPT soundings and the borings logs are presented on Plates B-8 and B-9, respectively. The stratification lines shown on the subsurface logs represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

2.2 Laboratory Testing

Laboratory tests were conducted on selected bulk (auger cuttings) and relatively undisturbed (2.5-inch diameter thin wall tubes) soil samples obtained from the soil borings to aid in classification and evaluation of selected engineering properties of the site soils. The tests were conducted in general conformance to the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. The laboratory testing program consisted of the following tests:

- Plasticity Index (ASTM D4318) – used for soil classification, settlement estimates and expansive soil design criteria.
- Unconfined Compression (ASTM D2166) – used for soil strength estimates.
- Unit Dry Densities (ASTM D2937) and Moisture Contents (ASTM D2216) – used for insitu soil parameters.
- Unconfined Compression (ASTM D2166) – used for soil strength estimates.
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods) – used for concrete mix evaluations and corrosion protection requirements.

The laboratory test results are presented on the subsurface logs in Appendix B and on Plates C-1 through C-8 in Appendix C.

Engineering parameters of soil strength, compressibility and relative density utilized for developing design criteria provided within this report were either extrapolated from correlations with the subsurface CPT data or from data obtained from the field and laboratory testing program.

Section 3
DISCUSSION

3.1 Site Conditions

The existing Heber Water Treatment Plant (HWTP) is located at 1085 Main Street in Heber, California. The locations of the proposed new structures are shown in the Site and Exploration Plan (Plate A-2) in Appendix A.

The proposed 3 MGD pre-stressed concrete water tank will be located at the west side of the plant, southwest of the existing 1.7 MGD steel water tank and west of the existing backwash basins. The proposed area for the 3 MGD pre-stressed concrete water tank is currently used as storage for pipe, concrete manholes, waste storage bins and some equipment.

The proposed backwash basins will be located along the west side of the existing backwash basins. The proposed sites for the waste and fresh water pump stations will be located north of the existing raw water storage basin No. 3 and west of the existing finish water pump station. The proposed site for the two new 2 MGD treatments units are located next to the existing treatment units, east of the existing water steel tank. Existing underground power lines, raw and fresh water supply lines cross the water plant in east to west and north to south directions.

Adjacent properties are flat-lying and are approximately at the same elevation with this site. The site is bounded on the south by an agricultural field and the west by the Dogwood Canal and Dogwood Road. Single family residential homes and apartments buildings lie to the north and east of the HWTP. The Community Service Center (County Fire/Sheriff Station) lies next to the southwest corner of the HWTP.

The project site lies at an elevation of approximately 15 feet below mean sea level (MSL) (El. 985 local datum) in the Imperial Valley region of the California low desert. The surrounding properties lie on terrain which is flat (planar), part of a large agricultural valley, which was previously an ancient lake bed covered with fresh water to an elevation of 43± feet above MSL. Annual rainfall in this arid region is less than 3 inches per year with four months of average summertime temperatures above 100 °F. Winter temperatures are mild, seldom reaching freezing.

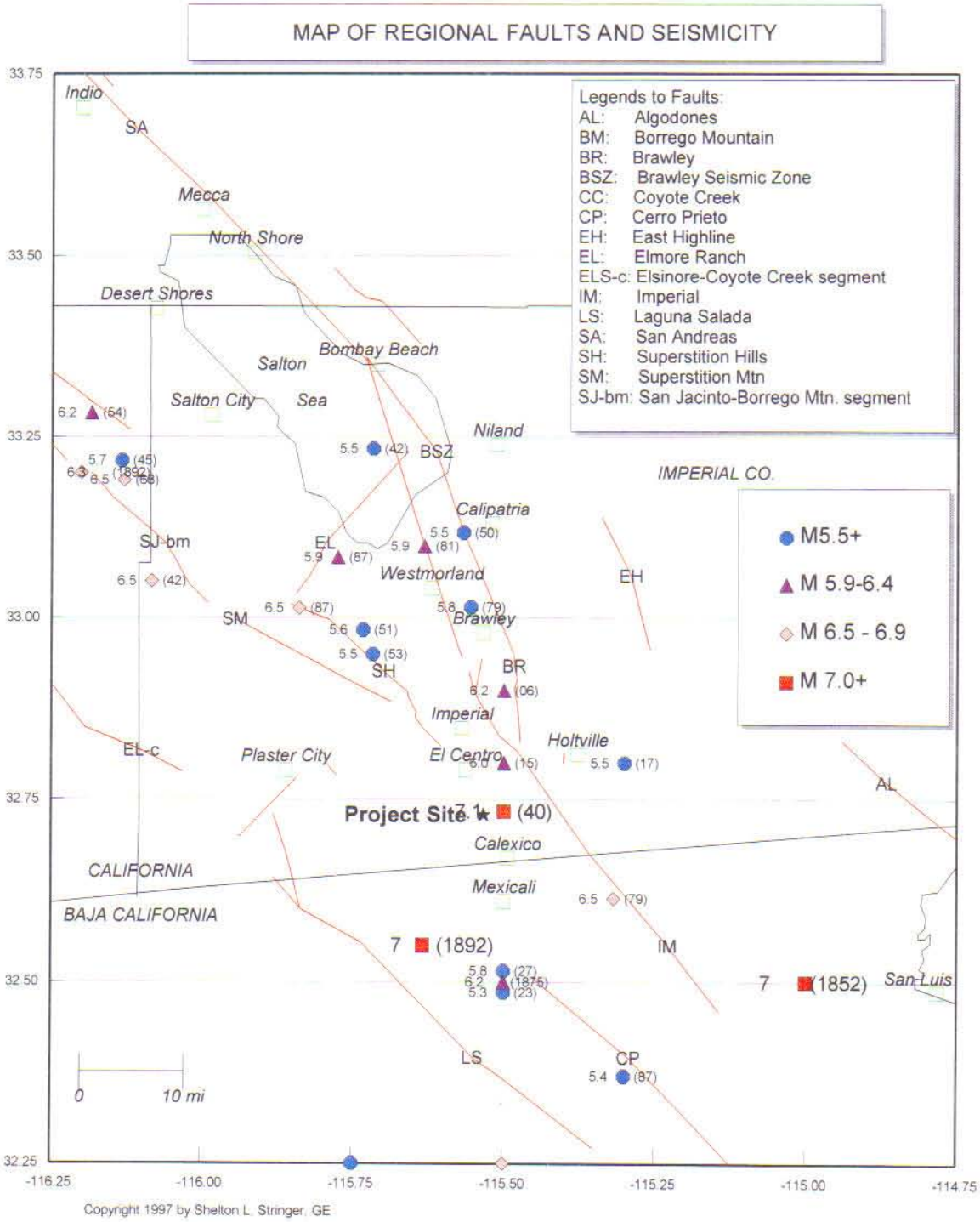
3.2 Geologic Setting

The project site is located in the Imperial Valley portion of the Salton Trough physiographic province. The Salton Trough is a topographic and geologic structural depression resulting from large scale regional faulting. The trough is bounded on the northeast by the San Andreas Fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments since the Miocene Epoch. Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.

The Imperial Valley is directly underlain by lacustrine deposits, which consist of interbedded lenticular and tabular silt, sand, and clay. The Late Pleistocene to Holocene lake deposits are probably less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed a fresh water lake (Lake Cahuilla). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 - 20,000 feet.

3.3 Seismicity and Faulting

Faulting and Seismic Sources: We have performed a computer-aided search of known faults or seismic zones that lie within a 62 mile (100 kilometers) radius of the project site as shown on Figure 1 and Table 1. The search identifies known faults within this distance and computes deterministic ground accelerations at the site based on the maximum credible earthquake expected on each of the faults and the distance from the fault to the site. The Maximum Magnitude Earthquake (Mmax) listed was taken from published geologic information available for each fault (CDMG OFR 96-08 and Jennings, 1994).



Faults and Seismic Zones from Jennings (1994). Earthquakes modified from Ellsworth (1990) catalog.

Figure 1. Map of Regional Faults and Seismicity

Table 1
FAULT PARAMETERS & DETERMINISTIC
ESTIMATES OF PEAK GROUND ACCELERATION (PGA)

Fault Name or Seismic Zone	Distance (mi) & Direction from Site	Fault Type		Fault Length (km)	Maximum Magnitude Mmax (Mw)	Avg Slip Rate (mm/yr)	Avg Return Period (yrs)	Date of Last Rupture (year)	Largest Historic Event >5.5M (year)		Est. Site PGA (g)
Reference Notes: (1)		(2)	(3)	(2)	(4)	(3)	(3)	(3)	(5)		(6)
Imperial Valley Faults											
Imperial	6.2 NE	A	B	62	**7.0**	20	79	1979	7.0	1940	**0.35**
Brawley	7.7 NNE	B	B	14	**7.0**	20	---	1979	5.8	1979	**0.31**
Brawley Seismic Zone	15 N	B	B	42	**6.4**	25	24		5.9	1981	**0.14**
Cerro Prieto	16 SSE	A	B	116	**7.2**	34	50	1980	7.1	1934	**0.20**
East Highline Canal	22 NE	C	C	22	**6.3**	1	774				**0.10**
San Jacinto Fault System											
- Superstition Hills	7.6 NW	B	A	22	**6.6**	4	250	1987	6.5	1987	**0.25**
- Superstition Mtn.	14 NW	B	A	23	**6.6**	5	500	1440 +/-			**0.16**
- Elmore Ranch	28 NW	B	A	29	**6.6**	1	225	1987	5.9	1987	**0.10**
- Borrego Mtn	33 WNW	B	A	29	**6.6**	4	175		6.5	1942	**0.09**
- Anza Segment	50 NW	A	A	90	**7.2**	12	250	1918	6.8	1918	**0.09**
- Coyote Creek	52 NW	B	A	40	**6.8**	4	175	1968	6.5	1968	**0.07**
- Whole Zone	14 NW	A	A	245	**7.5**	---	---				**0.26**
Elsinore Fault System											
- Laguna Salada	17 SW	B	B	67	**7.0**	3.5	336		7.0	1891	**0.18**
- Coyote Segment	29 W	B	A	38	**6.8**	4	625				**0.11**
- Julian Segment	55 WNW	A	A	75	**7.1**	5	340				**0.08**
- Earthquake Valley	57 WNW	B	A	20	**6.5**	2	351				**0.05**
- Whole Zone	29 W	A	A	250	**7.5**	---	---				**0.15**
San Andreas Fault System											
- Coachella Valley	44 NNW	A	A	95	**7.4**	25	220	1690+/-	6.5	1948	**0.10**
- Whole S. Calif. Zone	44 NNW	A	A	458	**7.9**	---	---	1857	7.8	1857	**0.14**
Algodones	35 E	C	C	74	**7.0**	0.1	20,000				**0.10**

Notes:

1. Jennings (1994) and CDMG (1996)
2. CDMG (1996), where Type A faults -- slip rate >5 mm/yr and well constrained paleoseismic data
   Type B faults -- all other faults.
3. WGCEP (1995)
4. CDMG (1996) based on Wells & Coppersmith (1994)
5. Ellsworth Catalog in USGS PP 1515 (1990) and USBR (1976), Mw = moment magnitude,
6. The deterministic estimates of the Site PGA are based on the attenuation relationship of:
   Boore, Joyner, Fumal (1997)

Seismic Risk: The project site is located in the seismically active Imperial Valley of southern California and is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. The proposed site structures should be designed in accordance with the California Building Code (CBC) for a "Design Basis Earthquake" (DBE) and with the appropriate near-source factors. The DBE is defined as the motion having a 10 percent probability of being exceeded in 50 years.

Seismic Hazards.

- **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Imperial, Brawley, and Superstition Hills Faults. A further discussion of groundshaking follows in Section 3.4.
- **Surface Rupture.** The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone. Surface fault rupture is considered to be unlikely at the project site because of the well-delineated fault lines through the Imperial Valley as shown on USGS and CGS maps. However, because of the high tectonic activity and deep alluvium of the region, we cannot preclude the potential for surface rupture on undiscovered or new faults that may underlie the site.
- **Liquefaction.** Liquefaction is a potential design consideration because of underlying saturated sandy substrata. The potential for liquefaction at the sites is discussed in more detail in Section 3.7.

Other Secondary Hazards.

- **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation.
- **Volcanic hazards.** The site is not located in proximity to any known volcanically active area and the risk of volcanic hazards is considered very low.
- **Tsunamis, seiches, and flooding.** The site does not lie near any large bodies of water, so the threat of tsunami, seiches, or other seismically-induced flooding is unlikely.
- **Expansive soil.** In general, much of the near surface soils in the Imperial Valley consist of silty clays and clays which are moderate to highly expansive. The expansive soil conditions are discussed in more detail in Section 3.5.

3.4 Site Acceleration and UBC Seismic Coefficients

Site Acceleration: Deterministic horizontal peak ground accelerations (PGA) from maximum probable earthquakes on regional faults have been estimated and are included in Table 1. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Accelerations also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

We have used the computer program FRISKSP (Blake, 2000) to provide a probabilistic estimate of the site PGA using the attenuation relationship of Boore, Joyner, and Fumal NEHRP D 250 (1997). The PGA estimate for the project site having a 10% probability of being exceeded in 50 years (return period of 475 years) is **0.64g**.

CBC Seismic Response Coefficients: The CBC seismic response coefficients are calculated from the near-source factors for Seismic Zone 4. The near-source factors are based on the distance from the fault and the seismic source type. The following table lists seismic and site coefficients (near source factors) determined by Chapter 16 of the 2001 CBC. ***This site lies about 10.0 km from a Type A fault and overlies S_D (stiff) soil.***

CBC Seismic Coefficients for Chapter 16 Seismic Provisions

CBC Code Edition	Soil Profile Type	Seismic Source Type	Distance to Critical Source	Near Source Factors		Seismic Coefficients	
				Na	Nv	Ca	Cv
2001	S_D (stiff soil)	A	10.0 km	1.00	1.20	0.44	0.77
Ref. Table	16-J	16-U	---	16-S	16-T	16-Q	16-R

AWWA Site Amplification Factor: Based on the soils encountered during the site exploration, a site amplification factor (S) of 1.2 (Soil Profile Type B) has been determined.

3.5 Subsurface Soil

Subsurface soils encountered during the field exploration conducted on April 3, 2006 consist of dominantly stiff to very stiff clay/silty clay to a depth of 41 feet. Interbedded layers of loose to dense clayey silts, sandy silts and silty sands were encountered between 41 to 84 feet, the maximum depth of exploration. The subsurface logs (Plates B-1 through B-7) depict the stratigraphic relationships of the various soil types.

The native surface clays likely exhibit moderate to high swell potential (Expansion Index, EI = 51 to 110) when correlated to Plasticity Index tests (ASTM D4318) performed on the native clays. The clay is expansive when wetted and can shrink with moisture loss (drying).

3.6 Groundwater

Three 2-inch diameter piezometers were installed in Boring B-4 and piezometers P-1 and P-2 to a depth of 20 feet at the project site. Groundwater was encountered in the piezometer installed at B-4 at a depth of 8.9 feet, P-1 at a depth of 9.3 feet and P-2 at a depth of 8.1 feet on August 30, 2006, 30 days after placement of the piezometers. Dewatering should be anticipated for excavations below 9 feet in depth. Excavations made adjacent to existing basins may encounter saturated soils at a shallower depth. There is uncertainty in the accuracy of short-term water level measurements, particularly in fine-grained soil. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, drainage, and site grading. The referenced groundwater level should not be interpreted to represent an accurate or permanent condition.

3.7 Liquefaction

Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations.

Four conditions are generally required for liquefaction to occur:

(1) the soil must be saturated (relatively shallow groundwater);
(2) the soil must be loosely packed (low to medium relative density);
(3) the soil must be relatively cohesionless (not clayey); and
(4) groundshaking of sufficient intensity must occur to function as a trigger mechanism.

All of these conditions exist to some degree at these sites.

Methods of Analysis: Liquefaction potential at the project sites were evaluated using the 1997 NCEER Liquefaction Workshop methods. The 1997 NCEER methods utilize direct SPT blow counts or CPT cone readings from site exploration and earthquake magnitude/PGA estimates from the seismic hazard analysis. The resistance to liquefaction is plotted on a chart of cyclic shear stress ratio (CSR) versus a corrected blow count $N_{1(60)}$ or Qc_{1N}. ***A ground acceleration of 0.64g was used in the analysis with a 9 foot groundwater depth.***

Liquefaction induced settlements have been estimated using the 1987 Tokimatsu and Seed method. Fines content of liquefiable sands and silt increase the liquefaction resistance in that more cycles of ground motions are required to fully develop pore pressures. The CPT tip pressures (Qc) were adjusted to an equivalent clean sand pressure (Q_{CINcs}). The adjusted tip pressures were converted to equivalent clean sand blow counts ($N_{1(60)cs}$) prior to calculating settlements. A computed factor of safety less than 1.0 indicates a liquefiable condition.

The soil encountered at the points of exploration included saturated silts and sands that could liquefy during a CBC Design Basis Earthquake (7M – 0.64g) for a 10% risk in 50 years. Liquefaction can occur within the sandy silty layer between depths of 41 to 45 feet. The likely triggering mechanism for liquefaction appears to be strong groundshaking associated with the rupture of the Imperial Fault and possibly the Cerro Prieto Fault.

SUMMARY OF LIQUEFACTION ANALYSES

Boring Location	Depth To First Liquefiable Zone (ft)	Potential Induced Settlement (in)
CPT-1	41	¼
CPT-2	41	½
CPT-3	42	½
B-1	41	½
B-2	---	0

Liquefaction Effects: ***Based on empirical relationships, total induced settlements are estimated to be about ¼ to ½ inch should liquefaction occur.*** Since the potentially liquefiable silty/sandy soils are overlain by 41 feet of non-liquefiable soils which resist groundwater movement, it is unlikely that liquefaction induced settlements will affect surface structures.

Mitigation: No mitigation of liquefaction induced settlements is required at this site.

Section 4
RECOMMENDATIONS

4.1 Site Preparation

Clearing and Grubbing: All surface improvements, debris or vegetation on the site at the time of construction should be removed from the construction area. Root balls should be completely excavated. Organic strippings should be hauled from the site and not used as fill. Any trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision. Any excavations resulting from site clearing should be sloped to a bowl shape to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer's representative.

Subgrade Preparation (Shallow Foundations): The exposed surface soil within the building pad/foundation areas should be removed to 30 inches below the building pad, base foundation elevation or existing grade (whichever is lower) extending five feet beyond all exterior wall/column lines (including concreted areas adjacent to the building). Exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to 5 to 10% above optimum moisture content and recompacted to 85 to 90% of the maximum density determined in accordance with ASTM D1557 methods.

The native soil is suitable for use as engineered fill provided it is free from concentrations of organic matter or other deleterious material. The fill soil should be uniformly moisture conditioned by discing and watering to the limits specified above, placed in maximum 6-inch lifts (loose), and compacted to the limits specified above. Clay soil should not be compacted greater than 90% relative compaction because highly compacted soil will result in increased swelling.

Alternately, the surface 36 inches of native clays may be removed and replaced with granular fill, placed and compacted to at least 95% of ASTM D1557 maximum density.

If building foundation designs are to be utilized which do not include provisions for expansive soil, an engineered building support pad consisting a minimum of 3.0 feet of granular soil (or to a minimum of 18 inches below the deepest footing), placed in maximum 8-inch lifts (loose), compacted to at least 95% of ASTM D1557 maximum density at 2% below to 4% above optimum moisture, should be placed below the bottom of the slab.

Imported fill soil (if required) should have a Plasticity Index less than 25 and sulfates (SO_4) less than 2,000 ppm or non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve. The geotechnical engineer should approve imported fill soil sources before hauling material to the site. Imported granular fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to at least of 95% of ASTM D1557 maximum dry density at optimum moisture ±2%.

In areas other than the building pad which are to receive area concrete slabs, the ground surface should be presaturated to a minimum depth of 24 inches and then scarified to 8 inches, moisture conditioned to a minimum of 5% over optimum, and recompacted to 83-87% of ASTM D1557 maximum density just prior to concrete placement.

Backwash Basin Site Preparation: The existing soil within the structures foundation areas should be removed to 12 inches below the bottom of the proposed foundation elevation extending five feet beyond the perimeter walls. The area should then be brought to bottom of structure grade with 12 inches of Class 2 aggregate base, compacted to at least of 95% of ASTM D1557 maximum density at 2% below to 4% above optimum moisture, or a geotextile filter fabric (Mirafi 140 or equivalent) and 12 inches of 1" x No. 4 crushed rock.

Concrete Water Tank Site Preparation: The existing soils underlying the 125-foot diameter water storage tank area should be removed to a depth of 36 inches below ground surface extending to a minimum of 5 feet beyond the perimeter of the tank. The native soil at the subexcavation and footing excavation level should be compacted to at least 90 % of ASTM D1557 maximum density at 2 to 8% above optimum moisture for a minimum depth of 8 inches. The area should then be brought to finish grade with engineered fill consisting of the following components:

- Geotextile subgrade reinforcing fabric
- 24 inches of crushed aggregate base
- 8 inches of crushed rock
- 4 inches of oiled sand

The engineered fill should be placed in 8-inch maximum loose lifts and compacted to a minimum 95% of ASTM D1557 maximum density within 2% of optimum moisture. The crushed rock tank underlayment should meet the gradation requirements of ASTM C33, size 57 (1" x No. 4 rock). The proposed source of engineered fill and rock should be submitted to the geotechnical engineer for review and testing to verify conformance to these requirements.

Trench Backfill: Trench backfill should conform to San Diego Regional Standard Drawing S-4 (Appendix E), using either Type A, B or C backfill.

Type A backfill for HDPE pipe consists of a 4 to 6 inch bed of ¾-inch crushed rock below the pipe and pipezone backfill (to 12" above top of pipe) consisting of crusher fines (sand). Sewer pipes (SDR-35), water mains, and stormdrain pipes of other that HDPE pipe may use crusher fines for bedding. The crusher fines shall be compacted to a minimum of 90% of ASTM D1557 maximum density. Pipe deflection should be checked to not exceed 2% of pipe diameter. Native clay/silt soils may be used to backfill the remainder of the trench.

Clays shall be compacted to a minimum of 85% of ASTM D1557 maximum density and silts shall be compacted to a minimum of 87% of ASTM D1557 maximum density, except that the top 12 inches of the trench shall be compacted to at least 90% of ASTM D1557 maximum density.

Type B backfill for HDPE pipe requires 6 inches of ¾-inch crushed rock as bedding and to springline of the pipe. Thereafter, sand/cement slurry (3 sack cement factor) should be used to 12 inches above the top of the pipe. Native clay and silt soils may be used in the remainder of the trench backfill as specified above.

Type C backfill for HDPE pipe shall consist of a geotextile filter fabric encapsulating ¾-inch crushed rock. The crushed rock thickness shall be 6 inches below and to the sides of the pipe and shall extend to 12 inches above the top of the pipe. The filter fabric shall cover the trench bottom, sidewalls and over the top of the crushed rock. Native clay and silt soils may be used in the remainder of the trench backfill as specified above.

Type C backfill must be used in wet soils and below groundwater for all buried utility pipelines unless dewatered to at least 24 inches below the trench bottom prior to excavation. Type A backfill may be used in the case of a dewatered trench condition.

On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill above pipezone, but may be difficult to uniformly maintain at specified moistures and compact to the specified densities. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material.

Imported granular material is acceptable for backfill of utility trenches. Granular trench backfill used in building pad areas should be plugged with a solid (no clods or voids) 2-foot width of native clay soils at each end of the building foundation to prevent landscape water migration into the trench below the building.

Backfill soil within paved areas should be placed in layers not more that 6 inches in thickness and mechanically compacted to a minimum of 87% of the ASTM D1557 maximum dry density except for the top 12 inches of the trench which shall be compacted to at least 90%.

Moisture Control and Drainage: The moisture condition of the building pad should be maintained during trenching and utility installation until concrete is placed or should be rewetted before initiating delayed construction. If soil drying is noted, a 2 to 3 inch depth of water may be used in the bottom of footings to restore footing subgrade moisture and reduce potential edge lift. Adequate site drainage is essential to future performance of the project. Infiltration of excess irrigation water and stormwaters can adversely affect the performance of the subsurface soil at the site. Positive drainage should be maintained away from all structures (5% for 5 feet minimum across unpaved areas) to prevent ponding and subsequent saturation of the native clay soil.

Observation and Density Testing: All site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area.

The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "*geotechnical engineer of record*" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the recommendations for site development.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have the existing soil beneath the structure foundation prepared in the manner recommended for the building pad except the preparation needed only to extend 18 inches below and beyond the footing.

4.2 Foundations and Settlements

Structural concrete mat foundations are suitable to support the treatment units and the pre-stressed concrete water tank. The mats shall be founded on a layer of properly prepared and compacted soil as described in Section 4.1. The foundations may be designed using an allowable soil bearing pressure of 1,500 psf for compacted native clay soil and 2,000 psf when foundations are supported on imported engineered fill (extending a minimum of 1.0 feet below footings). The allowable soil pressure may be increased by 20% for each foot of embedment depth in excess of 18 inches and by one-third for short term loads induced by winds or seismic events. The maximum allowable soil pressure at increased embedment depths shall not exceed 3,000 psf.

Flat Plate Structural Mats: Structural mats may be designed for a modulus of subgrade reaction (Ks) of 100 pci when placed on compacted native soil or a subgrade modulus of 200 pci when placed on 12 inches of base material (below grade structures) or a subgrade modulus of 300 pci when placed on 3.0 feet of granular fill. Mats for non-waterbearing basins shall overlay 2 inches of sand and a 10-mil polyethylene vapor retarder. The building support pad shall be moisture conditioned and recompacted as specified in Section 4.1 of this report.

All footings should be embedded a minimum of 18 inches below the building support pad or lowest adjacent final grade, whichever is deeper. Continuous wall footings should have a minimum width of 12 inches. Spread footings should have a minimum width of 24 inches. Recommended concrete reinforcement and sizing for all footings should be provided by the structural engineer.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 250 pcf (300 pcf for import granular material) to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.25 (0.35 for import granular material) may also be used at the base of the footings to resist lateral loading.

Shallow buildings foundation movement under the estimated static (non-seismic) loadings and static site conditions are estimated to not exceed ¾ inch with differential movement of about two-thirds of total movement for the loading assumptions stated above when the subgrade preparation guidelines given above are followed.

Estimated settlements for the pre-stressed concrete water tank were calculated using the mechanical parameters obtained from the laboratory consolidation tests results and from the field test data for the clay strata and Schmertman's analysis for the granular strata using the CPT data correlations.

Concrete water tank foundation movements under estimated loadings are shown on the Load/Settlement Curves (Plate D-1). Differential movement is estimated to be about 3 to 4 inches from center to edge of tank foundation. Seismically induced liquefaction settlement of the surrounding land mass and structure are unlikely since the potentially liquefiable silty/sandy soils are overlain by 41 feet of non-liquefiable soils which resist groundwater movement.

4.3 Slabs-On-Grade

Concrete slabs and flatwork placed over native clay soil should either be uniformly thick structural mats (10 inches or greater) or should be designed in accordance with Chapter 18, Division III of the 2001 CBC and shall be a minimum of 5 inches thick due to expansive soil conditions. Concrete floor slabs shall be monolithically placed with the foundations unless placed on 3.0 feet of granular fill soil.

The concrete slabs should be underlain by a 10-mil polyethylene vapor retarder that works as a capillary break to inhibit moisture migration into the slab section. The vapor retarder should be properly lapped and sealed and extend a minimum of 12 inches into the footings. The vapor retarder should be sandwiched by 4 inches (2 inches above and 2 inches below) of clean sand (Sand Equivalent SE>30) unless placed on 3.0 feet of granular fill which will allow the vapor retarder to lie directly on the granular fill with 2 inches of clean sand cover. Concrete slabs may be placed without a sand cover directly over a 15-mil vapor retarder if desired (Stego-Wrap or equivalent).

Concrete slab and flatwork reinforcement should consist of chaired rebar slab reinforcement (minimum of No. 3 bars at 18-inch centers, both horizontal directions) placed at slab mid-height to resist potential swell forces and cracking. Slab thickness and steel reinforcement are minimums only and should be verified by the structural engineer/designer knowing the actual project loadings. All steel components of the foundation system should be protected from corrosion by maintaining a 4-inch minimum concrete cover of densely consolidated concrete at footings (by use of a vibrator).

The construction joint between the foundation and any housekeeping slab/sidewalks placed adjacent to foundations should be sealed with a polyurethane based non-hardening sealant to prevent moisture migration between the joint. When less than 4 inches of concrete cover is provided epoxy coated embedded steel components or permanent waterproofing membranes placed at the exterior footing sidewall may also be used to mitigate the corrosion potential of concrete placed in contact with native soil.

Control joints should be provided in all concrete slabs-on-grade at a maximum spacing (in feet) of 2 to 3 times the slab thickness (in inches) as recommended by American Concrete Institute (ACI) guidelines. All joints should form approximately square patterns to reduce randomly oriented contraction cracks. Contraction joints in the slabs should be tooled at the time of the pour or sawcut (¼ of slab depth) within 6 to 8 hours of concrete placement. Construction (cold) joints in foundations and area flatwork should either be thickened butt-joints with dowels or a thickened keyed-joint designed to resist vertical deflection at the joint. All joints in flatwork should be sealed to prevent moisture, vermin, or foreign material intrusion. Precautions should be taken to prevent curling of slabs in this arid desert region (refer to ACI guidelines).

All independent flatwork (sidewalks, housekeeping slabs) should be placed on a minimum of 2 inches of concrete sand or aggregate base, dowelled to the perimeter foundations where adjacent to buildings and sloped 2% away from the building. A minimum of 24 inches of moisture conditioned (5% minimum above optimum) and 8 inches of compacted subgrade (83 to 87%) and a 10-mil (minimum) polyethylene separation sheet should underlie the flatwork containing steel reinforcing (unless reinforced with wire mesh). All flatwork should be jointed in square patterns and at irregularities in shape at a maximum spacing of 10 feet or the least width of the sidewalk.

4.4 Deep Foundations

In order to reduce settlement to accepted limits, existing soft, compressible ground may be improved by soil improvement (soil mixing with cement, stone columns, geopiers, etc) or by placement a deep foundation system like piles or drilled piers.

A. Soil-Cement Mixing

A technique to improve soft and compressible ground condition is through mixing of the subsurface soil with cement. Soil-cement mixing is accomplished by augering 36 to 48-inch diameter holes to a depth of about 30 to 40 feet below ground surface and mixing the soil with cement creating a soil-cement column. The deep soil mixing serves to reduce settlement by replacing the compressible clay soils below the structures with very stiff soil-cement columns, creating a stiffer composite soil matrix.

Soil-cement design should be provided by a licensed specialty contractor. Specialty contractor should also provide allowable soil bearing capacity and associated settlement.

B. Stone Columns

Stone columns consisting of gravel stones that are placed in underground columns by a vibro-replacement method are effective in mitigating the settlement hazard related to highly compressible soil layers. They have been used frequently in Southern California.

For preliminary design purposes, the stone columns should be extended to a dense, non-compressible layer, spaced on approximately 6-foot on centers, and have an effective diameter of approximately 30-36 inches. The vibro-replacement method densifies the soil around the column. Settlement potential of the soil is greatly reduced by densification, drainage, and increased stiffness of the soil within the treated area. The stone columns should extend to a depth determined by engineering design based on settlement risks, but should, as a minimum, be founded at depths greater than 30 to 40 feet.

A 24-inch thick aggregate base layer should overlie the stone column treated area beneath the foundation to act as a drainage layer and to spread transmitted loads to the stone columns.

The above data for stone columns is presented as preliminary information only. A specialty contractor should be consulted for the actual design and construction of stone columns. Specialty contract should also provide allowable soil bearing capacity and associated settlement.

All of the stone column installation operations should be conducted under the observation of the geotechnical engineer's representative.

C. Geopiers

Another technique to improve soft and compressible ground condition is through placement of geopiers. Geopiers are constructed by augering 30 to 36-inch diameter holes to depths of about 30 to 40 feet below the base of the footings and backfilling the holes with thin lifts of compacted aggregates. Compaction densifies the aggregate and increases lateral stress in the soil matrix. The system serves to reduce settlement by replacing the compressible clay soils below the structures with very stiff aggregate piers, creating a stiffer composite soil matrix.

Geopier design should be provided by a licensed specialty contractor. Specialty contractor should also provide allowable soil bearing capacity and associated settlement. One demonstration pier should be installed with the contractor's standard procedures and then load –tested to determine the soil modulus. The load testing setup and procedures should be selected by the geopier contractor and submitted for review to the project geotechnical engineer. The demonstration pier should be installed at the foundation grade level. All of the Geopier element installation operations should be conducted under the observation of the geotechnical engineer's representative.

D. Pile Foundation

Precast, prestressed concrete piles are often used in the corrosive soil environments of the Imperial Valley. Selection of pile type may be based on drivability and cost comparisons. The piles should be driven to a depth of about 55 feet from the existing ground surface.

The specified tip elevation (55 feet) and design load for prestressed driven piles are given in Tables 2.

TABLE 2

Allowable Capacities of Pile Foundations

Pile Type:	Precast, Prestressed Square Concrete	
Specified Tip Depth (ft):	**55 feet**	
Minimum Concrete Compressive Strength:	5,000 psi	
Pile Size:	12 inches	14 inches
Allowable Axial Capacity (tons) – FS=2.25:	44.0	57.0
Allowable Lateral Capacity (tons) for ¼ inch deflection:		
Free Head Condition (kips):	7.9	10.1
Fixed Head Condition (kips):	15.9	20.1
Maximum Moments from Lateral Load,		
Free Head Condition (kips-foot):	20.8	30.0
Fixed Head Condition (kips-foot):	-53.5	-76.3
Depth of Maximum Moment,		
Free Head (ft):	5.4	5.9
Fixed Head (ft):	0	0

Recommendations for other pile types and sizes can be made available upon request.

Vertical Capacity: The allowable pile capacities are based on a factor of safety of 2.25. Resistance to uplift may be considered equivalent to 40 percent of the allowable downward vertical capacity.

Lateral Capacity: The allowable lateral capacity of 12 and 14-inch sections are based on a deflection of one-quarter inch at the top of the pile. If greater deflection can be tolerated, lateral load capacity can be increased directly in proportion to a maximum of one inch deflection.

Settlement: Total settlements of less than ½ inch, and differential settlements of less than ¼ inch, are anticipated for single piles designed according to the preceding recommendations. If pile spacing is a least 2.5 pile diameters center-to-center, no reduction in axial load capacity is considered necessary for a group effect.

Pile Driving: Complete documentation of the proposed hammer should be submitted to the City Engineer for approval prior to mobilization. Driving records should be maintained on each pile. The numbers of blows required to drive a pile each foot should be recorded. Driving energy necessary to insure development of full design capacity shall be established after each selection of the pile driver.

The geotechnical engineer should observe pile driving and evaluate each pile on a case-by-case basis. Pre-drilling of pilot holes for piles to a depth of half the pile depth will be allowed without reduction in pile capacity.

E. Drilled Piers

Recommendations for 24 and 48 inch diameter cast-in place drilled piers are provided below.

Vertical Capacity: Vertical capacity for 24 and 48 inch diameter shafts are presented in Plate D-2. Capacities for other shaft sizes can be determined in direct proportion to shaft diameters. End bearing and skin friction parameters have been used to determine the allowable shaft capacity. The allowable capacities include a factor of safety of 2.0. The allowable vertical compression capacities may be increased by 33 percent to accommodate temporary loads such as from wind or seismic forces. The allowable vertical shaft capacities are based on the supporting capacity of the soil. The structural capacity of the piers should be verified by the structural engineer. The minimum depth of pier should be 55 feet in order to maintain static settlements in acceptable levels (½-inch or less).

Lateral Capacity: The allowable lateral capacity for 24 and 48 inch diameter shafts are given in the table shown below. The allowable horizontal deflection at the shaft head has been assumed to be one-half inch (0.50 inch).

Lateral Pier Capacities

Shaft Diameter (in.)	**24**		**48**	
Head Condition	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5
Length (ft.)	**55**	**55**	**55**	**55**
Lateral Capacity (kips)	27.5	58.5	88	192
Maximum Moment (foot-kips)	123.3	342.5	687.5	1900
@Depth from Pier Head (ft.)	9.0	0	14.9	0

Uplift Capacity: Pier capacity in tension should be taken as 50% of the compression capacity.

Settlement: Total settlements of less than ½ inch, and differential settlements of less than ¼ inch, are anticipated for single cast-in place drilled piers designed according to the preceding recommendations.

Installation: The drilled pier shall be placed in conformance to ACI 336 guidelines. Excavation for piers should be inspected by the geotechnical consultant. The bottom of the excavation for piers should be reasonably free of loose or slough material. A tremie pipe should be used to pour concrete from the bottom up and to ensure less than five feet of free fall.

All drilled piers extending below groundwater (about 9.0 feet deep) shall be cased to prevent caving or lateral deformation, provided that the structural steel and concrete shall be placed immediately after drilling.

4.5 Raw and Fresh Water Pump Stations Geotechnical Design Criteria

The pump stations may be designed for an allowable soil bearing pressure of 2,000 pounds per square foot (psf) at the base of the station (approximately 10 feet below grade). Footings and equipment foundations which are embedded a minimum of 18 inches into native soil or compacted backfill around the pump wet-well may be designed for an allowable bearing pressure of 1,500 psf. It is suggested that rigid mat be used for structures placed over wet well backfill.
Horizontal sliding can be resisted with passive earth pressure equivalent to 250 pounds per cubic foot (pcf) of fluid pressure and a coefficient of friction of 0.25. Groundwater buoyant forces and lateral loads should be considered in the wet well design. Active earth pressures of 55 pcf should be used above groundwater and at-rest pressures of 70 pcf should be used for braced walls. Dewatering of the wet well site prior to excavation will be required at a depth below 9 feet.

4.6 Excavations

All site excavations should conform to CalOSHA requirements for Type B soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be cut nearly vertical for short duration. Excavations deeper than 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type B soil. These temporary deep excavations will require slope inclinations no steeper than 1½(H):1(V) unless trench shoring is used. If excavations are planned below groundwater (9 feet below ground surface), all excavation slopes should be excavated according to OSHA Standards for Type C soils.

All unlined permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination. Embankment construction shall be properly prepared and compacted as described in Section 4.1.

All discussions in this section regarding stable excavation slopes assumes minimal equipment vibration and adequate setback of excavated material and construction equipment from the top of the excavation. We recommended that the minimum setback distance be equal to the depth of excavation and at least 10 feet from the crown of the slope. If excavated materials are stockpiled adjacent to the excavation, the weight of the material should be considered as a surcharge load for slope stability.

Excavation for the pump stations will encounter the groundwater table (9 feet depth). Therefore, seepage and pumping subgrade conditions should be anticipated. An adequately designed dewatering system (well points) will be required to control groundwater seepage and prevent running ground conditions. The responsibility for dewatering and selection of an appropriate system for dewatering is beyond the scope of this report.

4.7 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate C-8). The native soils were found to have severe levels of sulfate ion concentration (3,836 to 5,310 ppm). Sulfate ions in high concentrations can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. The California Building Code recommends that increased quantities of Type II Portland Cement be used at a low water/cement ratio when concrete is subjected to moderate sulfate concentrations. Type V Portland Cement and/or Type II/V cement with 25% flyash replacement is recommended when the concrete is subjected to soil with severe sulfate concentration.

A minimum of 6.0 sacks per cubic yard of concrete (4,500 psi) of Type V Portland Cement with a maximum water/cement ratio of 0.45 (by weight) should be used for concrete placed in contact with native soil on this project (sitework including sidewalks, housekeeping slabs, and foundations). Admixtures may be required to allow placement of this low water/cement ratio concrete.

The native soil has very severe levels of chloride ion concentration (7,360 to 16,780 ppm). Chloride ions can cause corrosion of reinforcing steel, anchor bolts and other buried metallic conduits. Resistivity determinations on the soil indicate very severe potential for metal loss because of electrochemical corrosion processes. Mitigation of the corrosion of steel can be achieved by using steel pipes coated with epoxy corrosion inhibitors, asphaltic and epoxy coatings, cathodic protection or by encapsulating the portion of the pipe lying above groundwater with a minimum of 4 inches of densely consolidated concrete. ***No unprotected metallic pipes or conduits should be placed below foundations.***

Foundation designs shall provide a minimum concrete cover of four (4) inches around steel reinforcing or embedded components (anchor bolts, etc.) exposed to native soil or landscape water (to 18 inches above grade). If the 4-inch concrete edge distance cannot be achieved, all embedded steel components (anchor bolts, etc.) shall be epoxy dipped for corrosion protection or a corrosion inhibitor and a permanent waterproofing membrane shall be placed along the exterior face of the exterior footings. ***Hold-down straps should not be used at foundation edges due to corrosion of metal at its protrusion from the slab edge.*** Additionally, the concrete should be thoroughly vibrated at footings during placement to decrease the permeability of the concrete. ***Copper water piping should not be placed under floor slabs.***

4.8 Lateral Earth Pressures

Earth retaining structures, such as retaining walls, should be designed to resist the soil pressure imposed by the retained soil mass. Walls with granular drained backfill may be designed for an assumed static earth pressure equivalent to that exerted by a fluid weighing 55 pcf for unrestrained (active) conditions (able to rotate 0.1% of wall height), and 70 pcf for restrained (at-rest) conditions. These values should be verified at the actual wall locations during construction.

When applicable, seismic earth pressure on walls may be assumed to exert a uniform pressure distribution of 7.5H psf against the back of the wall, where H is the height of the backfill. The total seismic load is assumed to act as a point load at 0.6H above the base of the wall (tanks with equal burial on each side are generally not subjected to earthquake induced lateral soil pressures).

Surcharge loads should be considered if loads are applied within a zone between the face of the wall and a plane projected behind the wall 45 degrees upward from the base of the wall. The increase in lateral earth pressure acting uniformly against the back of the wall should be taken as 50% of the surcharge load within this zone. Areas of the retaining wall subjected to traffic loads should be designed for a uniform surcharge load equivalent to two feet of native soil.

4.9 Seismic Design

This site is located in the seismically active southern California area and the site structures are subject to strong ground shaking due to potential fault movements along the Brawley, Superstition Hills, and Imperial Faults. Engineered design and earthquake-resistant construction are the common solutions to increase safety and development of seismic areas. Designs should comply with the latest edition of the CBC for Seismic Zone 4 using the seismic coefficients given in Section 3.4 of this report. ***This site lies about 10.0 km from a Type A fault and overlies S_D (stiff) soil.***

AWWA Site Amplification Factor: Based on the soils encountered during the site exploration, a site amplification factor (S) of 1.2 (Soil Profile Type B) has been determined.

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The recommendations and conclusions within this report are based on current information regarding the proposed expansion of the Heber Public Utilities District (HPUD) Water Treatment Plant located at 1085 Main Street in Heber, California. The conclusions and recommendations of this report are invalid if:

- Structural loads change from those stated or the structures are relocated.
- The Additional Services section of this report is not followed.
- This report is used for adjacent or other property.
- Changes of grade or groundwater occur between the issuance of this report and construction other than those anticipated in this report.
- Any other change that materially alters the project from that proposed at the time this report was prepared.

Findings and recommendations in this report are based on selected points of field exploration, geologic literature, laboratory testing, and our understanding of the proposed project. Our analysis of data and recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil conditions can exist between and beyond the exploration points or groundwater elevations may change. If detected, these conditions may require additional studies, consultation, and possible design revisions.

This report contains information that may be useful in the preparation of contract specifications. However, the report is not worded is such a manner that we recommend its use as a construction specification document without proper modification. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

This report was prepared according to the generally accepted *geotechnical engineering standards of practice* that existed in Imperial County at the time the report was prepared. No express or implied warranties are made in connection with our services.

This report should be considered invalid for periods after two years from the report date without a review of the validity of the findings and recommendations by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice.

The client has responsibility to see that all parties to the project including, designer, contractor, and subcontractor are made aware of this entire report. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

5.2 Additional Services

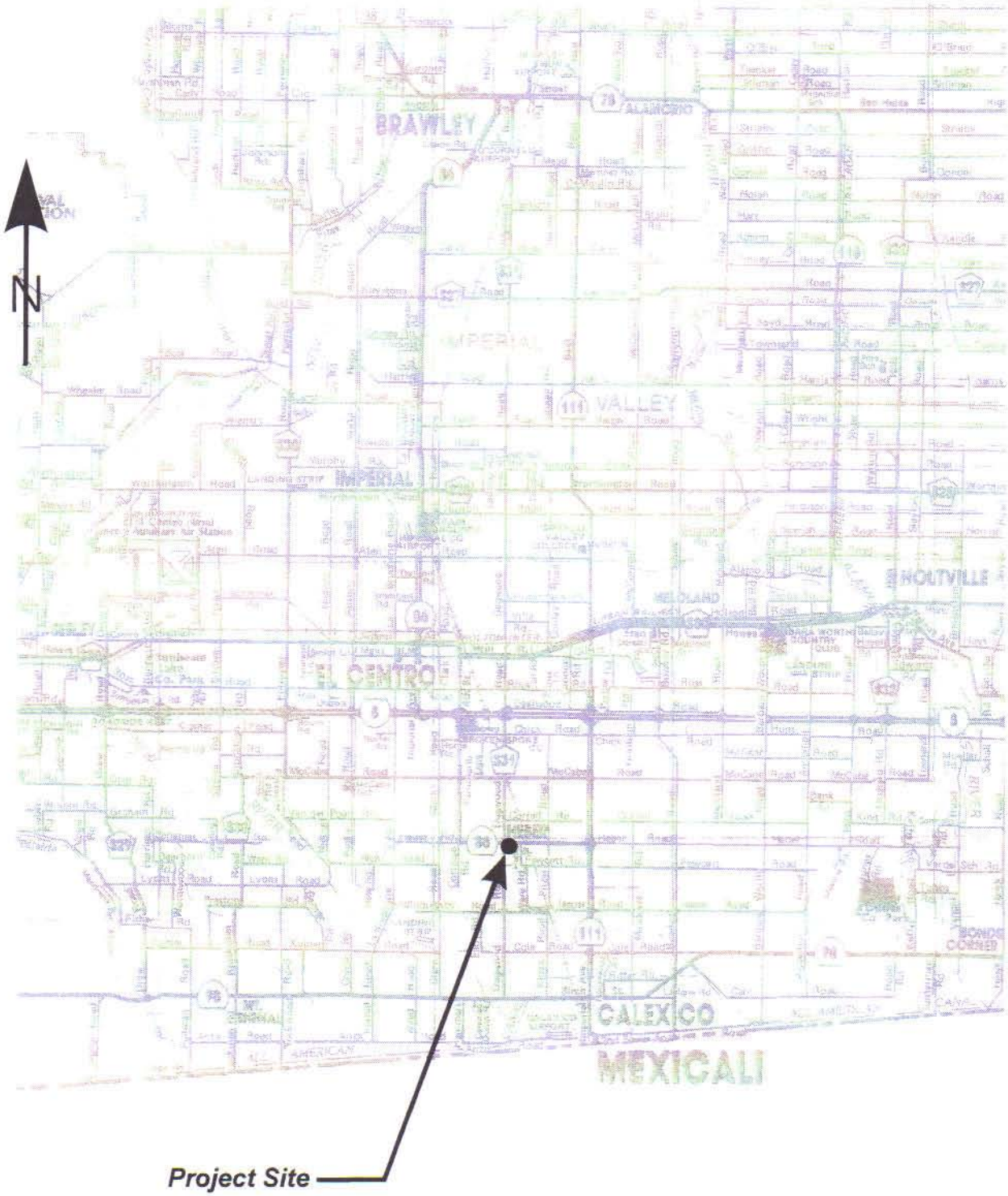
We recommend that Landmark Consultants, Inc. be retained as the geotechnical consultant to provide the tests and observations services during construction. If Landmark Consultants does not provide such services then *the geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

The recommendations presented in this report are based on the assumption that:

- Consultation during development of design and construction documents to check that the geotechnical recommendations are appropriate for the proposed project and that the geotechnical recommendations are properly interpreted and incorporated into the documents.
- Landmark Consultants will have the opportunity to review and comment on the plans and specifications for the project prior to the issuance of such for bidding.
- Continuous observation, inspection, and testing by the geotechnical consultant of record during site clearing, grading, excavation, placement of fills, building pad and subgrade preparation, and backfilling of utility trenches.
- Observation of foundation excavations and reinforcing steel before concrete placement.
- Observation of pile driving
- Other consultation as necessary during design and construction.

We emphasize our review of the project plans and specifications to check for compatibility with our recommendations and conclusions. Additional information concerning the scope and cost of these services can be obtained from our office.

APPENDIX A



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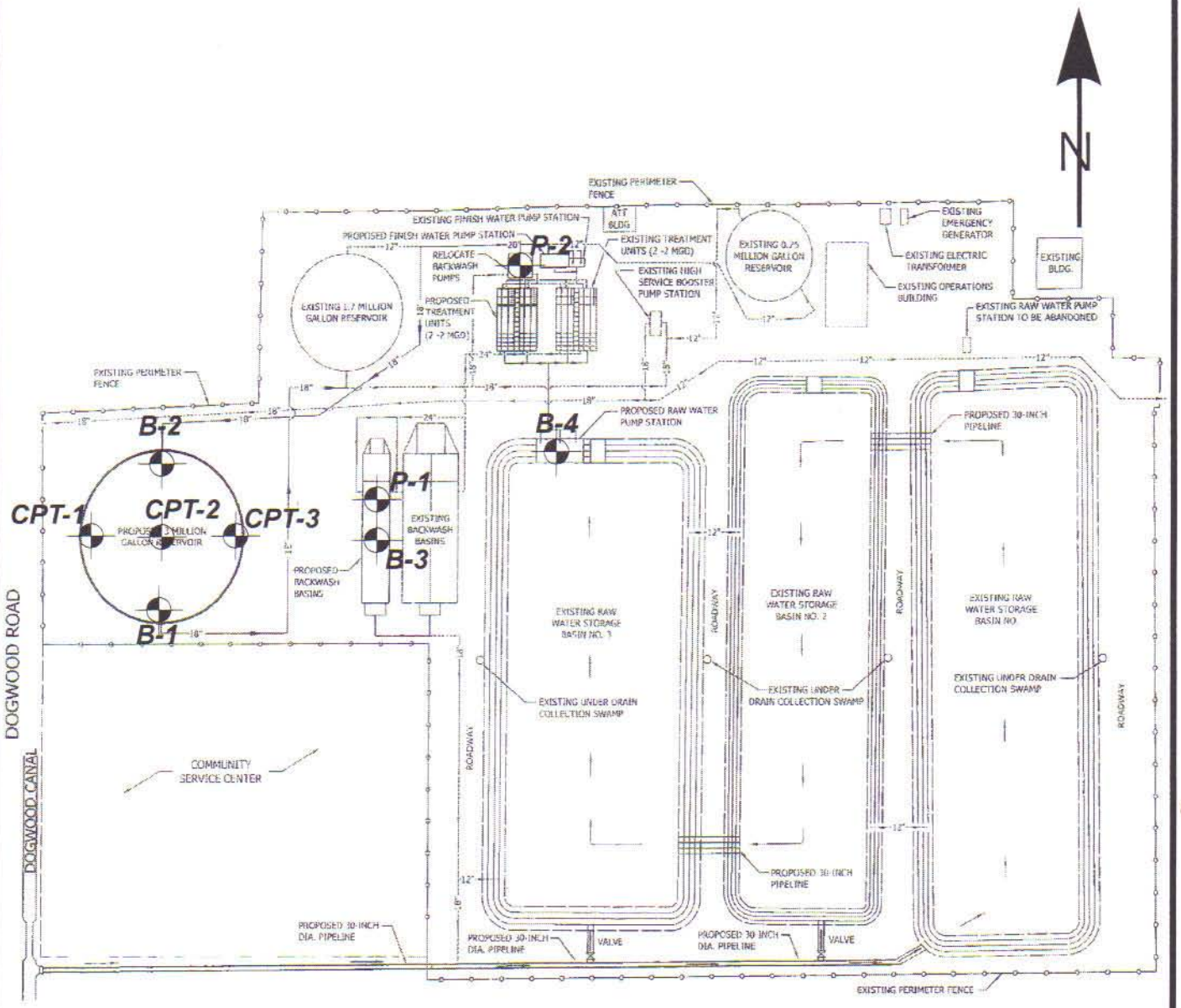
Vicinity Map

Plate
A-1



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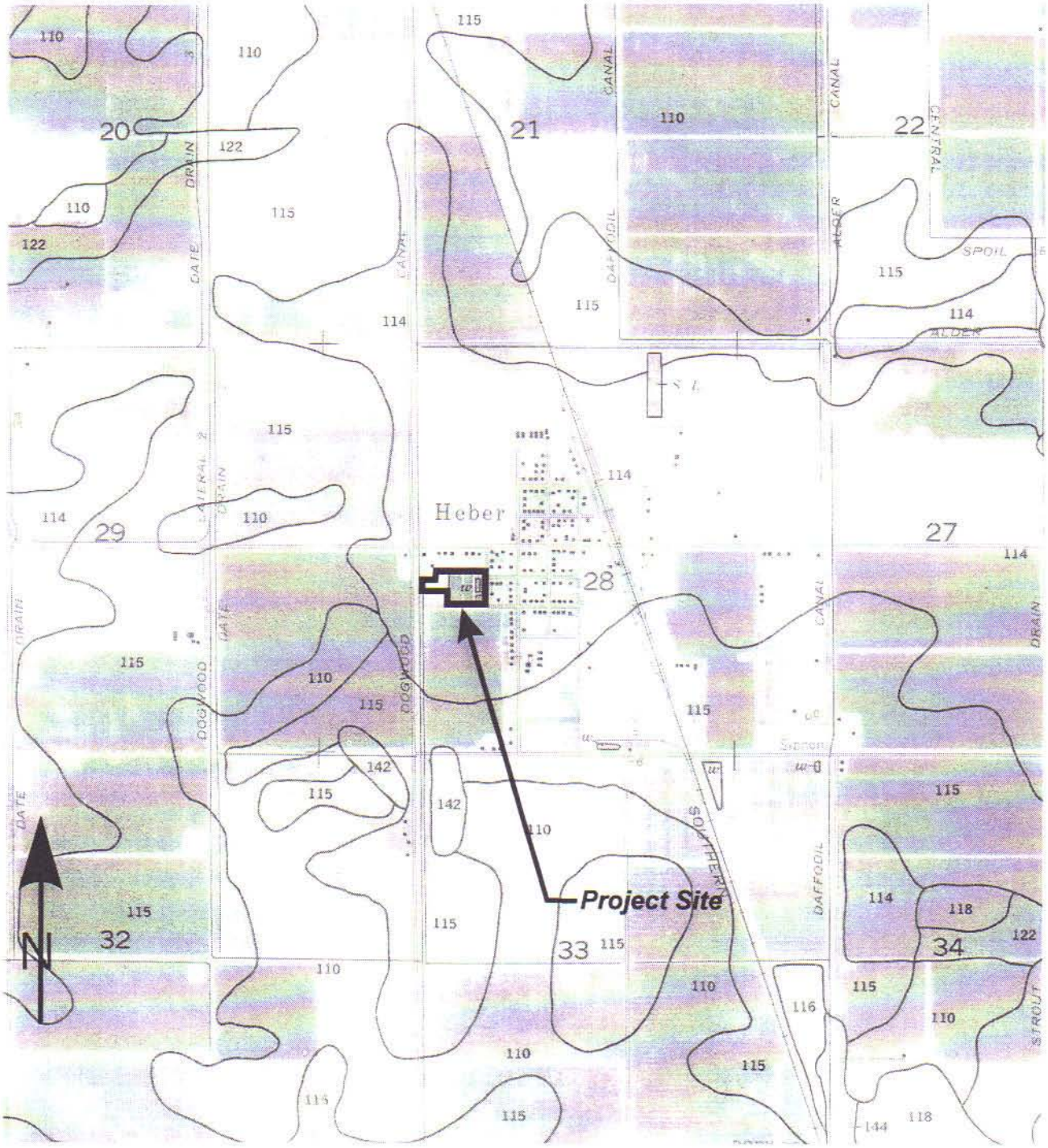
Project No.: LE06278

Site and Exploration Map

Plate A-2



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Project No.: LE06278

Soil Survey Map

Plate
A-3

Soil Survey of

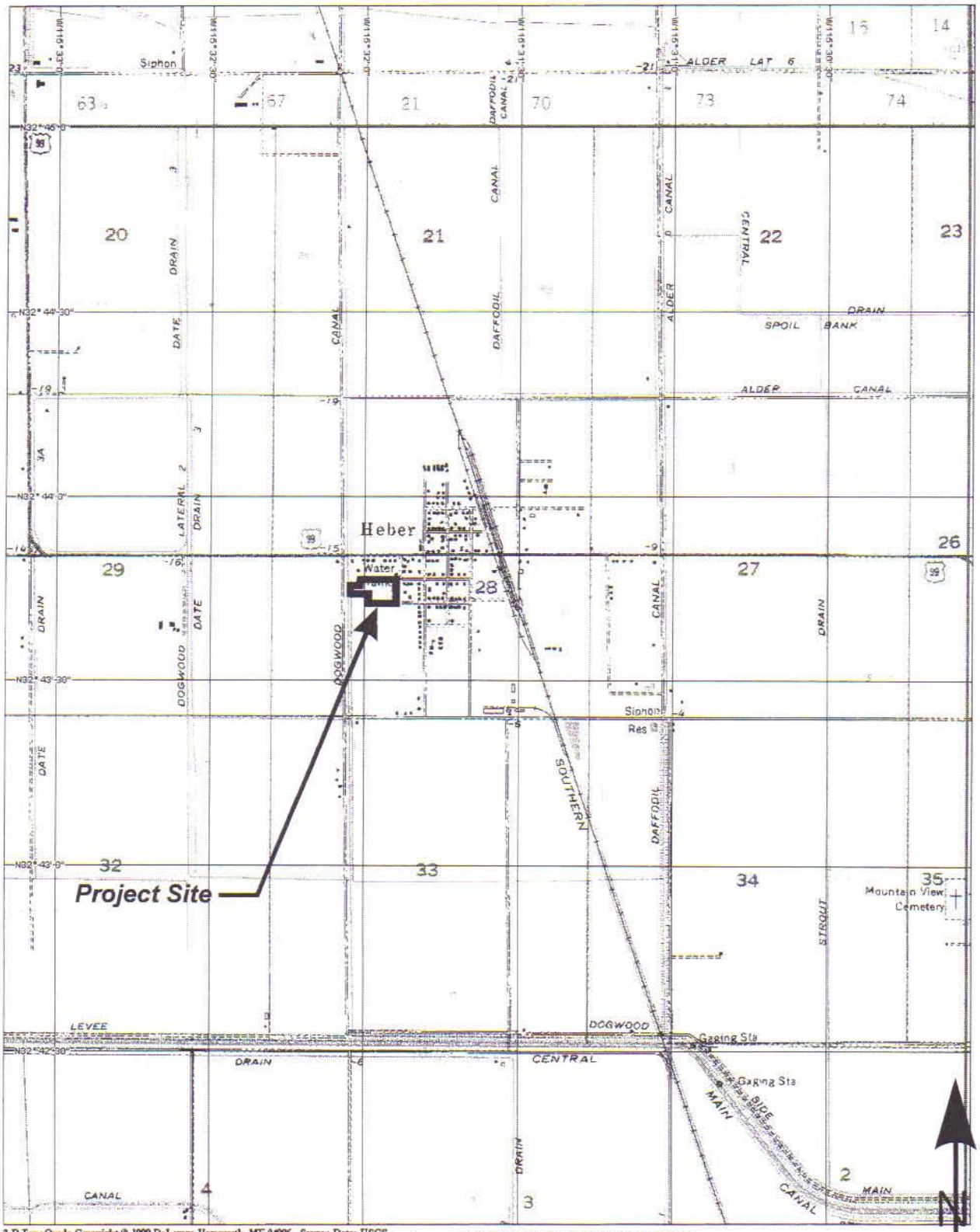
IMPERIAL COUNTY
CALIFORNIA
IMPERIAL VALLEY AREA

United States Department of Agriculture Soil Conservation Service
in cooperation with
University of California Agricultural Experiment Station
and
Imperial Irrigation District

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
111*:											
Holtville	0-10	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	10-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
Imperial	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
112 Imperial	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
113 Imperial	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	100	85-95	50-70	25-45
114 Imperial	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
115*:											
Imperial	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
116*:											
Imperial	0-13	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	13-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
117, 118 Indio	0-12	Loam	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
119*:											
Indio	0-12	Loam	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
Vint	0-10	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	25-35	---	NP
	10-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
120* Laveen	0-12	Loam	ML, CL-ML	A-4	0	100	95-100	75-85	55-65	20-30	NP-10
	12-60	Loam, very fine sandy loam.	ML, CL-ML	A-4	0	95-100	85-95	70-80	55-65	15-25	NP-10

See footnote at end of table.



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS 7.42 ft Scale: 1 : 25,000 Detail: 13-0 Datum: WGS84

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Project No.: LE06278

Topographic Map

Plate
A-4

APPENDIX B

CLIENT: The Holt Group

PROJECT: Heber Water Treatment Plant Expansion, Heber, CA

LOCATION: See Site and Boring Location Plan

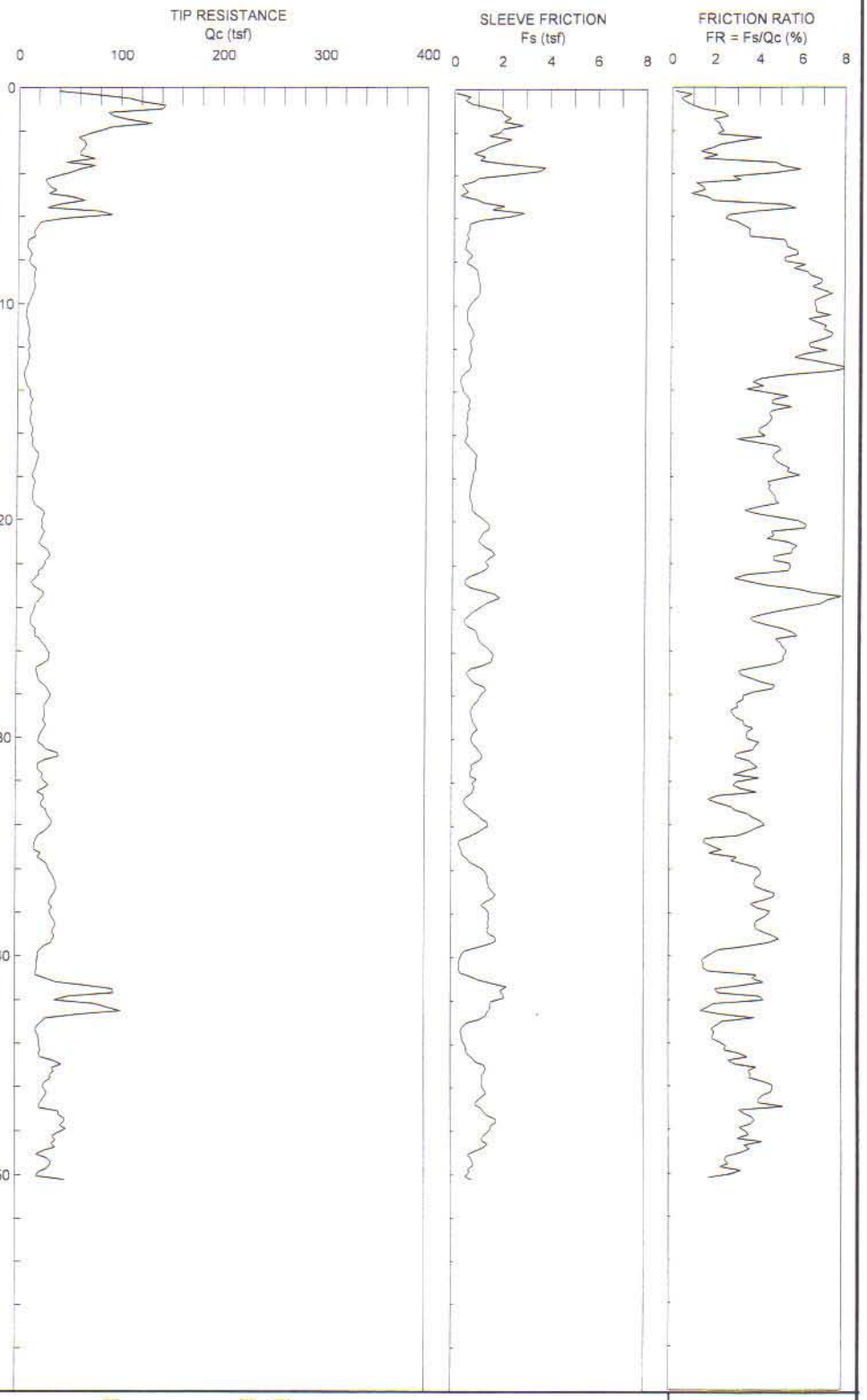
CONE PENETROMETER: HOLGUIN, FAHAN & ASSC Truck Mounted Electric Cone with 23 ton reaction weight

DATE: 08/16/06

LOG OF CONE SOUNDING DATA CPT-1

DEPTH (FEET)	INTERPRETED SOIL PROFILE From Robertson & Campanella (1989)		
	GROUND EL. +/-		
	Sand to Silty Sand	SP/SM	very dense
	Silty Sand to Sandy Silt	SM/ML	very dense
	Sandy Silt to Clayey Silt	ML	dense
	Clayey Silt to Silty Clay	ML/CL	hard
	Sandy Silt to Clayey Silt	ML	medium dense
	Sandy Silt to Clayey Silt	" "	dense
	Silty Clay to Clay	CL	stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
10	Clay	" "	stiff
	Clay	" "	firm
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	firm
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
20	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Clay	" "	stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
30	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Silty Clay to Clay	CL	hard
	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	hard
40	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Sandy Silt to Clayey Silt	" "	medium dense
	Sandy Silt to Clayey Silt	" "	loose
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
	Clayey Silt to Silty Clay	ML/CL	hard
	Clayey Silt to Silty Clay	" "	very stiff
50	Clayey Silt to Silty Clay	" "	very stiff

End of Sounding @ 50.0 ft.



Project No: LE06278

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Plate B-1

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: HWTP Expansion, Heber, CA Project No: LE06278 Date: 08/16/06

CONE SOUNDING: CPT-1

Est. GWT (ft): 9.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17.0 Phi (deg.)	Su (tsf)	OCR
0.15	0.5	72.61	0.50 8	8	Sand to Silty Sand	SP/SM	very dense	115	5.5	13	2.00	137.3	10	125	45		
0.30	1.0	134.35	0.99 8	8	Sand to Silty Sand	SP/SM	very dense	115	5.5	24	2.00	254.0	10	127	46		
0.45	1.5	95.41	2.27 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	21	2.00	180.4	30	109	43		
0.60	2.0	100.16	2.26 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	22	2.00	189.3	30	106	43		
0.75	2.5	63.59	3.07 6	6	Sandy Silt to Clayey Silt	ML	dense	115	3.5	18	2.00	120.2	40	88	40		
0.93	3.0	63.36	1.82 7	7	Silty Sand to Sandy Silt	SM/ML	dense	115	4.5	14	2.00	119.8	30	85	40		
1.08	3.5	60.35	2.77 6	6	Sandy Silt to Clayey Silt	ML	dense	115	3.5	17	2.00	114.1	40	82	39		
1.23	4.0	61.41	5.23 11	11	Overconsolidated Soil	??	dense	120	1.0	61	2.00	116.1	55	80	39		
1.38	4.5	30.34	2.35 6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	9	2.00	57.3	50	57	36		
1.53	5.0	32.46	1.30 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	7	1.96	60.2	40	58	36		
1.68	5.5	46.55	3.62 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	19	1.87		55			2.72	>10
1.83	6.0	72.07	2.91 6	6	Sandy Silt to Clayey Silt	ML	dense	115	3.5	21	1.78	121.4	40	78	39		
1.98	6.5	19.83	3.28 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	1.71		70			1.15	>10
2.13	7.0	14.01	4.09 3	3	Clay	CL/CH	stiff	125	1.3	11	1.64		90			0.80	>10
2.28	7.5	9.84	5.45 3	3	Clay	CL/CH	stiff	125	1.3	8	1.58		100			0.55	>10
2.45	8.0	11.69	5.40 3	3	Clay	CL/CH	stiff	125	1.3	9	1.52		100			0.66	>10
2.60	8.5	15.36	6.00 3	3	Clay	CL/CH	stiff	125	1.3	12	1.47		100			0.88	>10
2.75	9.0	15.61	6.76 3	3	Clay	CL/CH	stiff	125	1.3	12	1.43		100			0.89	>10
2.90	9.5	15.37	6.95 3	3	Clay	CL/CH	stiff	125	1.3	12	1.41		100			0.87	>10
3.05	10.0	11.35	6.73 3	3	Clay	CL/CH	stiff	125	1.3	9	1.39		100			0.64	7.85
3.20	10.5	8.37	6.90 3	3	Clay	CL/CH	firm	125	1.3	7	1.37		100			0.46	4.47
3.35	11.0	9.63	6.73 3	3	Clay	CL/CH	stiff	125	1.3	8	1.35		100			0.53	5.42
3.50	11.5	11.07	7.29 3	3	Clay	CL/CH	stiff	125	1.3	9	1.33		100			0.62	6.54
3.65	12.0	10.97	6.56 3	3	Clay	CL/CH	stiff	125	1.3	9	1.31		100			0.61	6.21
3.80	12.5	10.91	6.33 3	3	Clay	CL/CH	stiff	125	1.3	9	1.30		100			0.60	5.88
3.95	13.0	9.39	7.42 3	3	Clay	CL/CH	stiff	125	1.3	8	1.28		100			0.51	4.37
4.13	13.5	6.74	5.68 3	3	Clay	CL/CH	firm	125	1.3	5	1.27		100			0.36	2.65
4.28	14.0	9.75	3.80 3	3	Clay	CL/CH	stiff	125	1.3	8	1.25		100			0.53	4.37
4.43	14.5	13.10	4.86 3	3	Clay	CL/CH	stiff	125	1.3	10	1.24		100			0.73	6.76
4.58	15.0	12.81	4.94 3	3	Clay	CL/CH	stiff	125	1.3	10	1.22		100			0.71	6.32
4.73	15.5	12.62	4.57 3	3	Clay	CL/CH	stiff	125	1.3	10	1.21		100			0.70	5.88
4.88	16.0	14.18	4.20 3	3	Clay	CL/CH	stiff	125	1.3	11	1.20		100			0.79	6.88
5.03	16.5	15.04	3.97 4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	1.19		100			0.84	>10
5.18	17.0	19.46	4.83 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.17		100			1.10	>10
5.33	17.5	18.52	5.13 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.16		100			1.04	>10
5.48	18.0	15.45	5.49 3	3	Clay	CL/CH	stiff	125	1.3	12	1.15		100			0.86	6.88
5.65	18.5	17.00	4.50 3	3	Clay	CL/CH	stiff	125	1.3	14	1.14		100			0.95	8.00
5.80	19.0	15.20	4.75 3	3	Clay	CL/CH	stiff	125	1.3	12	1.13		100			0.85	6.32
5.95	19.5	20.37	4.16 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	1.12		100			1.15	>10
6.10	20.0	25.53	4.87 3	3	Clay	CL/CH	very stiff	125	1.3	20	1.11		95			1.45	>10
6.25	20.5	25.33	5.70 3	3	Clay	CL/CH	very stiff	125	1.3	20	1.10		100			1.44	>10
6.40	21.0	23.39	4.87 3	3	Clay	CL/CH	very stiff	125	1.3	19	1.09		100			1.32	>10
6.55	21.5	28.23	5.67 3	3	Clay	CL/CH	very stiff	125	1.3	23	1.08		100			1.61	>10
6.70	22.0	29.51	4.99 3	3	Clay	CL/CH	very stiff	125	1.3	24	1.07		95			1.68	>10
6.85	22.5	22.69	4.82 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.06		100			1.28	>10
7.00	23.0	16.07	3.68 4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	1.05		100			0.89	7.13
7.18	23.5	24.41	6.77 3	3	Clay	CL/CH	very stiff	125	1.3	20	1.04		100			1.38	>10
7.33	24.0	19.57	6.71 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.04		100			1.09	7.27
7.48	24.5	15.33	4.34 3	3	Clay	CL/CH	stiff	125	1.3	12	1.03		100			0.84	4.78
7.63	25.0	15.32	4.48 3	3	Clay	CL/CH	stiff	125	1.3	12	1.02		100			0.84	4.57
7.78	25.5	19.77	5.44 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.01		100			1.10	6.76
7.93	26.0	27.86	5.20 3	3	Clay	CL/CH	very stiff	125	1.3	22	1.00		100			1.58	>10
8.08	26.5	30.70	5.18 3	3	Clay	CL/CH	very stiff	125	1.3	25	1.00		100			1.74	>10
8.23	27.0	20.02	3.46 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.99		100			1.11	>10
8.38	27.5	23.97	4.23 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	14	0.98		100			1.35	>10
8.53	28.0	32.26	3.97 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	13	0.98		90			1.83	>10
8.68	28.5	29.55	3.18 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.97		90			1.67	>10
8.85	29.0	27.80	2.91 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.96		90			1.57	>10
9.00	29.5	27.60	3.54 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.96		95			1.56	>10
9.15	30.0	23.44	3.56 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.95		100			1.31	>10

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: HWTP Expansion, Heber, CA Project No: LE06278 Date: 08/16/06

CONE SOUNDING: CPT-1

Est. GWT (ft): 9.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	1	Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17.0 Phi (deg.)	Su (tsf)	OCR
9.30	30.5	25.94	3.95	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	0.95		100			1.46	>10
9.45	31.0	36.98	3.24	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	15	0.94		85			2.10	>10
9.60	31.5	21.59	3.79	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	0.93		100			1.20	8.00
9.75	32.0	26.41	3.39	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.93		100			1.48	>10
9.90	32.5	26.96	3.40	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.92		100			1.51	>10
10.05	33.0	26.63	2.09	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	8	0.92	23.1	85	29	32		
10.20	33.5	28.46	3.15	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.91		95			1.60	>10
10.38	34.0	34.17	4.15	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	20	0.91		95			1.93	>10
10.53	34.5	27.35	3.60	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.90		100			1.53	>10
10.68	35.0	19.14	1.73	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.90	16.2	95	19	31		
10.83	35.5	21.21	2.45	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.89		100			1.17	9.39
10.98	36.0	29.93	3.45	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.89		100			1.68	>10
11.13	36.5	36.59	4.09	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	15	0.88		95			2.07	>10
11.28	37.0	39.12	4.37	4	4	Silty Clay to Clay	CL	hard	125	1.8	22	0.88		95			2.22	>10
11.43	37.5	34.14	4.29	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	20	0.87		100			1.93	>10
11.58	38.0	34.74	4.42	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	20	0.87		100			1.96	>10
11.73	38.5	38.14	4.09	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	15	0.86		95			2.16	>10
11.88	39.0	37.09	4.40	4	4	Silty Clay to Clay	CL	hard	125	1.8	21	0.86		100			2.10	>10
12.05	39.5	33.79	4.45	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	19	0.85		100			1.90	>10
12.20	40.0	22.87	2.02	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	7	0.85	18.4	100	22	31		
12.35	40.5	21.36	1.59	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	6	0.85	17.1	95	20	31		
12.50	41.0	23.67	3.24	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.84		100			1.30	9.19
12.65	41.5	68.79	3.28	6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	20	0.84	54.5	70	55	36		
12.80	42.0	62.16	3.63	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	25	0.83		75			3.57	>10
12.95	42.5	90.62	1.80	7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	20	0.83	71.2	50	62	37		
13.10	43.0	39.83	2.93	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	11	0.83	31.2	85	38	33		
13.25	43.5	21.24	2.12	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.82	16.5	100	19	31		
13.40	44.0	23.30	2.17	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	7	0.82	18.1	100	22	31		
13.58	44.5	24.15	2.82	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.82		100			1.33	8.56
13.73	45.0	36.16	3.15	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	14	0.81		95			2.03	>10
13.88	45.5	36.11	3.83	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	14	0.81		100			2.03	>10
14.03	46.0	30.51	4.30	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	17	0.81		100			1.70	8.85
14.18	46.5	29.89	4.62	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	17	0.80		100			1.66	8.27
14.33	47.0	29.15	4.21	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	17	0.80		100			1.62	7.85
14.48	47.5	46.55	3.76	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	19	0.79		90			2.64	>10
14.63	48.0	45.48	3.54	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	18	0.79		90			2.58	>10
14.78	48.5	37.20	3.72	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	15	0.79		100			2.09	>10
14.93	49.0	29.25	3.52	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.78		100			1.62	>10
15.10	49.5	33.37	2.67	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	10	0.78	24.7	95	31	32		
15.25	50.0	24.78	2.85	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.78		100			1.35	7.41

CLIENT: The Holt Group

PROJECT: Heber Water Treatment Plant Expansion, Heber, CA

LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric with 23 ton reaction weight

DATE: 08/16/05

LOG OF CONE SOUNDING DATA CPT-2

INTERPRETED SOIL PROFILE From Robertson & Campanella (1989)		
GROUND EL +/-		
Sand to Silty Sand	SP/SM	very dense
Sandy Silt to Clayey Silt	ML	dense
Sandy Silt to Clayey Silt	" "	very dense
Sandy Silt to Clayey Silt	" "	dense
Clay	CL/CH	hard
Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	stiff
Clay	CL/CH	stiff
Clay	" "	very stiff
Clay	" "	stiff
Silty Clay to Clay	CL	stiff
Clay	CL/CH	very stiff
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	medium dense
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	very stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clay	CL/CH	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clay	CL/CH	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	very stiff
Silty Clay to Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	very stiff
Clay	CL/CH	very stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	stiff
Clay	CL/CH	very stiff
Clay	" "	hard
Clayey Silt to Silty Clay	ML/CL	very stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	medium dense
Clayey Silt to Silty Clay	ML/CL	very stiff
Sandy Silt to Clayey Silt	ML	medium dense
Sandy Silt to Clayey Silt	" "	medium dense
Clayey Silt to Silty Clay	ML/CL	very stiff
Clay	CL/CH	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clay	CL/CH	very stiff
Sandy Silt to Clayey Silt	ML	medium dense
Sand to Silty Sand	SP/SM	medium dense
Sand to Silty Sand	" "	medium dense
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	very stiff
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Sandy Silt to Clayey Silt	ML	loose
Sandy Silt to Clayey Silt	" "	loose
Sandy Silt to Clayey Silt	" "	very loose
Sandy Silt to Clayey Silt	" "	very loose
Sandy Silt to Clayey Silt	" "	very loose
Sandy Silt to Clayey Silt	" "	very loose
Sandy Silt to Clayey Silt	" "	very loose
Sandy Silt to Clayey Silt	" "	medium dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Clayey Silt to Silty Clay	ML/CL	hard
Clayey Silt to Silty Clay	" "	hard
Sandy Silt to Clayey Silt	ML	very loose
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Clayey Silt to Silty Clay	ML/CL	hard
Clayey Silt to Silty Clay	" "	hard
Sandy Silt to Clayey Silt	ML	medium dense
Silty Sand to Sandy Silt	SM/ML	dense
Silty Sand to Sandy Silt	" "	medium dense
Sandy Silt to Clayey Silt	ML	medium dense
Silty Sand to Sandy Silt	SM/ML	dense
Silty Sand to Sandy Silt	" "	dense

End of Sounding @ 84 ft

Project No: LE06278

LANDMARK Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate B-2

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: HWTP Expansion, Heber, CA Project No: LE06278 Date: 08/16/06

CONE SOUNDING: CPT-2

Est. GWT (ft): 9.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17.0 Phi (deg.)	Su (tsf)	OCR
0.15	0.5	102.61	1.13 8	8	Sand to Silty Sand	SP/SM	very dense	115	5.5	19	2.00	194.0	15	135	47		
0.30	1.0	70.76	1.76 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	16	2.00	133.8	30	108	43		
0.45	1.5	46.35	1.55 7	7	Silty Sand to Sandy Silt	SM/ML	dense	115	4.5	10	2.00	87.6	35	88	40		
0.60	2.0	34.67	2.65 6	6	Sandy Silt to Clayey Silt	ML	dense	115	3.5	10	2.00	65.5	50	74	38		
0.75	2.5	94.43	3.27 6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	27	2.00	178.5	35	100	42		
0.93	3.0	86.79	2.75 6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	25	2.00	164.1	35	95	41		
1.08	3.5	59.11	2.37 6	6	Sandy Silt to Clayey Silt	ML	dense	115	3.5	17	2.00	111.7	40	81	39		
1.23	4.0	58.94	4.09 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	24	2.00		50			3.45	>10
1.38	4.5	41.85	5.54 3	3	Clay	CL/CH	hard	125	1.3	33	2.00		65			2.45	>10
1.53	5.0	31.01	4.62 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	1.95		70			1.81	>10
1.68	5.5	26.65	4.80 3	3	Clay	CL/CH	very stiff	125	1.3	21	1.85		75			1.55	>10
1.83	6.0	21.66	4.62 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.76		80			1.25	>10
1.98	6.5	20.60	4.39 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.69		80			1.19	>10
2.13	7.0	18.59	4.04 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.62		80			1.07	>10
2.28	7.5	18.49	3.66 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.56		80			1.06	>10
2.45	8.0	14.32	3.86 4	4	Silty Clay to Clay	CL	stiff	125	1.8	8	1.51		90			0.81	>10
2.60	8.5	15.13	4.46 3	3	Clay	CL/CH	stiff	125	1.3	12	1.46		90			0.86	>10
2.75	9.0	16.05	4.58 3	3	Clay	CL/CH	stiff	125	1.3	13	1.42		95			0.91	>10
2.90	9.5	18.09	4.50 3	3	Clay	CL/CH	very stiff	125	1.3	14	1.39		90			1.03	>10
3.05	10.0	17.42	4.26 3	3	Clay	CL/CH	stiff	125	1.3	14	1.38		90			0.99	>10
3.20	10.5	17.56	4.63 3	3	Clay	CL/CH	stiff	125	1.3	14	1.36		95			1.00	>10
3.35	11.0	16.82	4.78 3	3	Clay	CL/CH	stiff	125	1.3	13	1.34		95			0.95	>10
3.50	11.5	16.35	4.02 4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	1.32		95			0.93	>10
3.65	12.0	18.66	3.73 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.30		85			1.06	>10
3.80	12.5	19.13	4.12 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.29		90			1.09	>10
3.95	13.0	16.27	4.81 3	3	Clay	CL/CH	stiff	125	1.3	13	1.27		100			0.92	>10
4.13	13.5	10.77	3.09 4	4	Silty Clay to Clay	CL	stiff	125	1.8	6	1.26		100			0.59	6.65
4.28	14.0	12.78	3.13 4	4	Silty Clay to Clay	CL	stiff	125	1.8	7	1.24		100			0.71	8.70
4.43	14.5	17.44	4.03 4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	1.23		95			0.98	>10
4.58	15.0	16.13	3.55 4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	1.22		95			0.91	>10
4.73	15.5	17.13	3.14 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	1.20		90			0.96	>10
4.88	16.0	18.03	3.77 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	10	1.19		95			1.02	>10
5.03	16.5	34.38	3.95 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	14	1.18		75			1.98	>10
5.18	17.0	46.54	1.93 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	10	1.17	51.4	50	53	35		
5.33	17.5	17.36	3.78 4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	1.16		100			0.97	>10
5.48	18.0	18.22	4.06 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	10	1.15		100			1.02	>10
5.65	18.5	18.21	4.43 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.14		100			1.02	9.00
5.80	19.0	19.37	5.46 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.12		100			1.09	9.79
5.95	19.5	24.41	6.87 3	3	Clay	CL/CH	very stiff	125	1.3	20	1.11		100			1.39	>10
6.10	20.0	25.61	6.68 3	3	Clay	CL/CH	very stiff	125	1.3	20	1.10		100			1.46	>10
6.25	20.5	46.97	3.32 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	19	1.09		65			2.71	>10
6.40	21.0	19.73	4.21 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.09		100			1.11	>10
6.55	21.5	22.91	3.93 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	13	1.08		95			1.29	>10
6.70	22.0	22.01	5.44 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.07		100			1.24	>10
6.85	22.5	23.02	4.92 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.06		100			1.30	>10
7.00	23.0	18.43	4.20 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.05		100			1.03	9.19
7.18	23.5	26.04	5.75 3	3	Clay	CL/CH	very stiff	125	1.3	21	1.04		100			1.47	>10
7.33	24.0	25.80	4.19 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	1.03		95			1.46	>10
7.48	24.5	24.94	3.77 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	14	1.02		95			1.41	>10
7.63	25.0	28.19	4.02 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	16	1.02		95			1.60	>10
7.78	25.5	23.51	4.94 3	3	Clay	CL/CH	very stiff	125	1.3	19	1.01		100			1.32	9.39
7.93	26.0	29.94	6.47 3	3	Clay	CL/CH	very stiff	125	1.3	24	1.00		100			1.70	>10
8.08	26.5	22.15	5.51 3	3	Clay	CL/CH	very stiff	125	1.3	18	0.99		100			1.24	7.85
8.23	27.0	26.93	4.31 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	0.99		100			1.52	>10
8.38	27.5	17.14	3.97 4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	0.98		100			0.94	6.32
8.53	28.0	11.86	3.76 3	3	Clay	CL/CH	stiff	125	1.3	9	0.97		100			0.63	2.82
8.68	28.5	18.68	3.98 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.97		100			1.03	7.00
8.85	29.0	24.74	3.74 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.96		100			1.39	>10
9.00	29.5	19.79	3.89 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.95		100			1.10	7.41
9.15	30.0	14.97	3.07 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.95		100			0.81	6.21

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: HWTP Expansion, Heber, CA Project No: LE06278 Date: 08/16/06

CONE SOUNDING: CPT-2

Est. GWT (ft): 9.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17.0 Phi (deg.)	Su (tsf)	OCR
9.30	30.5	13.14	2.46 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	5	0.94		100			0.70	4.89
9.45	31.0	15.39	3.13 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.94		100			0.83	6.21
9.60	31.5	23.85	3.99 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	14	0.93		100			1.33	9.59
9.75	32.0	27.27	2.90 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.93		95			1.53	>10
9.90	32.5	16.31	3.11 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.92		100			0.89	6.43
10.05	33.0	17.60	2.58 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.91		100			0.96	7.13
10.20	33.5	18.97	3.24 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.91		100			1.04	8.14
10.38	34.0	21.88	3.27 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.90		100			1.21	>10
10.53	34.5	27.17	4.72 3	3	Clay	CL/CH	very stiff	125	1.3	22	0.90		100			1.52	8.00
10.68	35.0	26.60	5.29 3	3	Clay	CL/CH	very stiff	125	1.3	21	0.89		100			1.49	7.41
10.83	35.5	20.14	4.80 3	3	Clay	CL/CH	very stiff	125	1.3	16	0.89		100			1.11	4.57
10.98	36.0	18.08	2.81 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.88		100			0.98	6.65
11.13	36.5	14.10	2.65 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.88		100			0.75	4.37
11.28	37.0	17.57	3.99 4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	0.87		100			0.95	4.47
11.43	37.5	19.06	4.16 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.87		100			1.04	5.10
11.58	38.0	23.82	5.34 3	3	Clay	CL/CH	very stiff	125	1.3	19	0.86		100			1.32	5.53
11.73	38.5	33.94	5.75 3	3	Clay	CL/CH	very stiff	125	1.3	27	0.86		100			1.91	>10
11.88	39.0	38.66	5.39 3	3	Clay	CL/CH	hard	125	1.3	31	0.86		100			2.19	>10
12.05	39.5	34.07	4.52 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	19	0.85		100			1.92	>10
12.20	40.0	22.04	2.01 6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	6	0.85	17.6	100	21	31		
12.35	40.5	20.07	1.75 6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.84	16.0	100	18	31		
12.50	41.0	22.30	2.11 6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	6	0.84	17.7	100	21	31		
12.65	41.5	64.46	1.93 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	14	0.84	50.9	60	53	35		
12.80	42.0	54.77	2.83 6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	16	0.83	43.0	75	48	35		
12.95	42.5	28.08	3.77 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.83		100			1.56	>10
13.10	43.0	39.57	3.37 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	16	0.82		90			2.24	>10
13.25	43.5	59.85	3.32 6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	17	0.82	46.4	75	50	35		
13.40	44.0	91.32	2.07 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	20	0.82	70.5	50	62	37		
13.58	44.5	85.51	1.87 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	19	0.81	65.8	50	60	36		
13.73	45.0	29.69	3.88 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.81		100			1.65	>10
13.88	45.5	26.97	3.45 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.81		100			1.49	>10
14.03	46.0	25.12	4.19 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	14	0.80		100			1.38	6.21
14.18	46.5	23.27	4.86 3	3	Clay	CL/CH	very stiff	125	1.3	19	0.80		100			1.27	4.18
14.33	47.0	17.61	4.29 3	3	Clay	CL/CH	stiff	125	1.3	14	0.80		100			0.94	2.73
14.48	47.5	29.09	3.46 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.79		100			1.61	>10
14.63	48.0	39.08	3.63 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	16	0.79		100			2.20	>10
14.78	48.5	25.72	4.02 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	0.78		100			1.41	6.00
14.93	49.0	32.85	3.66 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	13	0.78		100			1.83	>10
15.10	49.5	20.50	2.68 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.78		100			1.10	5.42
15.25	50.0	18.35	2.37 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.78		100			0.98	4.37
15.40	50.5	29.36	3.06 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.77		100			1.62	>10
15.55	51.0	25.18	4.27 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	14	0.77		100			1.38	5.31
15.70	51.5	33.81	2.77 6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	10	0.77	24.5	100	31	32		
15.85	52.0	28.15	2.96 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.76		100			1.55	8.70
16.00	52.5	26.26	2.43 6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	8	0.76	18.9	100	23	31		
16.15	53.0	30.87	3.51 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.76		100			1.71	>10
16.30	53.5	33.88	5.46 3	3	Clay	CL/CH	very stiff	125	1.3	27	0.75		100			1.88	6.32
16.45	54.0	37.45	5.15 3	3	Clay	CL/CH	hard	125	1.3	30	0.75		100			2.09	7.41
16.60	54.5	49.68	4.04 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	20	0.75		95			2.81	>10
16.78	55.0	102.69	1.88 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	23	0.75	72.3	50	63	37		
16.93	55.5	125.83	1.54 8	8	Sand to Silty Sand	SP/SM	medium dense	115	5.5	23	0.74	88.3	40	69	38		
17.08	56.0	125.36	1.75 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	28	0.74	87.7	45	69	38		
17.23	56.5	128.51	1.59 8	8	Sand to Silty Sand	SP/SM	medium dense	115	5.5	23	0.74	89.6	45	69	38		
17.38	57.0	116.53	1.53 8	8	Sand to Silty Sand	SP/SM	medium dense	115	5.5	21	0.74	81.0	45	66	37		
17.53	57.5	63.29	2.21 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	14	0.73	43.8	70	48	35		
17.68	58.0	22.31	2.13 6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.73	15.4	100	17	30		
17.83	58.5	30.27	2.77 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.73		100			1.66	8.41
17.98	59.0	37.14	3.10 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	15	0.73		100			2.07	>10
18.13	59.5	79.22	2.95 6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	23	0.72	54.1	70	54	36		
18.30	60.0	134.25	2.22 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	30	0.72	91.4	50	70	38		
18.45	60.5	164.84	1.77 8	8	Sand to Silty Sand	SP/SM	dense	115	5.5	30	0.72	111.9	40	76	39		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: HWTP Expansion, Heber, CA Project No: LE06278 Date: 08/16/06

CONE SOUNDING: CPT-2

Est. GWT (ft): 9.0 Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: **17.0** Phi (deg.)	Su (tsf)	OCR
18.60	61.0	81.17	3.44	6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	23	0.72	54.9	75	55	36		
18.75	61.5	29.22	2.39	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	8	0.71	19.7	100	25	31		
18.90	62.0	25.69	2.09	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	7	0.71	17.3	100	21	31		
19.05	62.5	34.10	2.00	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	10	0.71	22.9	95	29	32		
19.20	63.0	23.55	1.63	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	7	0.71	15.7	100	18	31		
19.35	63.5	22.01	1.33	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.70	14.7	100	16	30		
19.50	64.0	24.24	1.63	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	7	0.70	16.1	100	19	31		
19.65	64.5	22.77	1.61	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	7	0.70	15.1	100	17	30		
19.80	65.0	26.94	1.93	6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	8	0.70	17.8	100	21	31		
19.98	65.5	21.73	1.74	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.70	14.3	100	15	30		
20.13	66.0	21.86	1.98	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.69	14.3	100	15	30		
20.28	66.5	21.52	2.04	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.69	14.1	100	15	30		
20.43	67.0	21.55	1.92	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.69	14.1	100	15	30		
20.58	67.5	21.63	1.87	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.69	14.1	100	15	30		
20.73	68.0	21.00	2.12	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.69	13.6	100	14	30		
20.88	68.5	51.72	3.49	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	21	0.68		95			2.91	>10
21.03	69.0	97.64	2.47	7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	22	0.68	62.9	65	59	36		
21.18	69.5	110.06	2.09	7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	24	0.68	70.7	55	62	37		
21.33	70.0	104.02	2.05	7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	23	0.68	66.6	60	60	36		
21.50	70.5	73.31	3.71	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	29	0.68		85			4.18	>10
21.65	71.0	29.48	2.97	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.67		100			1.60	6.10
21.80	71.5	40.22	3.69	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	16	0.67		100			2.23	>10
21.95	72.0	37.27	3.89	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	15	0.67		100			2.05	9.19
22.10	72.5	24.22	2.30	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	7	0.67	15.3	100	17	30		
22.25	73.0	23.55	2.24	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	7	0.67	14.8	100	16	30		
22.40	73.5	78.61	2.88	6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	22	0.66	49.3	80	52	35		
22.55	74.0	145.33	2.43	7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	32	0.66	90.9	55	70	38		
22.70	74.5	149.18	1.76	8	8	Sand to Silty Sand	SP/SM	dense	115	5.5	27	0.66	93.1	45	70	38		
22.85	75.0	64.71	3.78	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	26	0.66		95			3.66	>10
23.00	75.5	35.73	4.78	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	20	0.66		100			1.96	5.65
23.18	76.0	80.52	3.27	6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	23	0.65	49.8	80	52	35		
23.33	76.5	53.94	3.83	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	22	0.65		100			3.03	>10
23.48	77.0	57.56	3.28	6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	16	0.65	35.4	95	42	34		
23.63	77.5	53.14	4.16	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	21	0.65		100			2.98	>10
23.78	78.0	139.99	2.22	7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	31	0.65	85.6	55	68	38		
23.93	78.5	163.50	2.37	7	7	Silty Sand to Sandy Silt	SM/ML	dense	115	4.5	36	0.65	99.8	50	72	38		
24.08	79.0	151.77	2.75	7	7	Silty Sand to Sandy Silt	SM/ML	dense	115	4.5	34	0.64	92.4	60	70	38		
24.23	79.5	168.74	1.73	8	8	Sand to Silty Sand	SP/SM	dense	115	5.5	31	0.64	102.4	45	73	38		
24.38	80.0	73.40	3.84	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	29	0.64		90			4.17	>10
24.53	80.5	47.16	3.80	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	19	0.64		100			2.62	>10
24.68	81.0	119.33	3.46	6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	34	0.64	71.9	70	63	37		
24.83	81.5	279.26	2.28	7	7	Silty Sand to Sandy Silt	SM/ML	dense	115	4.5	62	0.64	167.7	40	88	40		
24.98	82.0	262.19	2.83	7	7	Silty Sand to Sandy Silt	SM/ML	dense	115	4.5	58	0.63	157.1	45	86	40		
25.13	82.5	270.20	2.39	7	7	Silty Sand to Sandy Silt	SM/ML	dense	115	4.5	60	0.63	161.5	40	87	40		
25.28	83.0	185.60	2.52	7	7	Silty Sand to Sandy Silt	SM/ML	dense	115	4.5	41	0.63	110.6	50	75	39		
25.43	83.5	140.15	2.29	7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	31	0.63	83.3	55	67	37		

CLIENT: The Holt Group

PROJECT: Heber Water Treatment Plant Expansion, Heber, CA

LOCATION: See Site and Boring Location Plan

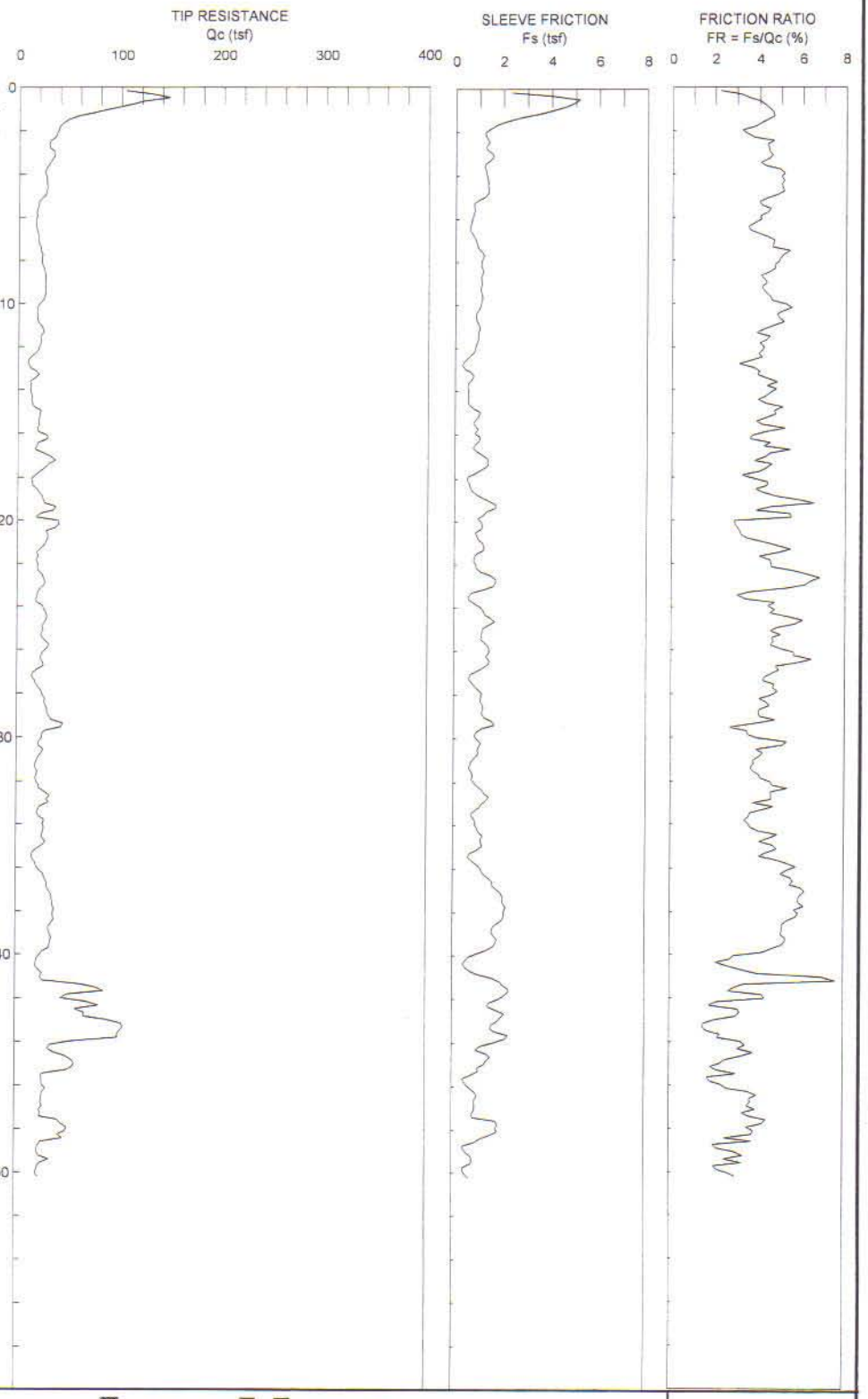
CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric Cone with 23 ton reaction weight

DATE: 08/16/06

LOG OF CONE SOUNDING DATA CPT-3

DEPTH (FEET)	INTERPRETED SOIL PROFILE From Robertson & Campanella (1989)		
	GROUND EL. +/-		
	Sandy Silt to Clayey Silt	ML	very dense
	Clayey Silt to Silty Clay	ML/CL	hard
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Clay	CL/CH	very stiff
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Clay	CL/CH	very stiff
	Silty Clay to Clay	CL	very stiff
10	Silty Clay to Clay	" "	very stiff
	Clay	CL/CH	very stiff
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	very stiff
	Clay	CL/CH	very stiff
20	Silty Clay to Clay	CL	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clay	CL/CH	very stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
30	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	very stiff
	Clay	CL/CH	stiff
	Clay	" "	very stiff
	Clay	" "	hard
	Clay	" "	very stiff
40	Silty Clay to Clay	CL	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	hard
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Sandy Silt to Clayey Silt	" "	loose
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	hard
	Clayey Silt to Silty Clay	" "	very stiff
50	Clayey Silt to Silty Clay	" "	very stiff

End of Sounding @ 50.0 ft.



Project No: LE06278

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate B-3

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: HWTP Expansion, Heber, CA Project No: LE06278 Date: 08/16/06

CONE SOUNDING: CPT-3

Est. GWT (ft): 9.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	1	Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17.0 Phi (deg.)	Su (tsf)	OCR
0.15	0.5	126.42	2.94	6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	36	2.00	239.0	30	141	48		
0.30	1.0	106.88	4.24	11	11	Overconsolidated Soil	??	very dense	120	1.0	107	2.00	202.0	40	120	45		
0.45	1.5	60.19	4.53	4	4	Silty Clay to Clay	CL	hard	125	1.8	34	2.00		55			3.54	>10
0.60	2.0	39.84	3.67	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	16	2.00		55			2.34	>10
0.75	2.5	33.87	3.92	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	14	2.00		60			1.98	>10
0.93	3.0	30.94	4.38	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	2.00		70			1.81	>10
1.08	3.5	32.20	4.33	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	2.00		65			1.88	>10
1.23	4.0	26.31	4.77	3	3	Clay	CL/CH	very stiff	125	1.3	21	2.00		75			1.53	>10
1.38	4.5	26.67	5.03	3	3	Clay	CL/CH	very stiff	125	1.3	21	2.00		75			1.55	>10
1.53	5.0	26.51	4.98	3	3	Clay	CL/CH	very stiff	125	1.3	21	1.91		75			1.54	>10
1.68	5.5	19.40	4.22	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.81		80			1.12	>10
1.83	6.0	16.80	4.14	4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	1.73		85			0.97	>10
1.98	6.5	16.79	3.60	4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	1.66		80			0.97	>10
2.13	7.0	18.60	4.31	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.60		85			1.07	>10
2.28	7.5	20.60	4.87	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.54		85			1.19	>10
2.45	8.0	22.59	4.98	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.49		80			1.30	>10
2.60	8.5	24.32	4.60	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.44		80			1.40	>10
2.75	9.0	25.82	4.20	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	1.40		75			1.49	>10
2.90	9.5	25.70	4.19	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	1.38		75			1.48	>10
3.05	10.0	22.89	4.76	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.36		85			1.31	>10
3.20	10.5	17.87	5.10	3	3	Clay	CL/CH	very stiff	125	1.3	14	1.34		95			1.02	>10
3.35	11.0	19.47	4.91	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.32		95			1.11	>10
3.50	11.5	23.52	4.17	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	13	1.31		80			1.35	>10
3.65	12.0	21.26	4.17	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	1.29		85			1.21	>10
3.80	12.5	16.49	4.07	4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	1.28		95			0.93	>10
3.95	13.0	10.26	3.47	4	4	Silty Clay to Clay	CL	stiff	125	1.8	6	1.26		100			0.56	6.21
4.13	13.5	17.61	4.08	4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	1.25		95			1.00	>10
4.28	14.0	11.75	4.64	3	3	Clay	CL/CH	stiff	125	1.3	9	1.23		100			0.65	5.53
4.43	14.5	12.89	4.24	3	3	Clay	CL/CH	stiff	125	1.3	10	1.22		100			0.72	6.21
4.58	15.0	16.97	4.68	3	3	Clay	CL/CH	stiff	125	1.3	14	1.21		100			0.96	>10
4.73	15.5	20.49	4.30	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	1.19		95			1.16	>10
4.88	16.0	21.72	4.32	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	1.18		95			1.23	>10
5.03	16.5	21.90	4.10	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	13	1.17		90			1.24	>10
5.18	17.0	24.49	4.72	3	3	Clay	CL/CH	very stiff	125	1.3	20	1.16		95			1.39	>10
5.33	17.5	30.91	4.23	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	1.15		85			1.77	>10
5.48	18.0	17.30	3.69	4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	1.13		100			0.97	>10
5.65	18.5	15.73	4.19	3	3	Clay	CL/CH	stiff	125	1.3	13	1.12		100			0.88	6.65
5.80	19.0	23.20	4.92	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.11		100			1.31	>10
5.95	19.5	32.74	5.00	3	3	Clay	CL/CH	very stiff	125	1.3	26	1.10		90			1.87	>10
6.10	20.0	26.34	4.60	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	1.09		95			1.50	>10
6.25	20.5	35.03	3.04	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	14	1.08		70			2.01	>10
6.40	21.0	28.91	3.62	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	1.08		85			1.65	>10
6.55	21.5	22.29	5.05	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.07		100			1.26	>10
6.70	22.0	19.52	4.36	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.06		100			1.09	7.85
6.85	22.5	21.28	5.45	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.05		100			1.20	8.85
7.00	23.0	26.17	6.46	3	3	Clay	CL/CH	very stiff	125	1.3	21	1.04		100			1.48	>10
7.18	23.5	20.69	3.97	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	1.03		100			1.16	>10
7.33	24.0	20.46	4.20	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	1.02		100			1.14	>10
7.48	24.5	27.66	4.88	3	3	Clay	CL/CH	very stiff	125	1.3	22	1.02		100			1.57	>10
7.63	25.0	26.13	5.53	3	3	Clay	CL/CH	very stiff	125	1.3	21	1.01		100			1.48	>10
7.78	25.5	24.24	4.72	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.00		100			1.36	9.59
7.93	26.0	29.35	4.75	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	17	0.99		100			1.66	>10
8.08	26.5	24.28	5.90	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.99		100			1.36	9.00
8.23	27.0	20.30	4.78	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.98		100			1.13	6.43
8.38	27.5	16.38	4.40	3	3	Clay	CL/CH	stiff	125	1.3	13	0.97		100			0.90	4.47
8.53	28.0	23.09	4.72	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.97		100			1.29	7.70
8.68	28.5	27.18	4.31	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	16	0.96		100			1.53	>10
8.85	29.0	30.02	4.04	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	17	0.95		95			1.70	>10
9.00	29.5	40.46	3.75	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	16	0.95		85			2.31	>10
9.15	30.0	25.44	3.67	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.94		100			1.43	>10

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: HWTP Expansion, Heber, CA Project No: LE06278 Date: 08/16/06

CONE SOUNDING: CPT-3

Est. GWT (ft): 9.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17.0 Phi (deg.)	Su (tsf)	OCR
9.30	30.5	22.68	4.78 3	3	Clay	CL/CH	very stiff	125	1.3	18	0.94		100			1.26	6.65
9.45	31.0	21.89	4.02 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	13	0.93		100			1.22	8.14
9.60	31.5	18.68	3.75 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.92		100			1.03	6.00
9.75	32.0	19.01	4.24 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.92		100			1.04	6.10
9.90	32.5	23.91	4.86 3	3	Clay	CL/CH	very stiff	125	1.3	19	0.91		100			1.33	6.65
10.05	33.0	31.14	4.32 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	0.91		100			1.76	>10
10.20	33.5	21.33	4.17 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	0.90		100			1.18	6.88
10.38	34.0	25.25	3.52 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.90		100			1.41	>10
10.53	34.5	26.29	4.22 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	0.89		100			1.47	9.79
10.68	35.0	26.53	4.45 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	0.89		100			1.48	9.79
10.83	35.5	17.07	4.45 3	3	Clay	CL/CH	stiff	125	1.3	14	0.88		100			0.92	3.50
10.98	36.0	18.06	5.29 3	3	Clay	CL/CH	stiff	125	1.3	14	0.88		100			0.98	3.74
11.13	36.5	26.40	5.39 3	3	Clay	CL/CH	very stiff	125	1.3	21	0.87		100			1.47	6.76
11.28	37.0	30.87	5.89 3	3	Clay	CL/CH	very stiff	125	1.3	25	0.87		100			1.73	8.70
11.43	37.5	35.13	5.92 3	3	Clay	CL/CH	very stiff	125	1.3	28	0.86		100			1.98	>10
11.58	38.0	36.58	5.91 3	3	Clay	CL/CH	hard	125	1.3	29	0.86		100			2.07	>10
11.73	38.5	35.95	5.46 3	3	Clay	CL/CH	hard	125	1.3	29	0.85		100			2.03	>10
11.88	39.0	32.39	5.12 3	3	Clay	CL/CH	very stiff	125	1.3	26	0.85		100			1.82	8.85
12.05	39.5	34.08	5.24 3	3	Clay	CL/CH	very stiff	125	1.3	27	0.84		100			1.92	9.59
12.20	40.0	26.90	3.96 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	15	0.84		100			1.49	8.14
12.35	40.5	19.83	2.53 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.83		100			1.08	6.43
12.50	41.0	23.98	4.76 3	3	Clay	CL/CH	very stiff	125	1.3	19	0.83		100			1.32	4.89
12.65	41.5	54.98	4.68 4	4	Silty Clay to Clay	CL	hard	125	1.8	31	0.83		90			3.14	>10
12.80	42.0	60.15	3.77 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	24	0.82		80			3.45	>10
12.95	42.5	69.39	2.39 6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	20	0.82	53.7	65	54	36		
13.10	43.0	74.20	2.80 6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	21	0.82	57.2	65	56	36		
13.25	43.5	103.64	1.61 7	7	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4.5	23	0.81	79.5	45	66	37		
13.40	44.0	84.20	2.62 6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	24	0.81	64.3	60	59	36		
13.58	44.5	34.41	3.48 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	14	0.81		100			1.93	>10
13.73	45.0	53.73	2.75 6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	15	0.80	40.7	75	46	34		
13.88	45.5	44.41	2.39 6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	13	0.80	33.5	80	40	34		
14.03	46.0	26.14	2.01 6	6	Sandy Silt to Clayey Silt	ML	loose	115	3.5	7	0.80	19.6	100	24	31		
14.18	46.5	27.86	3.44 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.79		100			1.54	>10
14.33	47.0	25.40	3.74 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.79		100			1.39	8.27
14.48	47.5	30.02	3.82 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	12	0.79		100			1.67	>10
14.63	48.0	48.47	3.91 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	19	0.78		90			2.75	>10
14.78	48.5	37.77	3.39 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	15	0.78		100			2.12	>10
14.93	49.0	22.20	2.43 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.78		100			1.20	6.10
15.10	49.5	27.34	3.09 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.77		100			1.50	8.70
15.25	50.0	21.34	2.34 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.77		100			1.15	5.53

CLIENT: The Holt Group
METHOD OF DRILLING: CME 55 w/autohammer
PROJECT Heber Water Treatment Plant Expansion, Heber, CA
DATE OBSERVED 07/31/06
LOCATION: See Site and Exploration Plan
LOGGED BY: J.R. Avalos

LOG OF BORING B-1

SHEET 1 OF 1

DEPTH	CLASSIFICATION	SAMPLE TYPE	BLOWS/FOOT **	POCKET PEN. (TSF)	DESCRIPTION OF MATERIAL SURFACE ELEV. +/-	MOISTURE CONTENT (%)	DRY UNIT WT. (PCF)	UNCONFINED COMPRESSION (TSF)	LIQUID LIMIT	PLASTICITY INDEX	PASSING #200
					SILTY CLAY (CL): Light brown, moist, medium plasticity				45	30	
5			22	3.50	CLAY (CL-CH): Reddish brown, very moist, stiff to very stiff consistency, medium to high plasticity	19.9	105.4				
					Anticipated groundwater level @ 9 ft.						
10			24	4.00		29.7	92.4				
15			14	2.50		29.7	95.6				
20			17	3.00	Thin interbedded silty sand layer	28.3	96.8				
25			7	4.00					56	39	
30			19	3.00		27.8	96.8				
35			7	2.00					48	32	
40			18	2.50		27.2	96.2				

Groundwater encountered at 24.3 ft at the time of exploration
** Blows not corrected for overburden pressure, sampler size or increase drive energy for automatic hammers.

Project No: LE06278

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Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate B-4

CLIENT: The Holt Group
METHOD OF DRILLING: CME 55 w/autohammer
PROJECT Heber Water Treatment Plant Expansion, Heber, CA
DATE OBSERVED 07/31/06
LOCATION: See Site and Exploration Plan
LOGGED BY: J.R. Avalos

LOG OF BORING B-1

SHEET 1 OF 1

DEPTH	CLASSIFICATION	SAMPLE TYPE	BLOWS/FOOT **	POCKET PEN. (TSF)	DESCRIPTION OF MATERIAL SURFACE ELEV. +/-	MOISTURE CONTENT (%)	DRY UNIT WT. (PCF)	UNCONFINED COMPRESSION (TSF)	LIQUID LIMIT	PLASTICITY INDEX	PASSING #200
			6	4.00	CLAY (CL-CH): Reddish brown, very moist, medium stiff to stiff consistency, medium to high plasticity, thin interbedded clayey silt layer						
50			5	0.75	SILTY CLAY (CL): Brown, very moist, medium stiff consistency, medium plasticity				41	25	
					End of Boring at 51.5 ft ** Blows not corrected for overburden pressure, sampler size or increase drive energy for automatic hammers.						
55											
60											
65											
70											
75											
80											
85											

CLIENT: The Holt Group
METHOD OF DRILLING: CME 55 w/autohammer
PROJECT Heber Water Treatment Plant Expansion, Heber, CA
DATE OBSERVED 07/31/06
LOCATION: See Site and Exploration Plan
LOGGED BY: J.R. Avalos

LOG OF BORING B-2

SHEET 1 OF 1

DEPTH	CLASSIFICATION	SAMPLE TYPE	BLOWS/FOOT **	POCKET PEN. (TSF)	DESCRIPTION OF MATERIAL SURFACE ELEV. +/-	MOISTURE CONTENT (%)	DRY UNIT WT. (PCF)	UNCONFINED COMPRESSION (TSF)	LIQUID LIMIT	PLASTICITY INDEX	PASSING #200
			8	3.00	SILTY CLAY (CL): Light brown, moist, medium plasticity	17.3			44	30	
5			18	2.00	CLAY (CL-CH): Reddish brown, very moist, stiff to very stiff consistency, high plasticity Anticipated groundwater level @ 9 ft.	31.6	90.3				
10			17	2.00		26.6	98.2				
15			20	3.00		25.9	101.0		50	33	
20			17	4.50		25.8	101.7				
25			5	3.00					53	36	
30			23	3.00		26.8	98.6				
35			6	3.00							
40			15	2.50	CLAYEY SILT (ML): Brown, saturated, medium dense Groundwater encountered at 21.4 ft at the time of exploration	27.4	100.3		34	---	

Project No: LE06278

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Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate B-5

CLIENT: The Holt Group
METHOD OF DRILLING: CME 55 w/autohammer
PROJECT Heber Water Treatment Plant Expansion, Heber, CA
DATE OBSERVED 07/31/06
LOCATION: See Site and Exploration Plan
LOGGED BY: J.R. Avalos

LOG OF BORING B-2

SHEET 1 OF 1

DEPTH	CLASSIFICATION	SAMPLE TYPE	BLOWS/FOOT **	POCKET PEN. (TSF)	DESCRIPTION OF MATERIAL SURFACE ELEV. +/-	MOISTURE CONTENT (%)	DRY UNIT WT. (PCF)	UNCONFINED COMPRESSION (TSF)	LIQUID LIMIT	PLASTICITY INDEX	PASSING #200
			7	2.50	SILTY CLAY (CL): Brown, very moist, stiff consistency medium plasticity						
50					End of Boring at 49.0 ft ** Blows not corrected for overburden pressure, sampler size or increase drive energy for automatic hammers.						
55											
60											
65											
70											
75											
80											
85											

CLIENT: The Holt Group
PROJECT: Heber Water Treatment Plant Expansion, Heber, CA
LOCATION: See Site and Exploration Plan

METHOD OF DRILLING: CME 55 w/autohammer
DATE OBSERVED: 07/31/06
LOGGED BY: J.R. Avalos

LOG OF BORING B-3

SHEET 1 OF 1

SURFACE ELEV. +/-

DEPTH	CLASSIFICATION	SAMPLE TYPE	BLOWS/FOOT **	POCKET PEN. (TSF)	DESCRIPTION OF MATERIAL	MOISTURE CONTENT (%)	DRY UNIT WT. (PCF)	UNCONFINED COMPRESSION (TSF)	LIQUID LIMIT	PLASTICITY INDEX	PASSING #200
					CLAY (CH): Brown, moist, high plasticity				62	42	
5			6	3.50	CLAY (CL-CH): Reddish brown, very moist, stiff to very stiff consistency, medium to high plasticity						
					Anticipated groundwater level @ 9 ft.						
10			26	3.00		25.0	101.8				
15			14	1.50					41	21	
20			10	2.50							
					End of Boring at 21.5 ft No groundwater was encountered ** Blows not corrected for overburden pressure, sampler size or increase drive energy for automatic hammers.						
25											
30											
35											
40											

Project No: LE06278

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Plate B-6

CLIENT: The Holt Group
PROJECT Heber Water Treatment Plant Expansion, Heber, CA
LOCATION: See Site and Exploration Plan

METHOD OF DRILLING: CME 55 w/autohammer
DATE OBSERVED 07/31/06
LOGGED BY: J.R. Avalos

LOG OF BORING B-4

SHEET 1 OF 1

DEPTH	CLASSIFICATION	SAMPLE TYPE	BLOWS/FOOT **	POCKET PEN. (TSF)	DESCRIPTION OF MATERIAL SURFACE ELEV. +/-	MOISTURE CONTENT (%)	DRY UNIT WT. (PCF)	UNCONFINED COMPRESSION (TSF)	LIQUID LIMIT	PLASTICITY INDEX	PASSING #200
					CLAY (CH): Brown, moist, high plasticity				53	36	
5			6	0.75	CLAY (CH): Reddish brown, very moist, firm consistency high plasticity	23.7	97.9				
					Groundwater encountered at 8.9 ft. (8-30-06)						
10			7	3.00	Stiff consistency				59	39	
15			14	2.00	SILTY CLAY (CL): Brown, very moist, stiff consistency, medium plasticity						
20			10	1.00		29.8	93.7		33	20	
25					End of Boring at 21.5 ft Groundwater encountered at 8.9 ft (8-30-06) ** Blows not corrected for overburden pressure, sampler size or increase drive energy for automatic hammers.						
30											
35											
40											

Project No: LE06278

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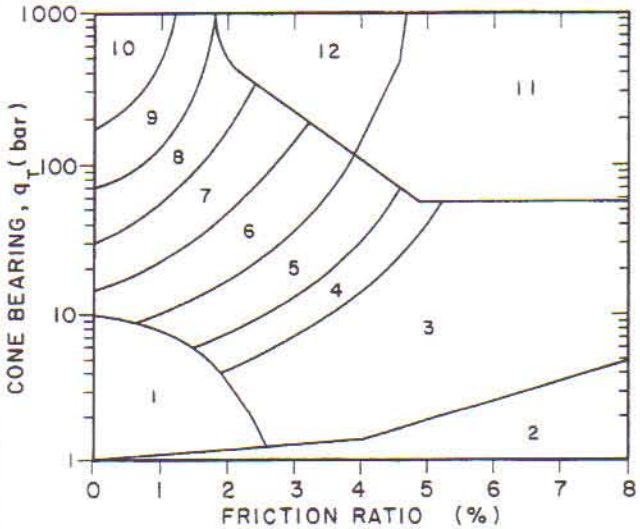
Plate B-7

Simplified Soil Classification Chart

After Robertson & Campanella (1989)



Geotechnical Parameters from CPT Data:

Equivalent SPT N(60) blow count = Qc/(Qc/N Ratio)

N1(60) = Cn*N(60) Normalized SPT blow count

Cn = 1/(p'o)^0.5 < 1.6 max. from Liao & Whitman (1986)

p'o = effective overburden pressure (tsf) using unit densities given below and estimated groundwater table.

Dr = Relative density (%) from Jamiolkowski et. al. (1986) relationship

= -98 +68*log(Qc/p'o^0.5) where Qc, p'o in tonne/sqm

Note: 1 tonne/sqm = 0.1024 tsf, 1 bar =1.0443 tsf

Phi = Friction Angle estimated from either:

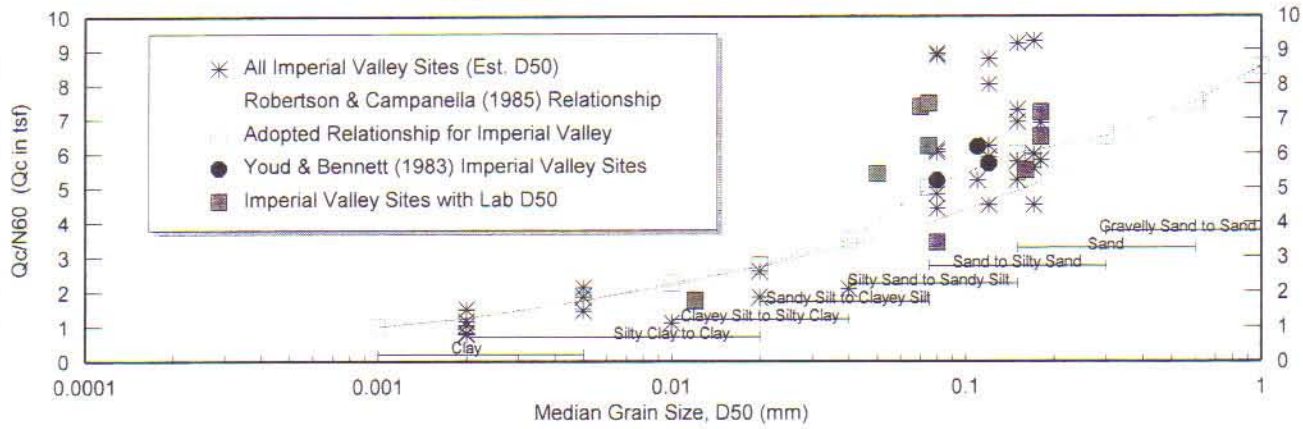
1. Roberton & Campanella (1983) chart:
   Phi = 5.3 + 24*(log(Qc/p'o))+3(log(Qc/p'o))^2
2. Peck, Hansen & Thornburn (1974) N-Phi Correlation
3. Schmertman (1978) chart [Phi = 28+0.14*Dr for fine uniform sands]

Su = undrained shear strength (tsf)

= (Qc-p'o)/Nk where Nk varies from 10 to 22, 17 for OC clays

OCR = Overconsolidation Ratio estimated from Schmertman (1978) chart using Su/p'o ratio and estimated normal consolidated Su/p'o

Variation of Qc/N Ratio with Grain Size



Note: Assumed Properties and Adopted Qc/N Ratio based on correlations from Imperial Valley, California soils

Table of Soil Types and Assumed Properties

Zone	Soil Classification	UCS	Density (pcf)	R&C Qc/N	Adopted Qc/N	Est. PI	Fines (%)	D50 (mm)	Su (tsf)	Consistency
1	Sensitive fine grained	ML	120	2	2	NP-15	65-100	0.020	0-0.13	very soft
2	Organic Material	OL/OH	120	1	1	--	--	--	0.13-.25	soft
3	Clay	CL/CH	125	1	1.25	25-40+	90-100	0.002	0.25-0.5	firm
4	Silty Clay to Clay	CL	125	1.5	2	15-40	90-100	0.010	0.5-1.0	stiff
5	Clayey Silt to Silty Clay	ML/CL	120	2	2.75	5-25	90-100	0.020	1.0-2.0	very stiff
6	Sandy Silt to Clayey Silt	ML	115	2.5	3.5	NP-10	65-100	0.040	>2.0	hard
7	Silty Sand to Sandy Silt	SM/ML	115	3	5	NP	35-75	0.075	Dr (%)	Relative Density
8	Sand to Silty Sand	SP/SM	115	4	6	NP	5-35	0.150	0-15	very loose
9	Sand	SP	110	5	6.5	NP	0-5	0.300	15-35	loose
10	Gravelly Sand to Sand	SW	115	6	7.5	NP	0-5	0.600	35-65	medium dense
11	Overconsolidated Soil	--	120	1	1	NP	90-100	0.010	65-85	dense
12	Sand to Clayey Sand	SP/SC	115	2	2	NP-5	--	---	>85	very dense

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Project No: LE06278

Key to CPT Interpretation of Logs

Plate B-8

DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS	SECONDARY DIVISIONS
Coarse grained soils More than half of material is larger than No. 200 sieve	**Gravels** More than half of coarse fraction is larger than No. 4 sieve	Clean gravels (less than 5% fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, or gravel-sand mixtures, little or no fines
		Gravel with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	Sands More than half of coarse fraction is smaller than No. 4 sieve	Clean sands (less than 5% fines)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
		Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
Fine grained soils More than half of material is smaller than No. 200 sieve	**Silts and clays** Liquid limit is less than 50%		ML	Inorganic silts, clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravely, sandy, or lean clays
			OL	Organic silts and organic clays of low plasticity
	Silts and clays Liquid limit is more than 50%		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils			PT	Peat and other highly organic soils

GRAIN SIZES

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

200 4 10 4 3/4" 3" 12"

US Standard Series Sieve — Clear Square Openings

Sands, Gravels, etc.	Blows/ft. *
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays & Plastic Silts	Strength **	Blows/ft. *
Very Soft	0-0.25	0-2
Soft	0.25-0.5	2-4
Firm	0.5-1.0	4-8
Stiff	1.0-2.0	8-16
Very Stiff	2.0-4.0	16-32
Hard	Over 4.0	Over 32

* Number of blows of 140 lb. hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 in. I.D.) split spoon (ASTM D1586).

** Unconfined compressive strength in tons/s.f. as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D1586), Pocket Penetrometer, Torvane, or visual observation.

Type of Samples:

Ring Sample — Standard Penetration Test — Shelby Tube — Bulk (Bag) Sample

Drilling Notes:

1. Sampling and Blow Counts
   - Ring Sampler - Number of blows per foot of a 140 lb. hammer falling 30 inches
   - Standard Penetration Test - Number of blows per foot.
   - Shelby Tube - Three (3) inch nominal diameter tube hydraulically pushed.
2. P. P. = Pocket Penetrometer (tons/s.f.).
3. NR = No recovery.
4. GWT = Ground Water Table observed @ specified time

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Project No: LE06278

Key to Logs

Plate B-9

APPENDIX C

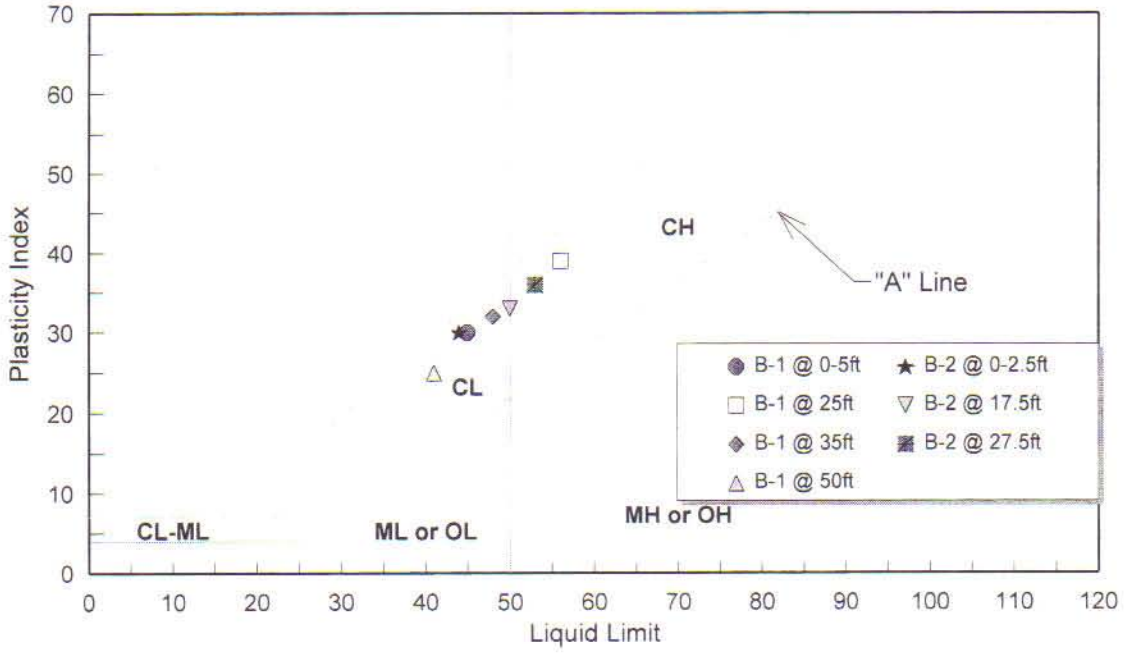
LANDMARK CONSULTANTS, INC.

CLIENT: The Holt Group
PROJECT: Heber Water Treatment Plant Expansion, Heber, CA
JOB NO: LE06278
DATE: 08/08/06

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classif-ation
B-1	0-5	45	15	30	CL
B-1	25	56	17	39	CH
B-1	35	48	16	32	CL
B-1	50	41	16	25	CL
B-2	0-2.5	44	14	30	CL
B-2	17.5	50	17	33	CL-CH
B-2	27.5	53	17	36	CH

PLASTICITY CHART



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Geo-Engineers and Geologists
Project No: LE06278

Atterberg Limits Test Results

Plate C-1

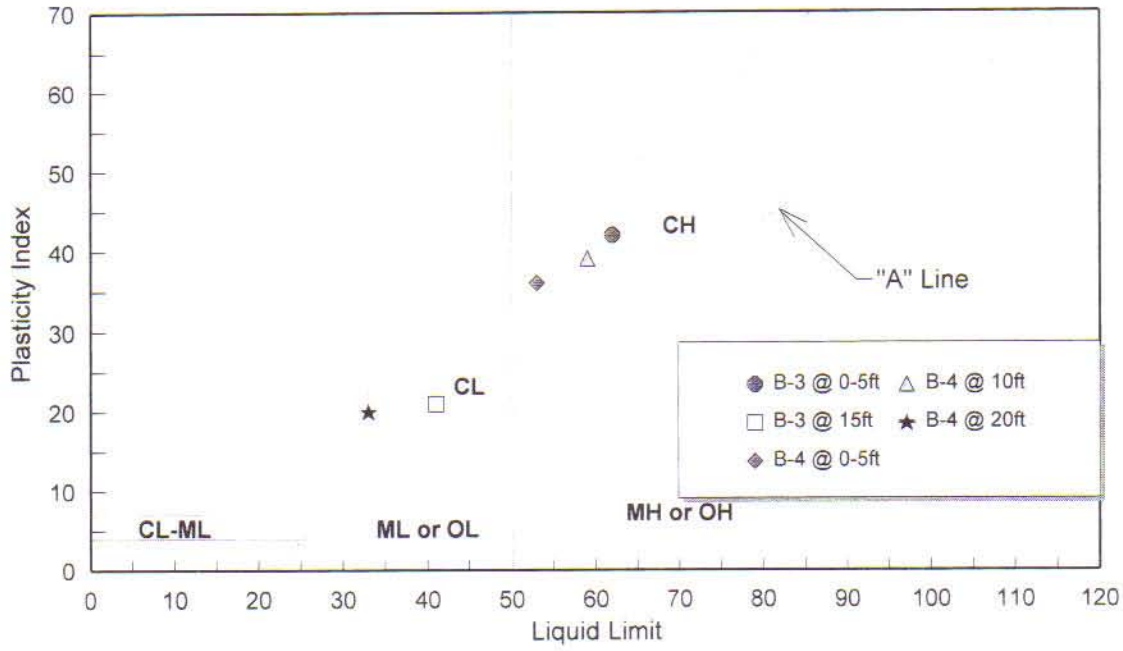
LANDMARK CONSULTANTS, INC.

CLIENT: The Holt Group
PROJECT: Heber Water Treatment Plant Expansion, Heber, CA
JOB NO: LE06278
DATE: 08/08/06

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classif-ation
B-3	0-5	62	20	42	CH
B-3	15	41	20	21	CL
B-4	0-5	53	17	36	CH
B-4	10	59	20	39	CH
B-4	20	33	13	20	CL

PLASTICITY CHART



LANDMARK
Geo-Engineers and Geologists
Project No: LE06278

Atterberg Limits Test Results

Plate C-2

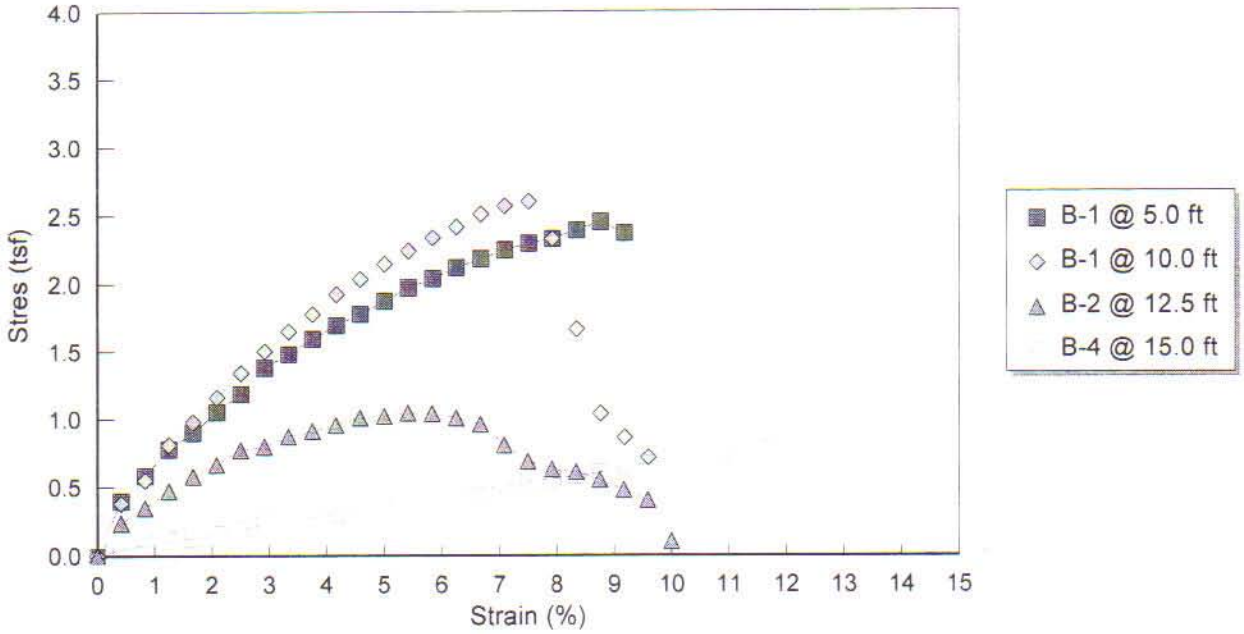
LANDMARK GEOTECHNICAL

CLIENT: The Holt Group
PROJECT: Heber Water Treatment Plant Expansion, Heber, CA
JOB NO: LE06278
DATE: 08/14/06

UNCONFINED COMPRESSION TEST (ASTM D2166)

Boring No.	Sample Depth (ft)	Natural Moisture Content (%)	Unit Dry Weight (pcf)	Maximum Compressive Strength (tsf)	Cohesion (tsf)	Failure Strain (%)
B-1	5.0	19.9	105.4	2.29	1.15	7.5
B-1	10.0	29.7	92.4	2.60	1.30	7.5
B-2	12.5	26.6	98.2	1.05	0.52	5.4
B-4	15.0	29.8	93.7	0.54	0.27	7.5

STRESS-STRAIN PLOT



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a DBE/MBE/SBE Company

Project No: **LE06278**

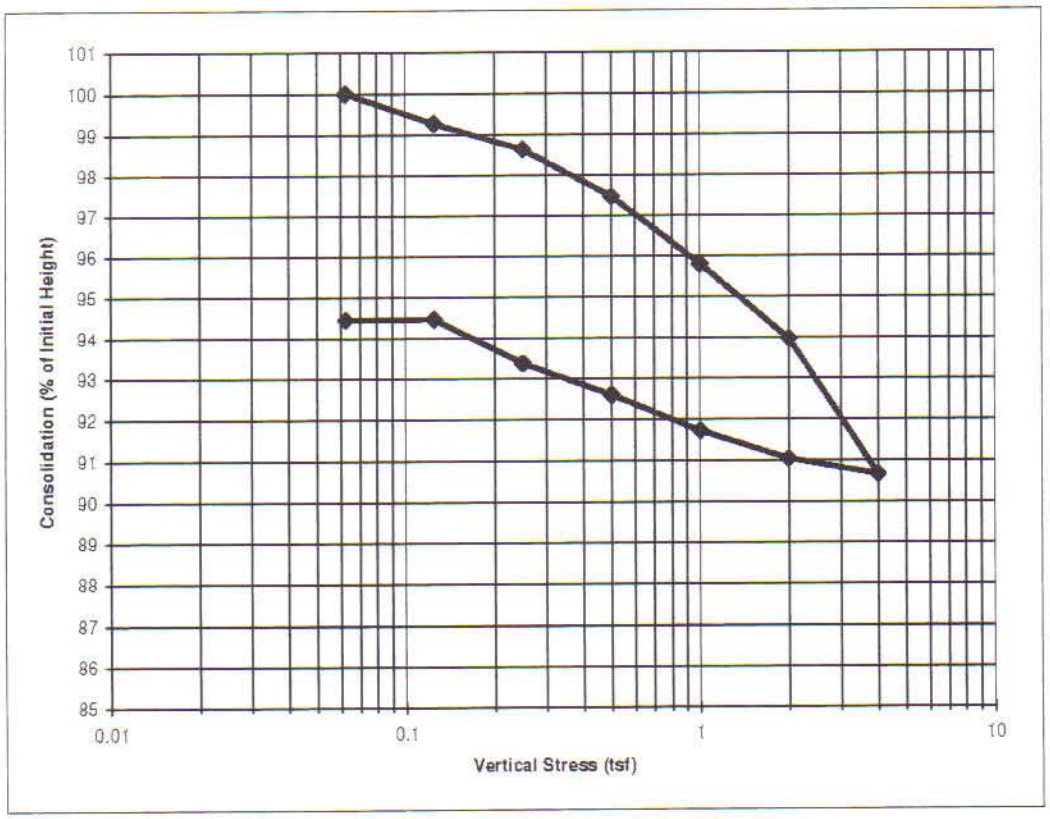
Unconfined Compression Test Results

Plate C-3

PROJECT:	Heber WTP Expansion (The Holt Group)	**JOB NO:**	LE06278
LOCATION:	Heber, CA	**DATE SAMPLED:**	07/31/06
MATERIAL:	Native Soil		
SAMPLE SOURCE:	B1 @ 15'		
SAMPLE PREP:	Insitu		

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.17
INITIAL MOISTURE CONTENT	29.7%	FINAL MOISTURE CONTENT	29.2%
INITIAL DRY DENSITY(pcf)	95.6	FINAL DRY DENSITY(pcf)	105.0
INITIAL DEGREE OF SATURATION	87%	FINAL DEGREE OF SATURATION	103%
INITIAL VOID RATIO	1.10	FINAL VOID RATIO	0.90
		SATURATED AT	1 tsf



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Project No.: LE06278

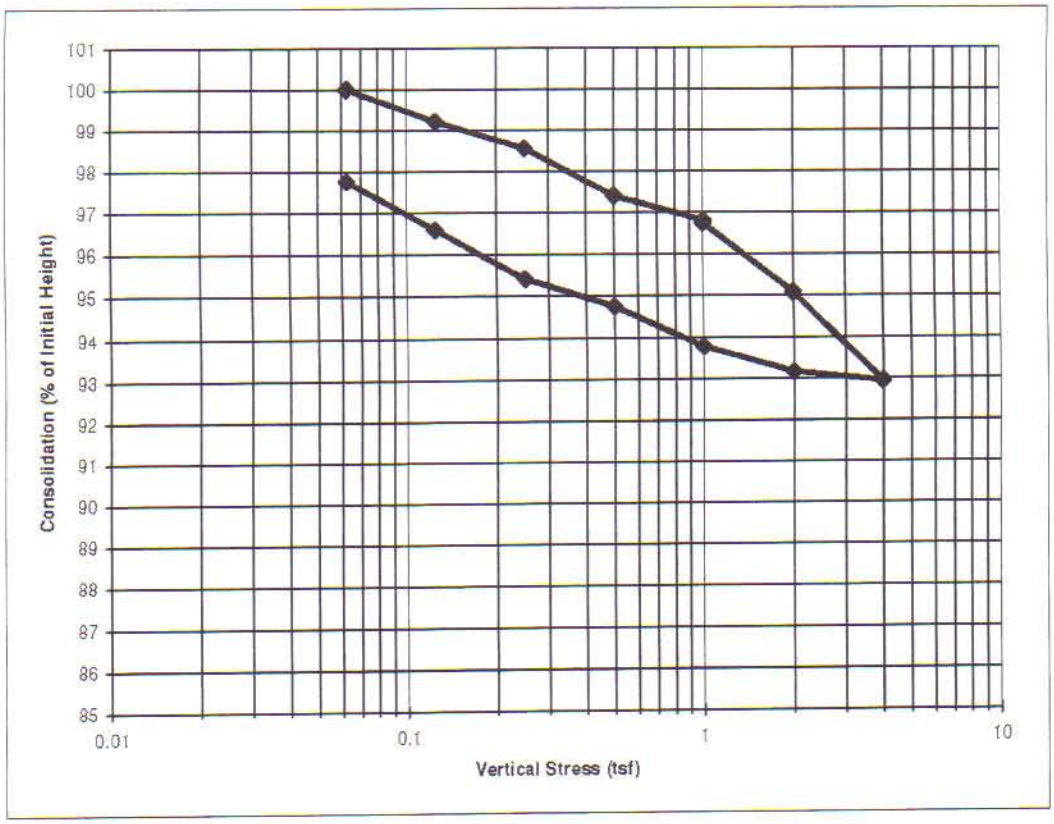
One-Dimensional Consolidation Test

Plate C-4

PROJECT:	Heber WTP Expansion (The Holt Group) LE 03278	**JOB NO:**	LE06278
LOCATION:	Heber, CA	**DATE SAMPLED:**	07/31/06
MATERIAL:	Native Soil		
SAMPLE SOURCE:	B1 @ 30'		
SAMPLE PREP:	Insitu		

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.28
INITIAL MOISTURE CONTENT	27.8%	FINAL MOISTURE CONTENT	27.7%
INITIAL DRY DENSITY(pcf)	96.8	FINAL DRY DENSITY(pcf)	103.7
INITIAL DEGREE OF SATURATION	89%	FINAL DEGREE OF SATURATION	103%
INITIAL VOID RATIO	0.94	FINAL VOID RATIO	0.81
		SATURATED AT	1 tsf



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Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No.: LE06278

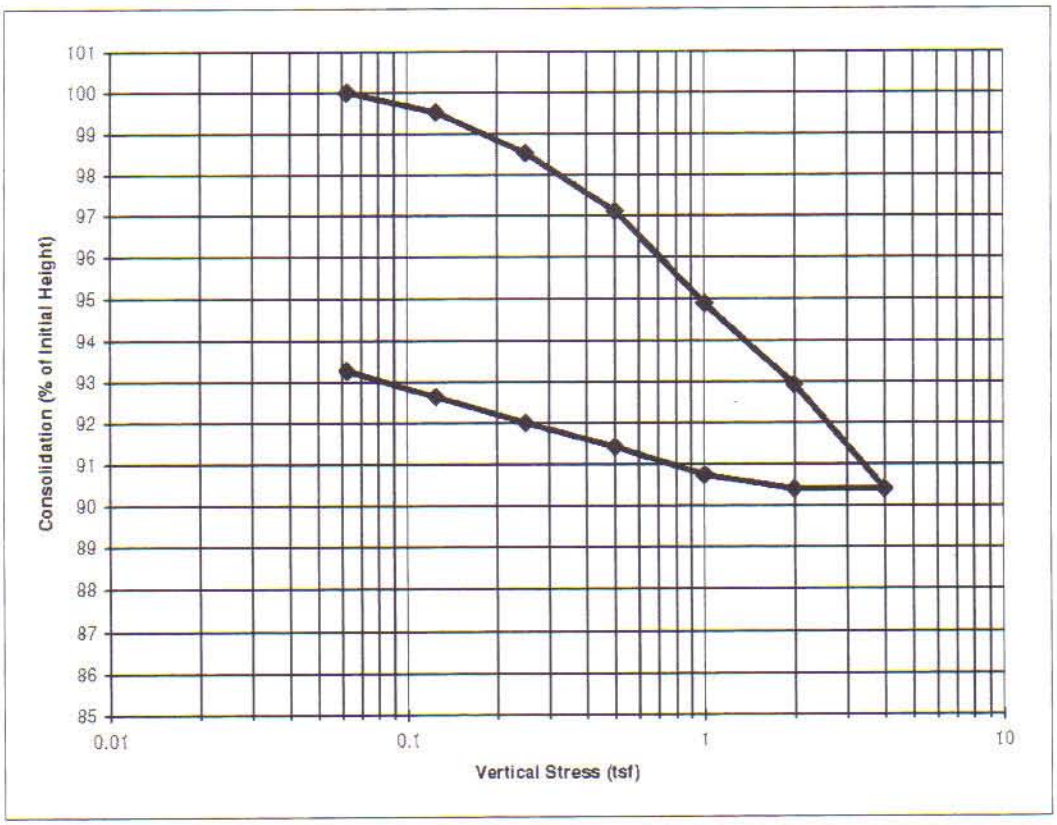
One-Dimensional Consolidation Test

Plate C-5

PROJECT:	Heber WTP Expansion (The Holt Group) LE 03278	**JOB NO:** LE06278	
LOCATION:	Heber, CA	**DATE SAMPLED:** 07/31/06	
MATERIAL:	Native Soil		
SAMPLE SOURCE:	B1 @ 40'		
SAMPLE PREP:	Insitu		

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.16
INITIAL MOISTURE CONTENT	27.2%	FINAL MOISTURE CONTENT	24.6%
INITIAL DRY DENSITY(pcf)	96.2	FINAL DRY DENSITY(pcf)	106.0
INITIAL DEGREE OF SATURATION	92%	FINAL DEGREE OF SATURATION	104%
INITIAL VOID RATIO	0.84	FINAL VOID RATIO	0.67
		SATURATED AT	1 tsf



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Project No.: LE06278

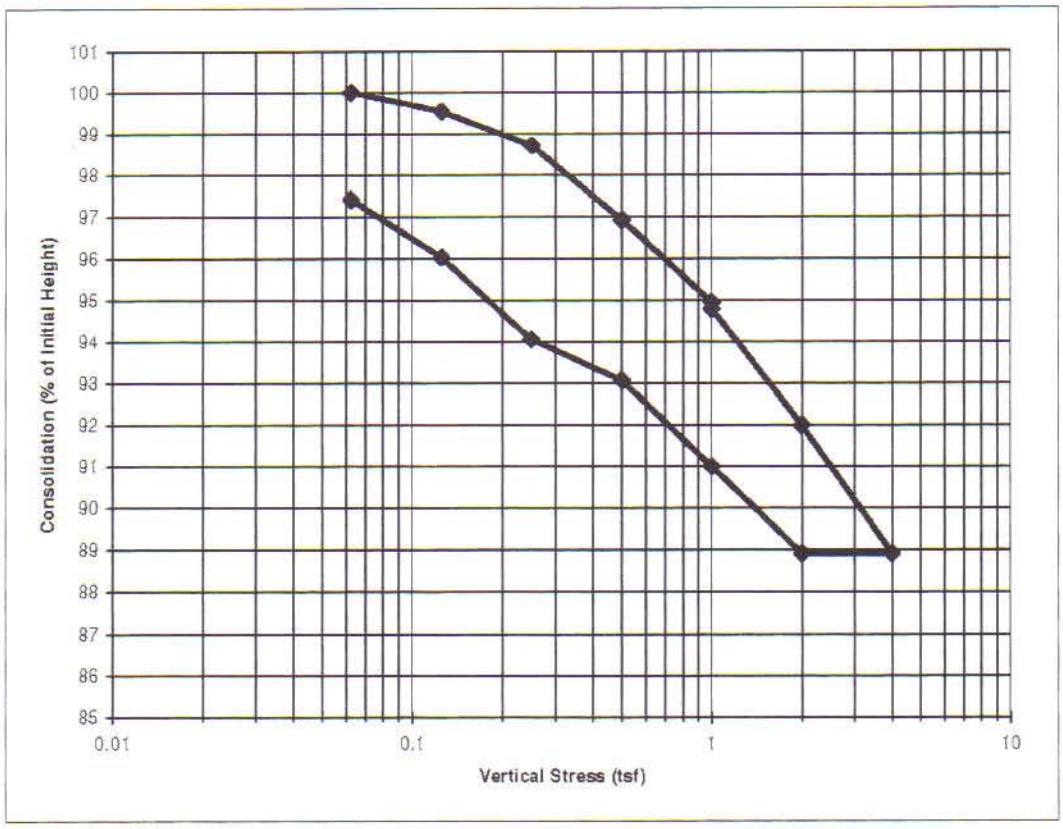
One-Dimensional Consolidation Test

Plate C-6

PROJECT:	Heber WTP Expansion (The Holt Group) LE 03278	**JOB NO:**	LE06278
LOCATION:	Heber, CA	**DATE SAMPLED:**	07/31/06
MATERIAL:	Native Soil		
SAMPLE SOURCE:	B2 @ 7.5'		
SAMPLE PREP:	Insitu		

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.09
INITIAL MOISTURE CONTENT	31.6%	FINAL MOISTURE CONTENT	34.4%
INITIAL DRY DENSITY(pcf)	90.3	FINAL DRY DENSITY(pcf)	101.2
INITIAL DEGREE OF SATURATION	77%	FINAL DEGREE OF SATURATION	102%
INITIAL VOID RATIO	1.50	FINAL VOID RATIO	1.22
		SATURATED AT	1 tsf



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Project No.: LE06278

One-Dimensional Consolidation Test

Plate C-7

LANDMARK CONSULTANTS, INC.

CLIENT: The Holt Group
PROJECT: Heber Water Treatment Plant Expansion, Heber, CA
JOB NO: LE06278
DATE: 08/18/06

CHEMICAL ANALYSES

Boring:	B-1	B-2	B-3	B-4	CalTrans
Sample Depth, ft:	0-5	0-2.5	0-3	0-3	Method
pH:	7.4	7.7	7.5	7.4	643
Electrical Conductivity (mmhos):	2.6	2.4	3.4	2.7	424
Resistivity (ohm-cm):	130	120	80	90	643
Chloride (Cl), ppm:	7,540	7,360	16,780	9,880	422
Sulfate (SO4), ppm:	4,692	3,848	5,310	3,836	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble Sulfates	0 -1000	Low
		1000 - 2000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1500	Severe
		> 1500	Very Severe
Normal Grade Steel	Resistivity	1-1000	Very Severe
		1000-2000	Severe
		2000-10,000	Moderate
		10,000+	Low

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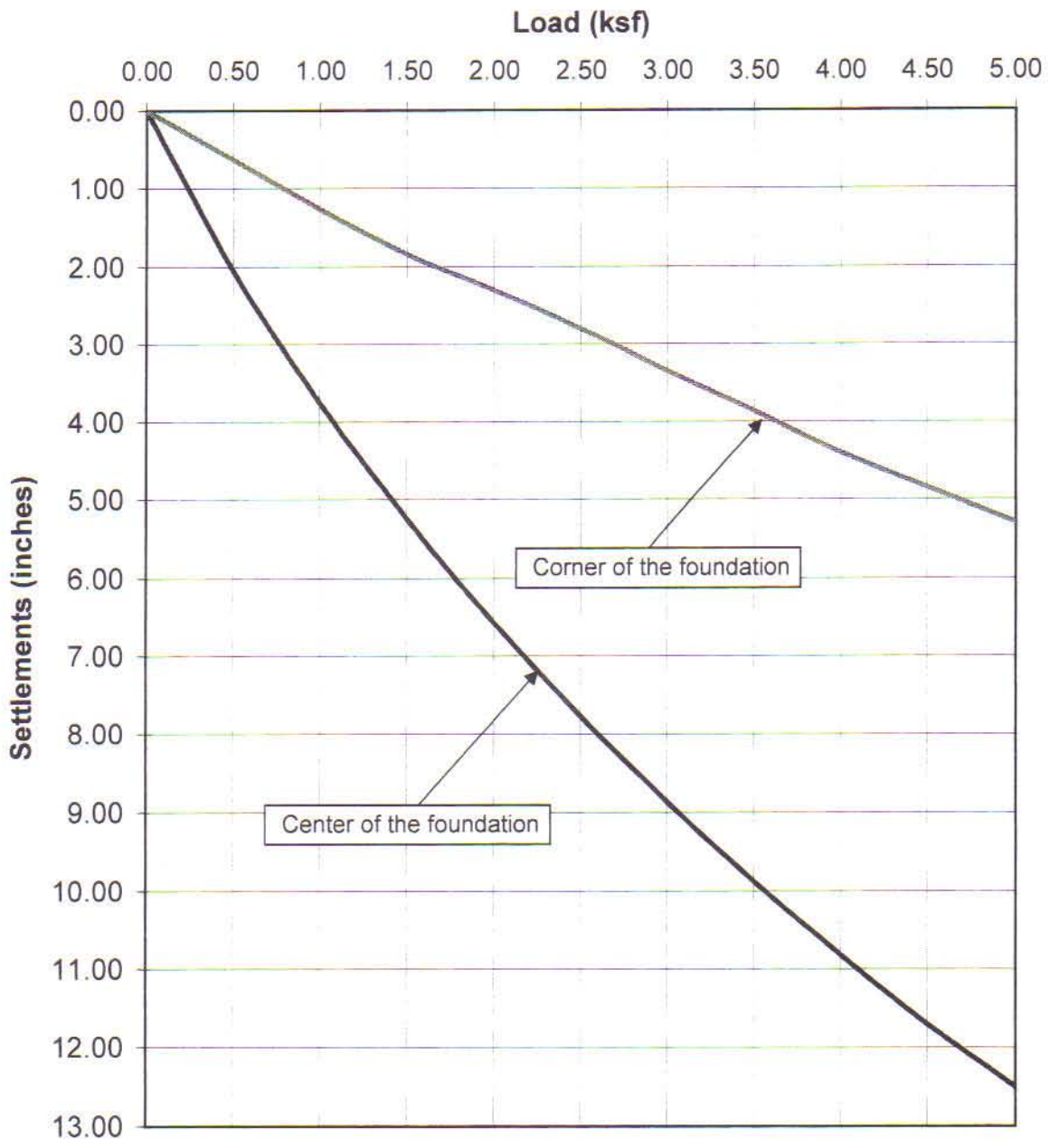
Geo-Engineers and Geologists

Project No: LE06278

Selected Chemical Analyses Results

Plate C-8

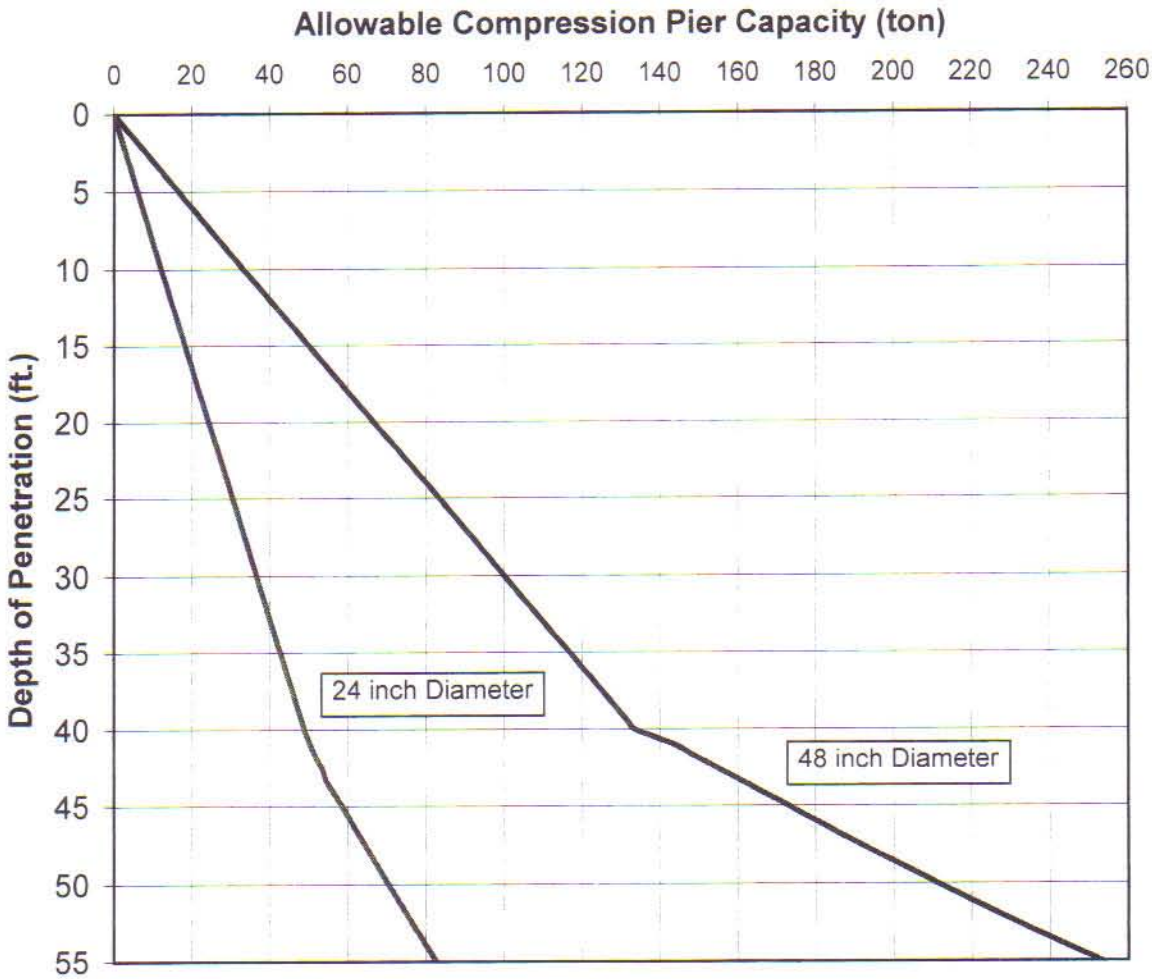
APPENDIX D



Notes:

1. A 125' diameter foundation and 2-foot embedment depth was used for settlement analysis

LANDMARK Geo-Engineers and Geologists *a DBE/MBE/SBE Company* **Project No.: LE06278**	**Total Settlements for a 125-ft Concrete Water Foundation at HWTP, Heber, CA**	**Plate D-1**

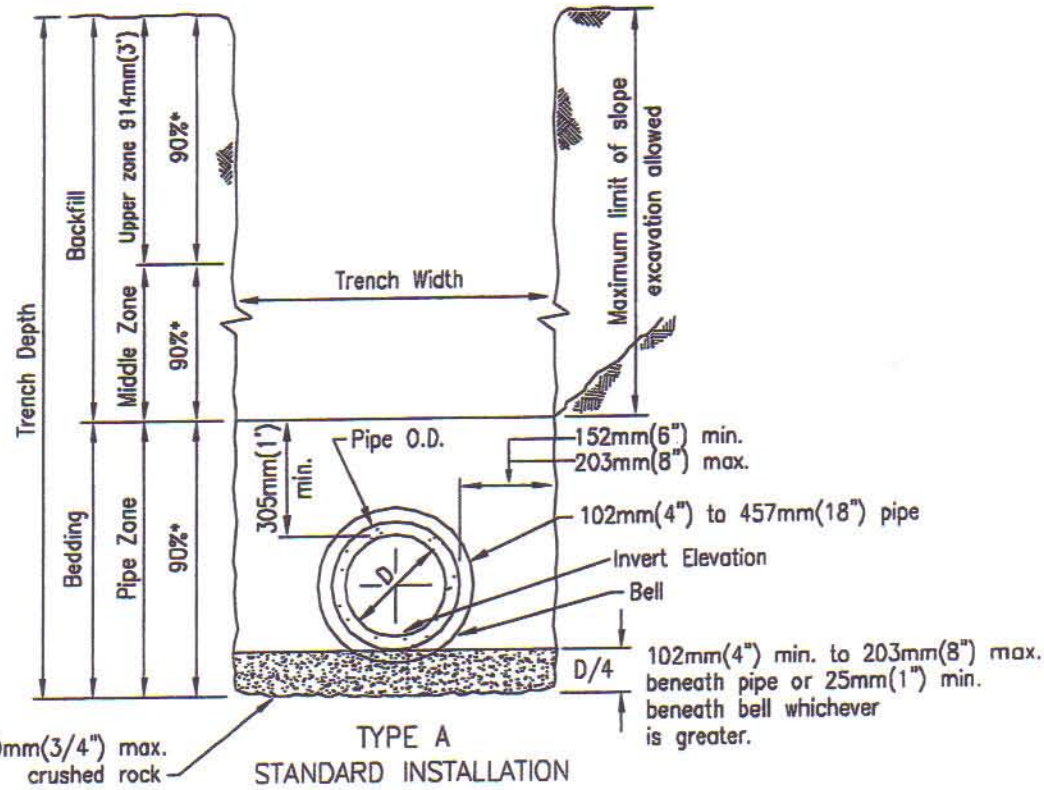


Notes:

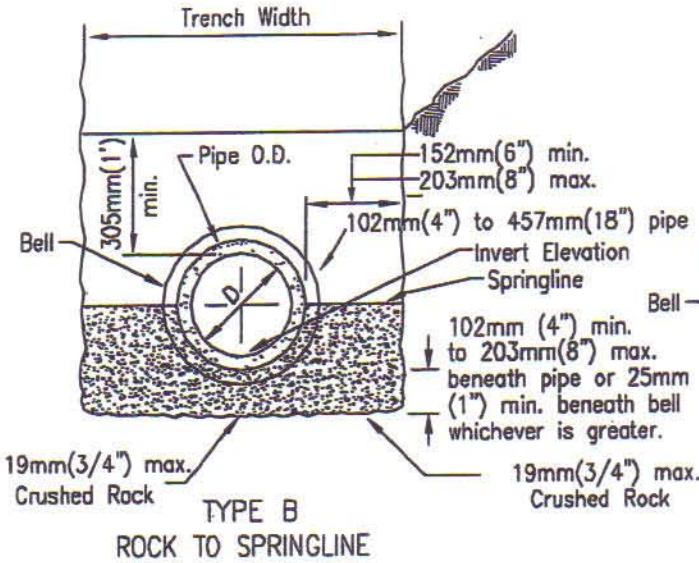
1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.0.
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pile diameter.

LANDMARK Geo-Engineers and Geologists *a DBE/MBE/SBE Company* **Project No.: LE06278**	**Drilled Pier Compression Capacity Chart** **Heber Public Utilities District WTP Expansion** **Heber, CA**	**Plate** **D-2**

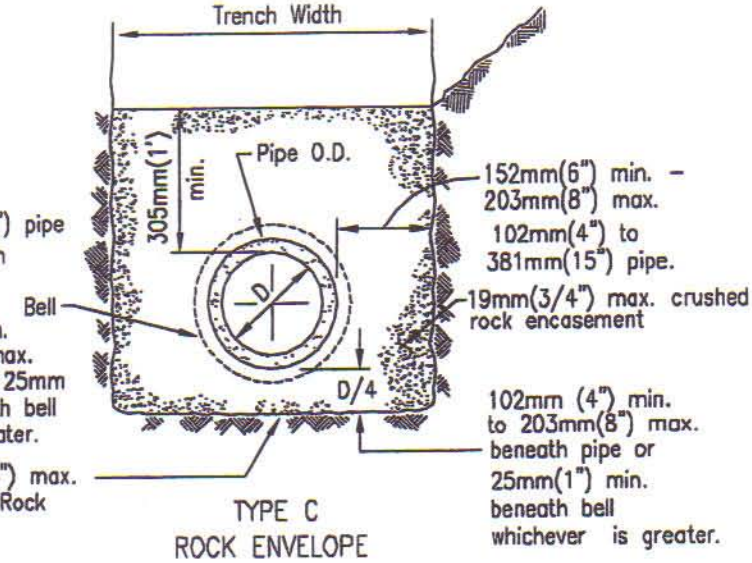
APPENDIX E



TYPE A
STANDARD INSTALLATION



TYPE B
ROCK TO SPRINGLINE



TYPE C
ROCK ENVELOPE

NOTES

1. For trenching in improved streets, see Standard Drawings G-24 or G-25 for trench resurfacing.
2. (*) indicates minimum relative compaction.
3. Minimum depth of cover from the top of pipe to finish grade for all sanitary sewer installations shall be 914mm(3') For cover less tnan 914mm(3'), see Standard Drawing S-7 for concrete encasement.
4. See Type A installation for details not shown for Types B and C.

Revision	By	Approved	Date
ORIGINAL		A.Kercheval	12/75
Add Metric		T. Stanton	03/03

SAN DIEGO REGIONAL STANDARD DRAWING

PIPE BEDDING AND TRENCH BACKFILL FOR SEWERS

RECOMMENDED BY THE SAN DIEGO REGIONAL STANDARDS COMMITTEE

3/01/2003

Chairperson R.C.E. 19246 Date

DRAWING NUMBER **S-4**

APPENDIX F

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APPENDIX D

Geotechnical Report

HPUD WTP Raw Water Supply Pipeline
Heber, California

Prepared for:

The Holt Group
1561 S. 4th Street
El Centro, CA 92243

LANDMARK
Geo-Engineers and Geologists

Prepared by:

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243
(760) 370-3000

September 2006

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

780 N. 4th Street
El Centro, CA 92243
(760) 370-3000
(760) 337-8900 fax

77-948 Wildcat Drive
Palm Desert, CA 92211
(760) 360-0665
(760) 360-0521 fax

September 1, 2006

Mr. Jack Holt
The Holt Group
1561 S. 4th Street
El Centro, CA 92243

Geotechnical Investigation
HPUD WTP Raw Water Supply Pipeline
Heber, California
LCI Report No. LE06276

Dear Mr. Holt:

We are pleased to present this geotechnical report for the proposed construction of the Heber Public Utilities District (HPUD) water supply pipeline located in southern Heber, California. The proposed project will consist of design and construction of approximately 9,500 linear feet of raw water pipeline and a pump station at the Central Main Canal. The water supply line is a secondary source of raw water to the existing HPUD water treatment plant.

Our geotechnical investigation was conducted in response to your request for our services. The enclosed report describes the investigation conducted and presents our professional opinions regarding geotechnical aspects of design and construction of the project.

This executive summary presents ***selected*** elements of our findings and recommendations only. It ***does not*** present crucial details needed for the proper application of our findings and recommendations. Our findings, recommendations, and application options are related ***only through reading the full report***, and are best evaluated with the active participation of the engineer of record who developed them.

The findings of this study indicate that the pipeline route along Ware Road, Fawcett Road and Heber Avenue is underlain by interbedded layers of different thickness and depths of fine grained lake bed sediments (silty sand, silty clay, silt, and clay) to a maximum depth of 21.5 feet below ground surface. Groundwater was not encountered at drill hole depths of 11.5 feet, except at the Central Main Canal, where groundwater was encountered at about 3 feet below ground surface (see section 3.6 of this report).

The soil is highly corrosive to metals and contains sufficient sulfates and chlorides to require special concrete mixes (4,500 psi with a 0.45 maximum water cement ratio and Type V cement) and protection of embedded steel components when concrete is placed in contact with native soil. All metal fittings, valves and appurtenances should be coated or wrapped in accordance with AWWA Standards for corrosion protection.

The site soil conditions are suitable for the proposed pipeline installation and pump station construction, provided the recommendations contained in this report are implemented in the design and construction of this project.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. If you have any questions or comments regarding our findings, please call our office at (760) 370-3000.

Respectfully Submitted,
Landmark Consultants, Inc.

PROFESSIONAL GEOLOGIST
STEVEN K. WILLIAMS
CERTIFIED ENGINEERING GEOLOGIST
CEG 2261
STATE OF CALIFORNIA

Steven K. Williams, CEG
Senior Engineering Geologist

Julian R. Avalos
Staff Engineer

Jeffrey O. Lyon, PE
President

REGISTERED PROFESSIONAL ENGINEER
JEFFREY O. LYON
No. 31921
EXPIRES 12-31-06
CIVIL
STATE OF CALIFORNIA

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Client (4)

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Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our geotechnical investigation for the proposed Heber Public Utilities District (HPUD) water supply pipeline located in the City of Heber, California. The pipeline will provide a secondary source of raw water for the HPUD Water Treatment Plant. The proposed project will consist of design and construction of approximately 9,500 linear feet of raw water pipeline (24-inch HDPE pipe) beginning at the north side of the Central Main Canal and connected at the Heber Water Treatment Plant along Ware Road, Fawcett Road and Heber Avenue. The proposed water pipeline will be connected to a new pump station that will be located at Ware Road and the north side of the Dogwood and Central Main Canals.

1.2 Purpose and Scope of Work

The purpose of this geotechnical study was to investigate the upper 11.5 to 21.5 feet of subsurface soils at selected locations along the pipeline route for physical/engineering properties. From this field and laboratory study, professional opinions are being provided regarding geotechnical design parameters at this site for the proposed construction. The scope of our services included the following:

- Field exploration and in-situ testing of the site soils at selected locations and depths
- Laboratory testing for physical and/or chemical properties and soil classification of selected samples
- Review of published geologic and seismologic literature in the project vicinity
- Analysis and evaluation of the data collected
- Preparation of this report presenting our findings, professional opinions, and recommendations for the geotechnical aspects of project design and construction

This report addresses the following geotechnical issues:

- Subsurface soil and groundwater conditions
- Site geology, regional faulting and seismicity, and site acceleration
- Liquefaction potential and its mitigation
- Aggressive soil conditions to metals and concrete

Professional opinions considering the above issues are presented for the following:

- Lateral earth pressures
- Excavation conditions and buried utility installations
- Backfill requirements
- Allowable soil bearing pressures
- Mitigation of the potential effects of salt concentrations (corrosivity) in native soils to concrete mixes and steel pipes

Our scope of work for this report did not include an evaluation of the site for the presence of potential environmental hazards or evaluation of effectiveness of dewatering methods.

1.3 Authorization

Mr. James G. "Jack" Holt of The Holt Group provided authorization by written agreement to proceed with our work on July 14, 2006. We conducted our work according to our written proposal dated June 6, 2006.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Subsurface exploration was performed on July 31 and August 16, 2006 using 2R Drilling of Ontario, California to advance five (5) borings to depths of 11.5 to 21.5 feet below existing ground surface. The borings were advanced with a truck-mounted, CME 55 drill rig using 8-inch diameter, hollow-stem, continuous-flight augers. The boring locations established by the client are shown on the Site and Exploration Plan (Plate A-2).

A staff engineer observed the drilling operations and maintained a log of the soil encountered and sampling depths, visually classified the soil encountered during drilling in accordance with the Unified Soil Classification System, and obtained drive tube and bulk samples of the subsurface materials at selected intervals. Relatively undisturbed soil samples were retrieved using a 2-inch outside diameter (OD) split-spoon sampler or a 3-inch OD Modified California Split-Barrel (ring) sampler. The samples were obtained by driving the sampler ahead of the auger tip at selected depths. The drill rig was equipped with a 140-pound CME automatic hammer for conducting Standard Penetration Tests (SPT). The number of blows required to drive the samplers 12 inches into the soil is recorded on the boring logs as "blows per foot". Blow counts (N values) reported on the boring logs represent the field blow counts. No corrections have been applied for effects of overburden pressure, automatic hammer drive energy, drill rod lengths, liners, and sampler diameter. Pocket penetrometer readings were also obtained to evaluate the stiffness of cohesive soils retrieved from sampler barrels.

After logging and sampling the soil, the exploratory borings were backfilled with the excavated material. The backfill was loosely placed and was not compacted to the requirements specified for engineered fill.

The subsurface logs are presented on Plates B-1 through B-5 in Appendix B. A key to the log symbols is presented on Plate B-6. The stratification lines shown on the subsurface log represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

2.2 Laboratory Testing

Laboratory tests were conducted on selected soil samples to aid in classification and evaluating selected engineering properties. The tests were conducted in general accordance with the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. Our laboratory testing program consisted of the following tests:

- Plasticity Index (ASTM D4318) – used for soil classification and expansive soil design criteria

- Particle Size Analyses (ASTM D422) – used for soil classification and liquefaction evaluation.

- Unit Dry Densities (ASTM D2937) and Moisture Contents (ASTM D2216) – used for insitu soil parameters.

- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods) – used for concrete mix evaluations and corrosion protection requirements.

The laboratory test results are presented on the subsurface logs (Appendix B) and on laboratory test summaries in Appendix C.

Engineering parameters of soil strength, compressibility and relative density utilized for developing design criteria provided within this report were derived from data obtained from the field and laboratory testing program.

Section 3
DISCUSSION

3.1 Site Conditions

The proposed project will consist of placing approximately 9,500 linear feet of raw water pipeline (24-inch HDPE pipe) at about 5 to 7 feet depth to pipe invert running north along the west side of Ware Road and west along the north side of Fawcett Road. The pipeline will then extend north along the west side of Heber Avenue to 9th Street where the Heber Water Treatment Plant is located. The proposed water pipeline will be connected to a new pump station that will be located at the north side of the Dogwood and Central Main Canals at Ware Road. The pipeline route is nearly level with no significant grade changes.

Adjacent properties are flat-lying and are approximately at the same elevation with the roads. The Central Main Canal (unlined) and the Dogwood Canal (concrete lined), both irrigation water canals, are located north of the intersection of Ware Road and Willoughby Road. Ware Road is a two lane rural paved road aligned in north-south direction. Fawcett Road and Heber Avenue are located within the City of Heber and are aligned in west-east and north-south directions, respectively. Heber Avenue is under reconstruction.

The El Toro Heber cattle feed yard is located at the southeast corner of the intersection of Ware and Fawcett Roads. Single family homes abut both sides of Heber Avenue and the north side of Fawcett Road. Ware Road is bounded on the east and west by agricultural fields. Ormat Nevada, LLC geothermal power plant is located to the east side of Ware Road across the agricultural fields. Geothermal production wells (2,000 to 10,000 feet deep) are located north and west of the geothermal plant facility.

A Backbone infrastructure project constructed by the HPUD about 20 years ago placed water and sewer mains in Fawcett and Ware Roads. The new raw water line will cross these improvements at various locations.

The project site lies at an elevation of approximately 15 feet below mean sea level (MSL) (El. 985 local datum) in the Imperial Valley region of the California low desert. The surrounding properties lie on terrain which is flat (planar), part of a large agricultural valley, which was previously an ancient lake bed covered with fresh water to an elevation of 43± feet above MSL. Annual rainfall in this arid region is less than 3 inches per year with four months of average summertime temperatures above 100 ^{o}F. Winter temperatures are mild, seldom reaching freezing.

3.2 Geologic Setting

The project site is located in the Imperial Valley portion of the Salton Trough physiographic province. The Salton Trough is a topographic and geologic structural depression resulting from large scale regional faulting. The trough is bounded on the northeast by the San Andreas Fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments since the Miocene Epoch. Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.

The Imperial Valley is directly underlain by lacustrine deposits, which consist of interbedded lenticular and tabular silt, sand, and clay. The Late Pleistocene to Holocene lake deposits are probably less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed a fresh water lake (Lake Cahuilla). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 - 20,000 feet.

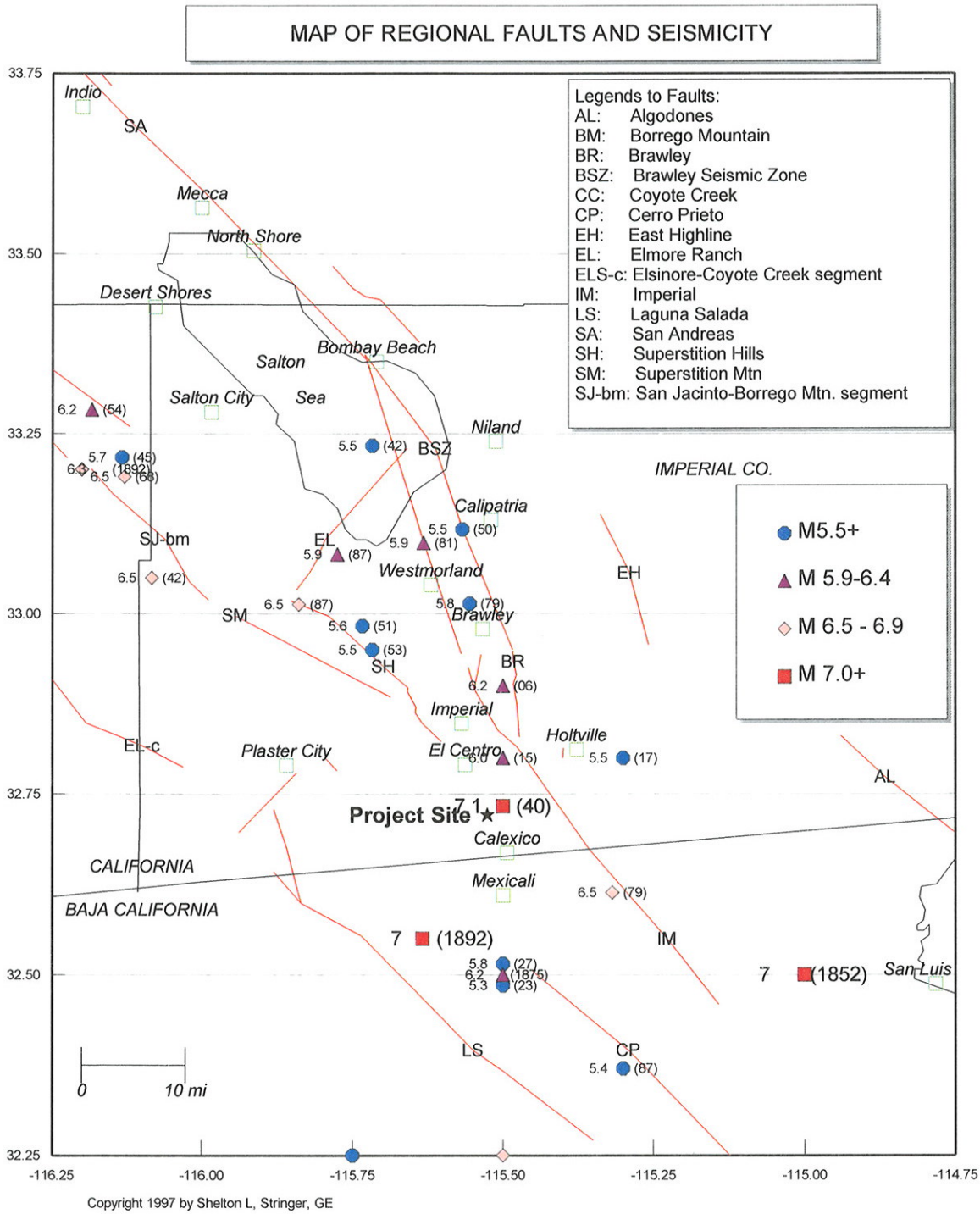
3.3 Seismicity and Faulting

Faulting and Seismic Sources: We have performed a computer-aided search of known faults or seismic zones that lie within a 62 mile (100 kilometers) radius of the project site as shown on Figure 1 and Table 1. The search identifies known faults within this distance and computes deterministic ground accelerations at the site based on the maximum credible earthquake expected on each of the faults and the distance from the fault to the site. The Maximum Magnitude Earthquake (Mmax) listed was taken from published geologic information available for each fault (CDMG OFR 96-08 and Jennings, 1994).

Seismic Risk: The project site is located in the seismically active Imperial Valley of southern California and is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. The proposed site structures should be designed in accordance with the California Building Code (CBC) for a "Design Basis Earthquake" (DBE) and with the appropriate near-source factors. The DBE is defined as the motion having a 10 percent probability of being exceeded in 50 years.

Seismic Hazards.

- **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Imperial, Brawley, and Superstition Hills Faults. A further discussion of groundshaking follows in Section 3.4.
- **Surface Rupture.** The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone. Surface fault rupture is considered to be unlikely at the project site because of the well-delineated fault lines through the Imperial Valley as shown on USGS and CDMG maps. However, because of the high tectonic activity and deep alluvium of the region, we cannot preclude the potential for surface rupture on undiscovered or new faults that may underlie the site.
- **Liquefaction.** Liquefaction can potentially occur at the site because of underlying saturated sandy substrata. In general, liquefaction studies performed by our firm in this region may result in ½ to 3 inches of settlement in the mass soil structure. The flexible nature of the water pipeline joints will generally accept this type of deflection.



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Faults and Seismic Zones from Jennings (1994), Earthquakes modified from Ellsworth (1990) catalog.

Figure 1. Map of Regional Faults and Seismicity

Table 1
FAULT PARAMETERS & DETERMINISTIC ESTIMATES OF PEAK GROUND ACCELERATION (PGA)

Fault Name or Seismic Zone	Distance (mi) & Direction from Site	Fault Type		Fault Length (km)	Maximum Magnitude Mmax (Mw)	Avg Slip Rate (mm/yr)	Avg Return Period (yrs)	Date of Last Rupture (year)	Largest Historic Event >5.5M	(year)	Est. Site PGA (g)
Reference Notes: (1)		(2)	(3)	(2)	(4)	(3)	(3)	(3)	(5)		(6)
Imperial Valley Faults											
Imperial	6.2 NE	A	B	62	**7.0**	20	79	1979	7.0	1940	**0.35**
Brawley	8.0 NNE	B	B	14	**7.0**	20	----	1979	5.8	1979	**0.30**
Cerro Prieto	15 SSE	A	B	116	**7.2**	34	50	1980	7.1	1934	**0.21**
Brawley Seismic Zone	16 N	B	B	42	**6.4**	25	24		5.9	1981	**0.14**
East Highline Canal	22 NE	C	C	22	**6.3**	1	774				**0.10**
San Jacinto Fault System											
- Superstition Hills	8.3 NW	B	A	22	**6.6**	4	250	1987	6.5	1987	**0.24**
- Superstition Mtn.	15 NW	B	A	23	**6.6**	5	500	1440 +/-			**0.16**
- Elmore Ranch	28 NW	B	A	29	**6.6**	1	225	1987	5.9	1987	**0.10**
- Borrego Mtn	34 WNW	B	A	29	**6.6**	4	175		6.5	1942	**0.08**
- Anza Segment	51 NW	A	A	90	**7.2**	12	250	1918	6.8	1918	**0.08**
- Coyote Creek	53 NW	B	A	40	**6.8**	4	175	1968	6.5	1968	**0.07**
- Whole Zone	15 NW	A	A	245	**7.5**	---	---				**0.26**
Elsinore Fault System											
- Laguna Salada	17 SW	B	B	67	**7.0**	3.5	336		7.0	1891	**0.18**
- Coyote Segment	30 W	B	A	38	**6.8**	4	625				**0.10**
- Julian Segment	55 WNW	A	A	75	**7.1**	5	340				**0.08**
- Earthquake Valley	57 WNW	B	A	20	**6.5**	2	351				**0.05**
- Whole Zone	30 W	A	A	250	**7.5**	---	---				**0.15**
San Andreas Fault System											
- Coachella Valley	45 NNW	A	A	95	**7.4**	25	220	1690+/-	6.5	1948	**0.10**
- Whole S. Calif. Zone	45 NNW	A	A	458	**7.9**	---	---	1857	7.8	1857	**0.13**
Algodones	35 E	C	C	74	**7.0**	0.1	20,000				**0.10**

Notes:

1. Jennings (1994) and CDMG (1996)
2. CDMG (1996), where Type A faults -- slip rate >5 mm/yr and well constrained paleoseismic data
   Type B faults -- all other faults.
3. WGCEP (1995)
4. CDMG (1996) based on Wells & Coppersmith (1994)
5. Ellsworth Catalog in USGS PP 1515 (1990) and USBR (1976), Mw = moment magnitude,
6. The deterministic estimates of the Site PGA are based on the attenuation relationship of:
   Boore, Joyner, Fumal (1997)

Other Secondary Hazards.

- **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation.
- **Volcanic hazards.** The site is not located in proximity to any known volcanically active area and the risk of volcanic hazards is considered very low.
- **Tsunamis, sieches, and flooding.** The site does not lie near any large bodies of water, so the threat of tsunami, sieches, or other seismically-induced flooding is unlikely.
- **Expansive soil.** In general, much of the near surface soils in the Imperial Valley consist of silty clays and clays which are moderate to highly expansive.
- **Geothermal Ground Movements.** The Project site lies within the Heber Geothermal Unit which has active ground movement resulting from the Ormat Nevada geothermal field extraction/reinjection activities. In general, the land mass along the Central Main Canal (from Ware to Dogwood Road) has been settling (13-inch overall movement in 20 years). Lesser movement has been measured in the Town site of Heber.

3.4 Site Acceleration and CBC Seismic Coefficients

Site Acceleration: Deterministic horizontal peak ground accelerations (PGA) from maximum probable earthquakes on regional faults have been estimated and are included in Table 1. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Accelerations also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

We have used the computer program FRISKSP (Blake, 2000) to provide a probabilistic estimate of the site PGA using the attenuation relationship of Boore, Joyner, and Fumal NEHRP D 250 (1997). The PGA estimate for the project site having a 10% probability of being exceeded in 50 years (return period of 475 years) is **0.65g**.

CBC Seismic Response Coefficients: The CBC seismic response coefficients are calculated from the near-source factors for Seismic Zone 4. The near-source factors are based on the distance from the fault and the seismic source type. The following table lists seismic and site coefficients (near source factors) determined by Chapter 16 of the 2001 CBC. ***This site lies approximately 10.0 km from a Type A fault (Imperial Fault) and overlying S_D (stiff) soil.***

CBC Seismic Coefficients for Chapter 16 Seismic Provisions

CBC Code Edition	Soil Profile Type	Seismic Source Type	Distance to Critical Source	Near Source Factors		Seismic Coefficients	
				Na	Nv	Ca	Cv
2001	S_D (stiff soil)	A	10 km	1.00	1.20	0.44	0.77
Ref. Table	16-J	16-U	---	16-S	16-T	16-Q	16-R

3.5 Subsurface Soil

Subsurface soils encountered during the field exploration conducted on July 31 and August 16, 2006 are fine grained lake bed sediments consisting of interbedded layers of silty sand, silty clay, silt, and clay. The thicknesses of the individual soil stratums are variable and should be reviewed at each pipeline segment. The subsurface logs (Plates B-1 through B-5) depict the stratigraphic relationships of the various soil types.

3.6 Groundwater

A temporary piezometer was installed in Boring B-1 to a depth of 15 feet at the pumping station site. Groundwater was encountered in the piezometer (next to the north side of Dogwood canal) at a depth of 2.8 feet on August 30, 2006, two weeks after placement of the piezometer. Groundwater was not encountered to a depth of 11.5 feet in the rest of the borings (B-2 through B-5) during the time of exploration, but may rise with time to approximately 8 to 10 feet below ground surface at this site. There is uncertainty in the accuracy of short-term water level measurements, particularly in fine-grained soil. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, drainage, and site grading. The referenced groundwater level should not be interpreted to represent an accurate or permanent condition.

Section 4
RECOMMENDATIONS

4.1 Excavations for Pipeline and Pump Station

Shallow, temporary excavations, less than four feet deep, in native clayey/silty soils should stand nearly vertical for short duration. All temporary excavations over four feet in depth will require shoring or slope inclinations in conformance to Cal OSHA standards for Type B soils. These temporary excavations will require slope inclinations no steeper than 1½(H):1(V) unless trench shoring is used. If excavations are planned below groundwater (8 to 10 feet below ground surface (bgs) at pipeline route and 2.8 feet bgs at pump station site), all excavation slopes should be excavated according to OSHA Standards for Type C soils. Due to an existing silty/sandy layer encountered between 4 to 9 feet at the pump station site, the use of a sheet-pile shoring system should be planned. Dewatering of the excavation site will be required prior to start of excavation. However, recharge of groundwater from the unlined Central Main Canal should be considered. Dewatering systems should provide adequate filters so that fine silts are not pumped from depth. Pumping of the fine soils can result in area settlement.

All discussions in this section regarding stable excavation slopes assumes minimal equipment vibration and adequate setback of excavated material and construction equipment from the top of the excavation. We recommended that the minimum setback distance be equal to the depth of excavation and at least 10 feet from the crown of the slope. If excavated materials are stockpiled adjacent to the excavation, the weight of the material should be considered as a surcharge load for slope stability.

The excavation for the pump station will encounter the groundwater table. Therefore, seepage and pumping subgrade conditions should be anticipated. An adequately designed dewatering system (well points) will be required to control groundwater seepage and prevent running ground conditions. The bottom of pump station should be underlain by a minimum of 18 inches of 1.5-inch crushed rock (ASTM C33, size 467) encapsulated in a geotextile filter fabric. The responsibility for dewatering and selection of an appropriate system is beyond the scope of this report.

4.2 Bedding and Backfill of Pipeline

Trench Backfill: Trench backfill should conform to San Diego Regional Standard Drawing S-4 (Appendix D), using either Type A, B or C backfill.

Type A backfill for HDPE pipe consists of a 4 to 6 inch bed of ¾-inch crushed rock below the pipe and pipezone backfill (to 12" above top of pipe) consisting of crusher fines (sand). The crusher fines shall be compacted to a minimum of 90% of ASTM D1557 maximum density. Pipe deflection should be checked to not exceed 2% of pipe diameter. Native clay/silt soils may be used to backfill the remainder of the trench. Clays shall be compacted to a minimum of 85% of ASTM D1557 maximum density and silts shall be compacted to a minimum of 87% of ASTM D1557 maximum density, except that the top 12 inches of the trench shall be compacted to at least 90% of ASTM D1557 maximum density.

Type B backfill for HDPE pipe requires 6 inches of ¾-inch crushed rock as bedding and to springline of the pipe. Thereafter, sand/cement slurry (3 sack cement factor) should be used to 12 inches above the top of the pipe. Native clay and silt soils may be used in the remainder of the trench backfill as specified above.

Type C backfill for HDPE pipe shall consist of a geotextile filter fabric encapsulating ¾-inch crushed rock. The crushed rock thickness shall be 6 inches below and to the sides of the pipe and shall extend to 12 inches above the top of the pipe. The filter fabric shall cover the trench bottom, sidewalls and over the top of the crushed rock. Native clay and silt soils may be used in the remainder of the trench backfill as specified above.

Type C backfill must be used in wet soils and below groundwater for all buried utility pipelines unless dewatered to at least 24 inches below the trench bottom prior to excavation. Type A backfill may be used in the case of a dewatered trench condition.

On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill above pipezone, but may be difficult to uniformly maintain at specified moistures and compact to the specified densities. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material. Imported granular material is acceptable for backfill of utility trenches

Backfill soil within paved areas should be placed in layers not more that 6 inches in thickness and mechanically compacted to a minimum of 87% of the ASTM D1557 maximum dry density except for the top 12 inches of the trench which shall be compacted to at least 90%. Precautions should be taken in the compaction of the backfill to avoid damage to the pipes and structures.

4.3 Soil Parameters for Pipeline Design

Structural design of pipes require proper evaluation of all possible loads acting on the pipeline, including dead and live or transient loads. The stresses induced in a buried pipe by the imposed load depend on the type of pipe (i.e., rigid or flexible). The maximum dead load imposed on the pipeline by the backfilled soil is a function of the depth and width of the trench, soil unit weight, angle of internal friction, soil cohesion, coefficient of active earth pressure, and coefficient of friction at the interface between the pipe and native soils.

The recommended values of the various soils parameters that the pipe design engineer may use for the design of the pipelines are as follows:

- Soil bulk unit weight $\gamma = 125$ pcf
- Angle of internal friction of soils $\varphi = 28$ degrees
- Soil Cohesion $c = 500$ psf
- Coefficient of friction between pipe and native soils $f = 0.40$
- Coefficient of active earth pressure 0.35

For pipes bedded on the native soils, a modulus of Soil Reaction (E') of 700 psi may be used to estimate initial pipe deflection.

4.4 Bearing Capacity of Thrust Blocks

Resistance to lateral forces can be assumed to be provided by friction at the base of thrust blocks and by passive earth pressure. Thrust blocks for the pipeline may be designed using a lateral bearing capacity based on an allowable lateral soil pressure of 250 pcf, computed as an equivalent fluid pressure. An ultimate value of coefficient of friction of 0.35 may be used between the thrust block and the supporting natural soil or compacted fill. The allowable vertical soil pressure may be taken as 1,500 psf.

4.5 Pump Station Geotechnical Design Criteria

The pump station may be designed for an allowable soil bearing pressure of 2,000 pounds per square foot (psf) at the base of the station (around 10 feet depth). Footings and equipment foundations which are embedded a minimum of 18 inches into native soil or compacted backfill around the pump wet-well may be designed for an allowable bearing pressure of 1,500 psf. It is suggested that a rigid mat (12-inch minimum thickness) be used for structures placed over wet-well backfill.

Horizontal sliding can be resisted with passive earth pressure equivalent to 250 pounds per cubic foot (pcf) of fluid pressure and a coefficient of friction of 0.25. Groundwater buoyant forces and lateral loads should be considered in the wet well design. Active earth pressures of 55 pcf should be used above groundwater and at-rest pressures of 70 pcf should be used for braced walls.

Liquefaction: Liquefaction can potentially occur at the site because of underlying saturated sandy substrata. In general, liquefaction studies performed by our firm in this region may result in ½ to 3 inches of settlement in the mass soil structure.

It is not believed that mitigation for potential liquefaction settlement is warranted at this site. However, piping connections to the pump station should include provisions for differing settlement between the pipeline and the wet well shaft. A series of flexible (rubber gasketed) joints near the wet well is believed appropriate.

4.6 Dewatering

Groundwater was not encountered in the 11.5 feet deep borings (B-2 through B-5) at the time of exploration but may rise with time to approximately 8 to 10 feet below ground surface at the pipeline alignment. The proposed pipeline depths at most locations will vary from 5 to 7 feet below ground surface. We do not anticipate that dewatering will be required for the pipeline alignment.

The excavation for the pump station will encounter the groundwater table (2.8 feet bgs on August 30, 2006). Therefore, seepage and pumping subgrade conditions should be anticipated. An adequately designed dewatering system (well points) will be required to control groundwater seepage and prevent running ground conditions. The groundwater recharge from the unlined Central Main Canal should be considered. The responsibility for dewatering and selection of an appropriate system is beyond the scope of this report.

4.7 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate C-3). The native soil was found to have moderate to severe sulfate ion concentration (1,228 to 5,175 ppm). Sulfate ions in high concentrations can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. The Uniform Building Code recommends that increased quantities of Type II Portland Cement be used at a low water/cement ratio when concrete is subjected to moderate sulfate concentrations. Type V Portland Cement and/or Type II/V cement with 25% flyash replacement is recommended when the concrete is subjected to soil with severe sulfate concentration. A minimum of 6.0 sacks per cubic yard of concrete (4,500 psi) of Type V Portland Cement with a maximum water/cement ratio of 0.45 (by weight) should be used for concrete placed in contact with native soil on this project. Admixtures may be required to allow placement of this low water/cement ratio concrete.

The native soil has moderate to very severe chloride ion concentrations (340 to 9,940 ppm). Chloride ions can cause corrosion of reinforcing steel and buried metallic conduits. Resistivity determinations on the soil indicate very severe potential for metal loss because of electrochemical corrosion processes. A minimum concrete cover of 3.0 inches shall be provided around steel reinforcing or embedded components exposed to native soil. If the 3-inch concrete edge distance cannot be achieved, all embedded steel components shall be epoxy dipped for corrosion protection or a permanent waterproofing membrane shall be placed along the exterior face of the structure. Additionally, the concrete should be thoroughly vibrated at footings during placement to decrease the permeability of the concrete. All exposed metals/pipeline fittings should be coated or wrapped in polyethylene in accordance with AWWA Standards for corrosive protection.

4.8 Seismic Design

This site is located in the seismically active southern California area and the site structures are subject to strong ground shaking due to potential fault movements along the Brawley, Superstition Hills, and Imperial Faults. Engineered design and earthquake-resistant construction are the common solutions to increase safety and development of seismic areas. Designs should comply with the latest edition of the CBC for Seismic Zone 4 using the seismic coefficients given in Section 3.4 of this report. ***This site lies approximately 10.0 km from a Type A fault (Imperial Fault) and overlying S_D (stiff) soil.***

4.9 Pavements

Pavements should be designed according to CALTRANS or other acceptable methods. Traffic indices were not provided by the project engineer or owner; therefore, we have provided structural sections for several traffic indices for comparative evaluation. The public agency or design engineer should decide the appropriate traffic index for the site. Maintenance of proper drainage is necessary to prolong the service life of the pavements. Based on the current State of California CALTRANS method, an estimated R-value of 5 for the subgrade soil and assumed traffic indices, the following table provides our estimates for asphaltic concrete (AC) pavement sections.

RECOMMENDED PAVEMENTS SECTIONS

R-Value of Subgrade Soil - 5 (estimated) Design Method - CALTRANS 1990

Traffic Index (assumed)	Flexible Pavements	
	Asphaltic Concrete Thickness (in.)	Aggregate Base Thickness (in.)
4.0	3.0	8.0
5.0	3.0	9.0
6.0	3.0	14.0
6.5	4.0	14.0
8.0	4.0	18.0
10.0	4.5	26.0

Notes:

1) Asphaltic concrete shall be Caltrans, Type B, ¾ inch maximum medium grading (½ inch in parking areas), compacted to a minimum of 95% of the 75-blow Marshall density (ASTM D1559).
2) Aggregate base shall conform to Caltrans Class 2 (¾ in. maximum), compacted to a minimum of 95% of ASTM D1557 maximum dry density.
3) Place pavements on 8 inches of moisture conditioned (minimum 2% above optimum) native soil compacted to a minimum of 90% of the maximum dry density determined by ASTM D1557.
4) Typical Street Classifications (Imperial County)

Cul-de-Sacs:	TI = 5.0
Local Streets:	TI = 6.0
Minor Collectors:	TI = 6.5
Major Collectors:	TI = 8.0
Minor Arterial:	TI = 10.0
Primary Arterial:	TI = 11.0

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The recommendations and conclusions within this report are based on current information regarding the proposed Heber Public Utilities District (HPUD) raw water supply pipeline located in southern Heber, California. The conclusions and recommendations of this report are invalid if:

- The water line is relocated.
- The Additional Services section of this report is not followed.
- This report is used for adjacent or other property.
- Changes of grade or groundwater occur between the issuance of this report and construction other than those anticipated in this report.
- Any other change that materially alters the project from that proposed at the time this report was prepared.

Findings and recommendations in this report are based on selected points of field exploration, geologic literature, laboratory testing, and our understanding of the proposed project. Our analysis of data and recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil conditions can exist between and beyond the exploration points or groundwater elevations may change. If detected, these conditions may require additional studies, consultation, and possible design revisions.

This report contains information that may be useful in the preparation of contract specifications. However, the report is not worded is such a manner that we recommend its use as a construction specification document without proper modification. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

This report was prepared according to the generally accepted *geotechnical engineering standards of practice* that existed in Imperial County at the time the report was prepared. No express or implied warranties are made in connection with our services. This report should be considered invalid for periods after two years from the report date without a review of the validity of the findings and recommendations by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice.

The client has responsibility to see that all parties to the project including, designer, contractor, and subcontractor are made aware of this entire report. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

5.2 Additional Services

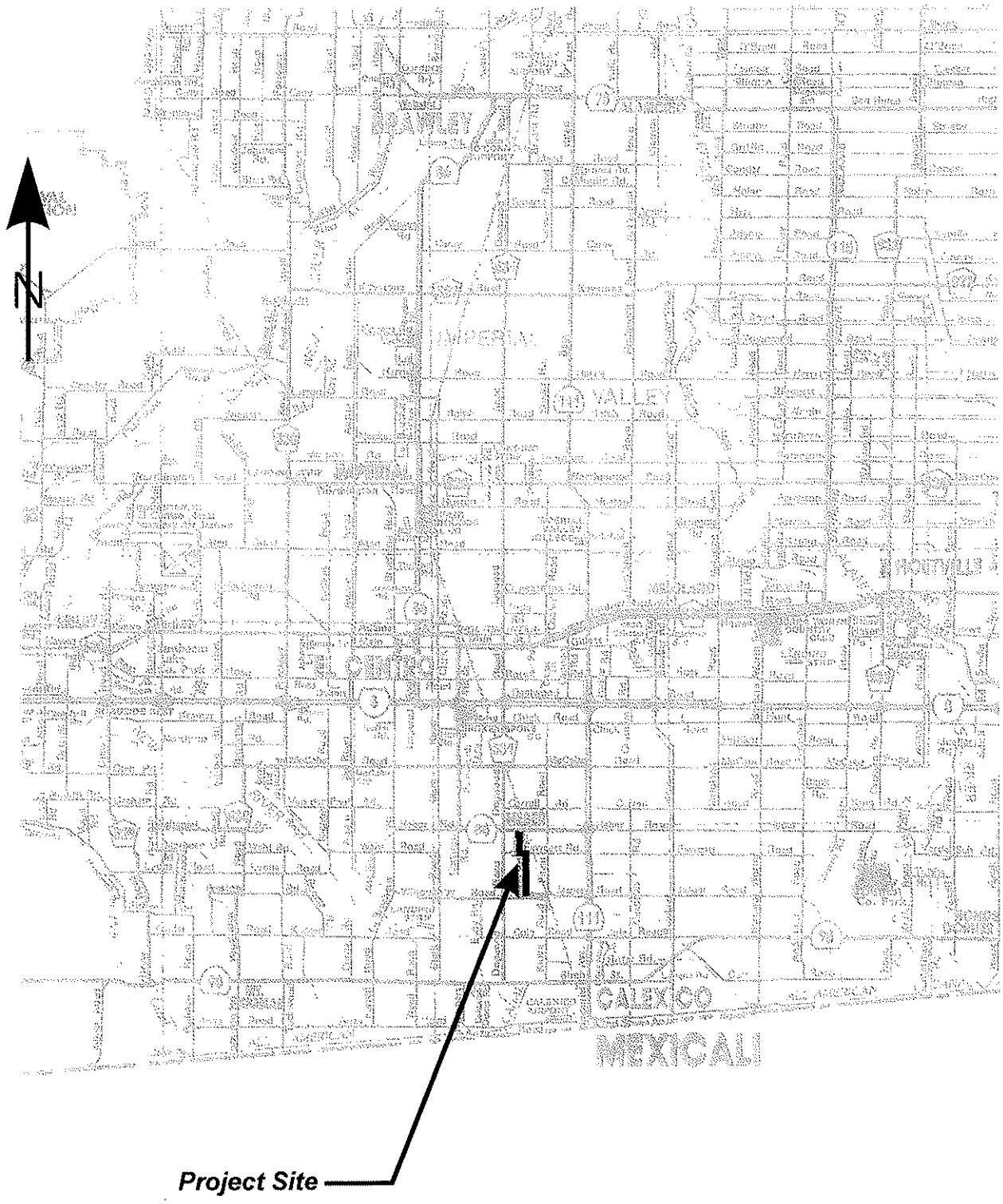
The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be conducted during construction to check the field subsurface conditions and compliance of the recommendations. *The geotechnical engineering firm providing the tests and observations shall assume the responsibility of geotechnical engineer of record.*

These tests and observations should include, but not necessarily be limited to the following:

- Observation and testing by the geotechnical consultant of record during excavation and backfilling of trench.
- Consultation as may be required during construction.

In addition, we should review the project plans and specifications to check for compatibility with our recommendations and conclusions. Additional information concerning the scope and cost of these services can be obtained from our office.

APPENDIX A



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Vicinity Map

Plate
A-1

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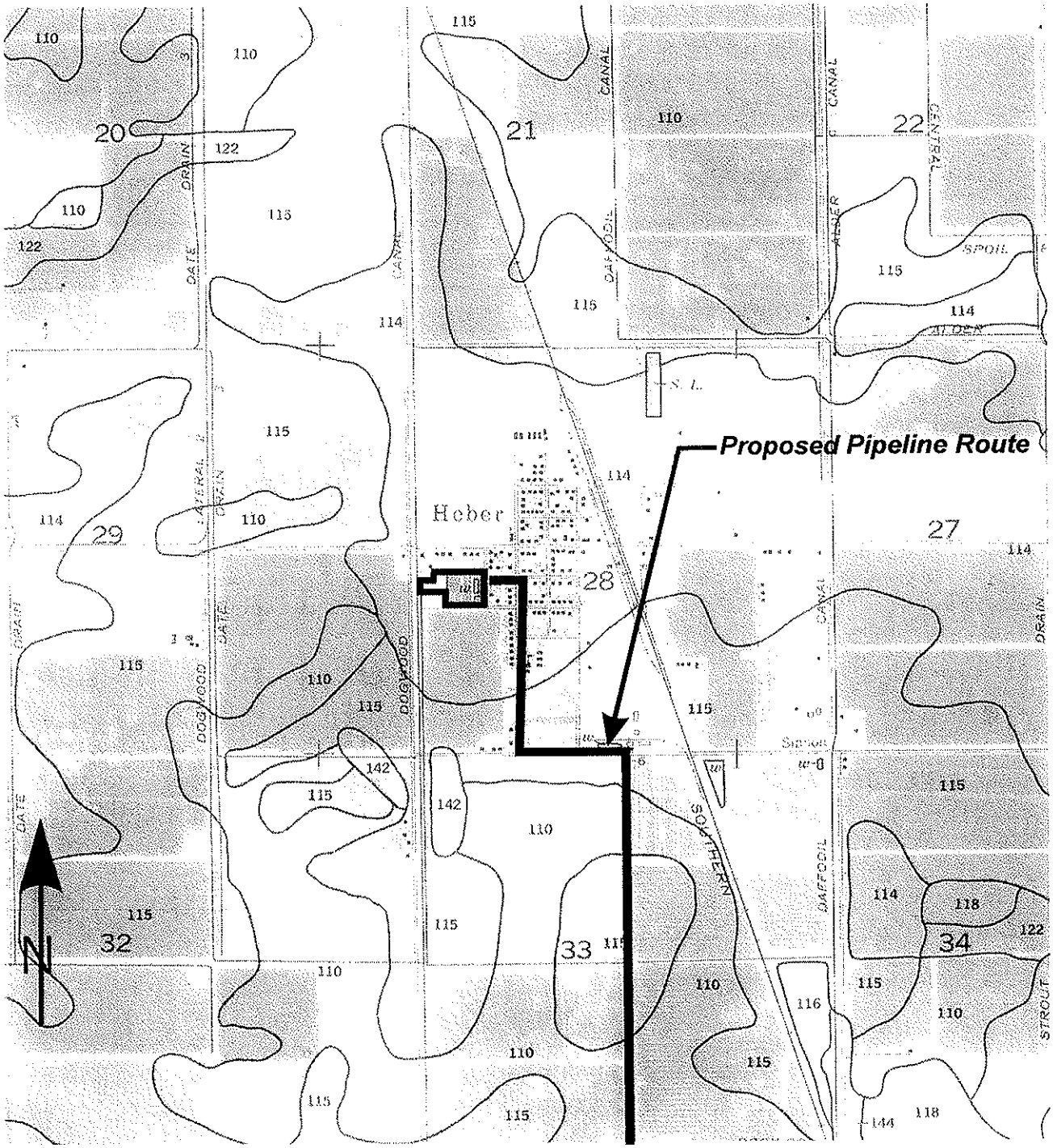
LANDMARK Geo-Engineers and Geologists a DBE/MBE/SBE Company Project No.: LE06276	Site and Exploration Map	Plate A-2



LANDMARK
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a DSE/MSE/SSE Company

Project No.: LE06276

Soil Survey Map

Plate
A-3

Soil Survey of

IMPERIAL COUNTY CALIFORNIA IMPERIAL VALLEY AREA

United States Department of Agriculture Soil Conservation Service
in cooperation with
University of California Agricultural Experiment Station
and
Imperial Irrigation District

TABLE 11.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

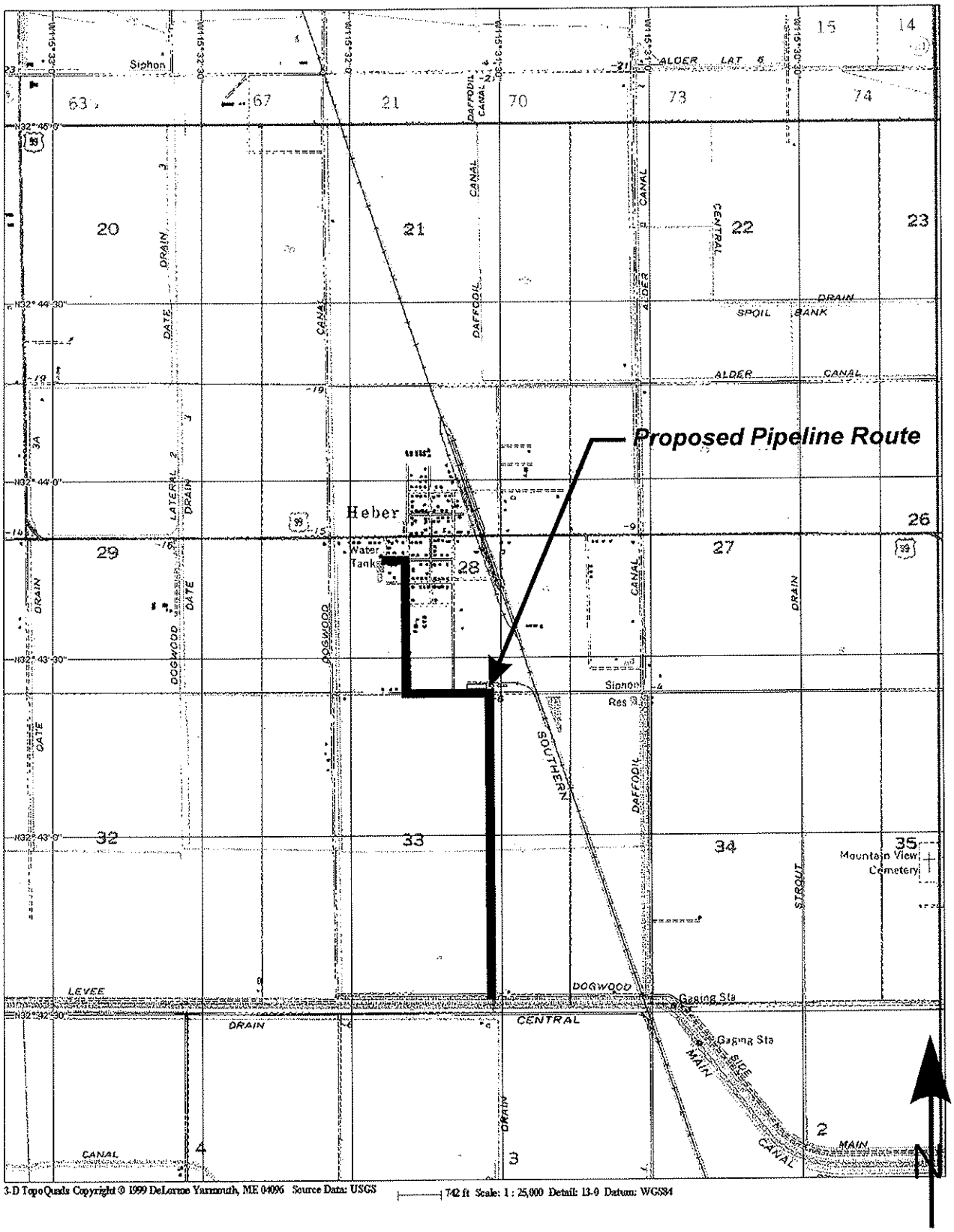
Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
100---------- Antho	0-13	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	13-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
101*:											
Antho----------	0-8	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	8-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
Superstition------	0-6	Fine sand--------	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
102*. Badland											
103---------- Carsitas	0-10	Gravelly sand---	SP, SP-SM	A-1, A-2	0-5	60-90	50-85	30-55	0-10	---	NP
	10-60	Gravelly sand, gravelly coarse sand, sand.	SP, SP-SM	A-1	0-5	60-90	50-85	25-50	0-10	---	NP
104* Fluvaquents											
105---------- Glenbar	0-13	Clay loam--------	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
106---------- Glenbar	0-13	Clay loam--------	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
107*---------- Glenbar	0-13	Loam----------	ML, CL-ML, CL	A-4	0	100	100	100	70-80	20-30	NP-10
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	75-95	35-45	15-30
108---------- Holtville	0-14	Loam----------	ML	A-4	0	100	100	85-100	55-95	25-35	NP-10
	14-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
109---------- Holtville	0-17	Silty clay------	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP
110---------- Holtville	0-17	Silty clay------	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	55-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
111*:											
Holtville	0-10	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	10-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
Imperial	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
112 Imperial	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
113 Imperial	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	100	85-95	50-70	25-45
114 Imperial	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
115*:											
Imperial	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
116*:											
Imperial	0-13	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	13-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
117, 118 Indio	0-12	Loam	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
119*:											
Indio	0-12	Loam	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
Vint	0-10	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	25-35	---	NP
	10-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
120* Laveen	0-12	Loam	ML, CL-ML	A-4	0	100	95-100	75-85	55-65	20-30	NP-10
	12-60	Loam, very fine sandy loam.	ML, CL-ML	A-4	0	95-100	85-95	70-80	55-65	15-25	NP-10

See footnote at end of table.



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS 742 ft Scale: 1 : 25,000 Detail: 13-0 Datum: WGS84

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Project No.: LE06276

Topographic Map

Plate A-4

APPENDIX B

LOG OF BORING NO. B-1

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
					SILTY CLAY (CL): Brown, dry to moist, low plasticity GWT @ 2.8 ft			LL=26 PI=9
5			5		SANDY SILT/SILTY SAND (ML-SM): Gray brown, saturated, loose, fine grained sand	25.8	99.9	Minus 200=51%
10			10	1.0	CLAY (CH): Brown, very moist, stiff consistency, high plasticity			
15			4	0.5	Firm consistency			LL=59 PI=40
20			4	1.0	Reddish brown			
					Total Depth = 21.5' Groundwater Encountered at 2.8 ft (08-30-06) Backfilled with excavated soil			
25								
30								

DATE DRILLED:	8/16/06	TOTAL DEPTH:	21.5 Feet	DEPTH TO WATER:	2.8 ft.
LOGGED BY:	J. Avalos	TYPE OF BIT:	CME 55 w/autohammer	DIAMETER:	8-inch
SURFACE ELEVATION:		HAMMER WT.:	140 lbs.	DROP:	30 inches

PROJECT NO. LE06276

LANDMARK
Geo-Engineers and Geologists

PLATE B-1

LOG OF BORING NO. B-2

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
	●				SILTY CLAY (CL): Brown, dry to moist, medium plasticity			LL=42 PI=27
5			10		CLAYEY SILT/SILT (ML):Brown, very moist, medium dense, some fine grained sand			
10			5	1.0	CLAY (CH): Brown, very moist, stiff consistency, high plasticity			LL=50 PI=34
					Total Depth = 11.5' No Free Water Encountered Backfilled with excavated soil			
15								
20								
25								
30								

DATE DRILLED:	7/31/06	TOTAL DEPTH:	11.5 Feet	DEPTH TO WATER:	N/A
LOGGED BY:	J. Avalos	TYPE OF BIT:	CME 55 w/autohammer	DIAMETER:	8-inch
SURFACE ELEVATION:		HAMMER WT.:	140 lbs.	DROP:	30 inches

PROJECT NO. LE06276

LANDMARK
Geo-Engineers and Geologists

PLATE B-2

LOG OF BORING NO. B-3

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
					SILTY CLAY (CL): Brown, dry to moist, medium plasticity			LL=41 PI=23
					SILTY SAND (SM):Light brown, moist, loose, fine grained sand			Minus 200=84%
5			6	2.5	CLAY (CH):Brown, moist to very moist, firm to stiff consistency, high plasticity			
10			3	0.5	SILTY CLAY (CL): Brown, very moist, soft consistency, medium plasticity			LL=31 PI=15
					Total Depth = 11.5' No Free Water Encountered Backfilled with excavated soil			
15								
20								
25								
30								

DATE DRILLED:	8/15/06	TOTAL DEPTH:	11.5 Feet	DEPTH TO WATER:	N/A
LOGGED BY:	J. Avalos	TYPE OF BIT:	CME 55 w/autohammer	DIAMETER:	8-inch
SURFACE ELEVATION:		HAMMER WT.:	140 lbs.	DROP:	30 inches

PROJECT NO. LE06276

LANDMARK
Geo-Engineers and Geologists

PLATE B-3

LOG OF BORING NO. B-4

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
					SILTY CLAY (CL): Brown, dry to moist, medium plasticity			LL=32 PI=14
5			6	3.5	CLAY (CH):Reddish brown, moist to very moist, stiff to very stiff consistency, high plasticity			LL=56 PI=38
10			10	4.0				
					Total Depth = 11.5' No Free Water Encountered Backfilled with excavated soil			
15								
20								
25								
30								

DATE DRILLED:	8/15/06	TOTAL DEPTH:	11.5 Feet	DEPTH TO WATER:	N/A
LOGGED BY:	J. Avalos	TYPE OF BIT:	CME 55 w/autohammer	DIAMETER:	8-inch
SURFACE ELEVATION:		HAMMER WT.:	140 lbs.	DROP:	30 inches

PROJECT NO. LE06276

LANDMARK
Geo-Engineers and Geologists

PLATE B-4

LOG OF BORING NO. B-5

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
					SILTY CLAY (CL): Brown, dry to moist, medium plasticity			LL=47 PI=32
5			10		SANDY SILT (ML):Light brown, moist, medium dense, with fine grained sand			Minus 200=80%
10			9	1.5	CLAY (CH):Reddish brown, very moist, stiff to very stiff consistency, high plasticity			LL=59 PI=35
					Total Depth = 11.5' No Free Water Encountered Backfilled with excavated soil			
15								
20								
25								
30								

DATE DRILLED:	8/15/06	TOTAL DEPTH:	11.5 Feet	DEPTH TO WATER:	N/A
LOGGED BY:	J. Avalos	TYPE OF BIT:	CME 55 w/autohammer	DIAMETER:	8-inch
SURFACE ELEVATION:		HAMMER WT.:	140 lbs.	DROP:	30 inches

PROJECT NO. LE06276

LANDMARK
Geo-Engineers and Geologists

PLATE B-5

DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS	SECONDARY DIVISIONS
Coarse grained soils More than half of material is larger than No. 200 sieve	**Gravels** More than half of coarse fraction is larger than No. 4 sieve	Clean gravels (less than 5% fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, or gravel-sand mixtures, little or no fines
		Gravel with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	Sands More than half of coarse fraction is smaller than No. 4 sieve	Clean sands (less than 5% fines)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
		Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
Fine grained soils More than half of material is smaller than No. 200 sieve	**Silts and clays** Liquid limit is less than 50%		ML	Inorganic silts, clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravely, sandy, or lean clays
			OL	Organic silts and organic clays of low plasticity
	Silts and clays Liquid limit is more than 50%		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils			PT	Peat and other highly organic soils

GRAIN SIZES

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

200 4 10 4 3/4" 3" 12"

US Standard Series Sieve — Clear Square Openings

Sands, Gravels, etc.	Blows/ft. *
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays & Plastic Silts	Strength **	Blows/ft. *
Very Soft	0-0.25	0-2
Soft	0.25-0.5	2-4
Firm	0.5-1.0	4-8
Stiff	1.0-2.0	8-16
Very Stiff	2.0-4.0	16-32
Hard	Over 4.0	Over 32

* Number of blows of 140 lb. hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 in. I.D.) split spoon (ASTM D1586).

** Unconfined compressive strength in tons/s.f. as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D1586), Pocket Penetrometer, Torvane, or visual observation.

Type of Samples:

Ring Sample — Standard Penetration Test — Shelby Tube — Bulk (Bag) Sample

Drilling Notes:

1. Sampling and Blow Counts
   - Ring Sampler - Number of blows per foot of a 140 lb. hammer falling 30 inches.
   - Standard Penetration Test - Number of blows per foot.
   - Shelby Tube - Three (3) inch nominal diameter tube hydraulically pushed.
2. P. P. = Pocket Penetrometer (tons/s.f.).
3. NR = No recovery.
4. GWT ▼ = Ground Water Table observed @ specified time.

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Project No: LE06276

Key to Logs

Plate B-6

APPENDIX C

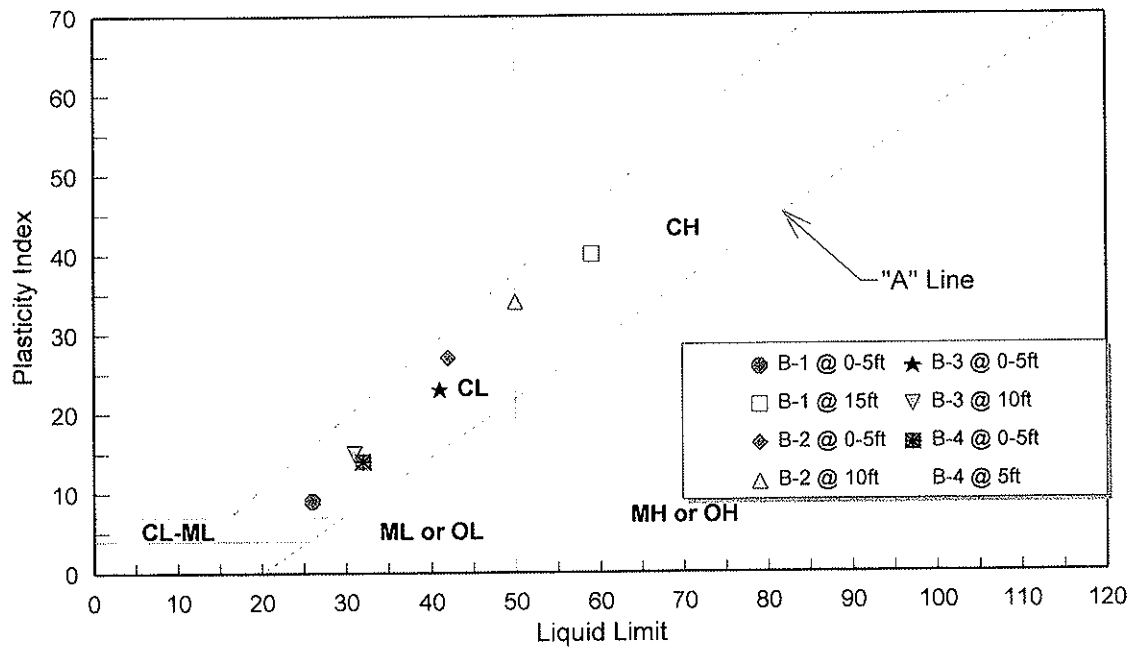
LANDMARK CONSULTANTS, INC.

CLIENT: The Holt Group
PROJECT: HPUD WTP Water Supply Pipeline, Heber, CA
JOB NO: LE06276
DATE: 08/25/06

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classif-ation
B-1	0-5	26	17	9	CL
B-1	15	59	19	40	CH
B-2	0-5	42	15	27	CL
B-2	10	50	16	34	CL-CH
B-3	0-5	41	18	23	CL
B-3	10	31	16	15	CL
B-4	0-5	32	18	14	CL
B-4	5	56	18	38	CH

PLASTICITY CHART



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Project No: LE06276

Atterberg Limits Test Results

Plate C-1

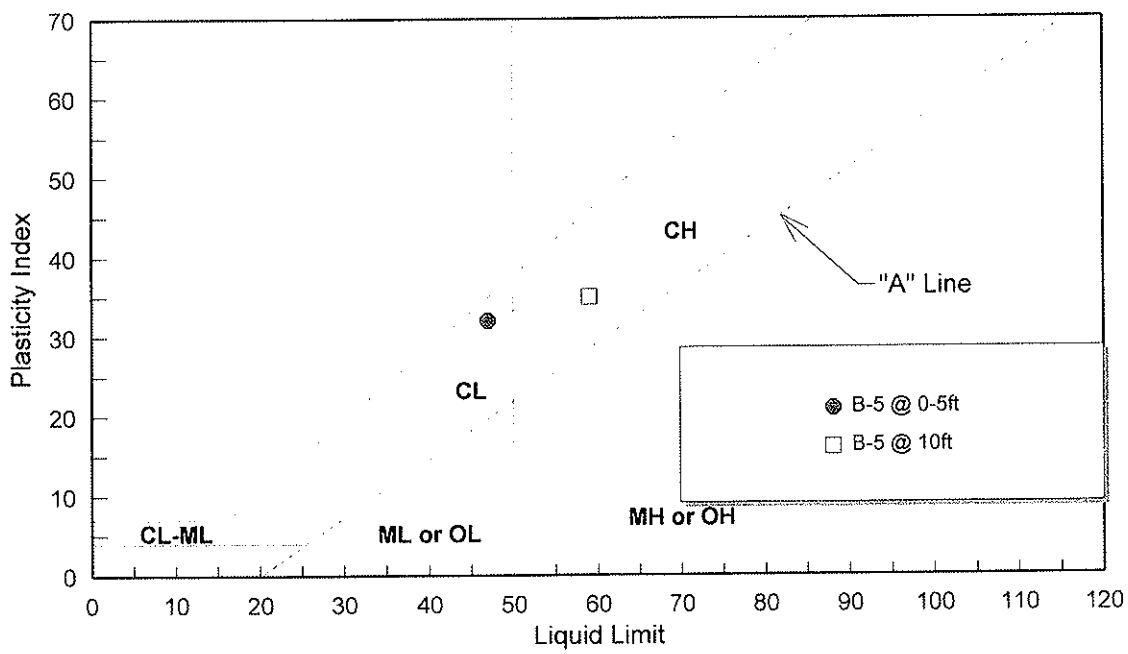
LANDMARK CONSULTANTS, INC.

CLIENT: The Holt Group
PROJECT: HPUD WTP Water Supply Pipeline, Heber, CA
JOB NO: LE06276
DATE: 08/25/06

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classif-ation
B-5	0-5	47	15	32	CL
B-5	10	59	24	35	CH

PLASTICITY CHART



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Project No: LE06276

Atterberg Limits Test Results

Plate C-2

LANDMARK CONSULTANTS, INC.

CLIENT: The Holt Group
PROJECT: HPUD WTP Water Supply Pipeline, Heber, CA
JOB NO: LE06276
DATE: 08/23/06

CHEMICAL ANALYSES

Boring:	B-1	B-3	B-4	B-5	CalTrans Method
Sample Depth, ft:	0-5	0-5	0-5	0-5	
pH:	7.9	7.5	7.6	7.5	643
Electrical Conductivity (mmhos):	0.6	2.3	1.9	2.4	424
Resistivity (ohm-cm):	580	110	210	120	643
Chloride (Cl), ppm:	340	9,940	3,070	8,800	422
Sulfate (SO4), ppm:	1,228	2,136	4,859	5,175	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble Sulfates	0 -1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity	1-1,000	Very Severe
		1,000-2,000	Severe
		2,000-10,000	Moderate
		> 10,000	Low

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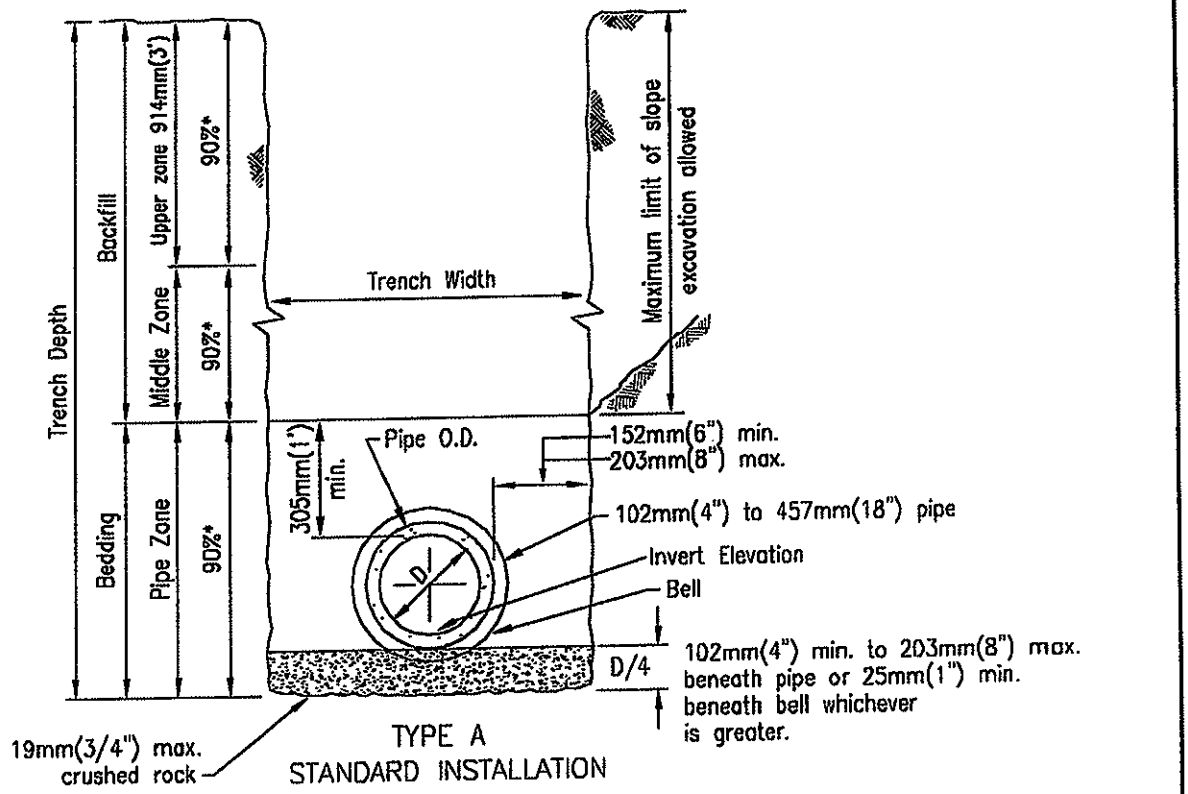
Project No: LE06276

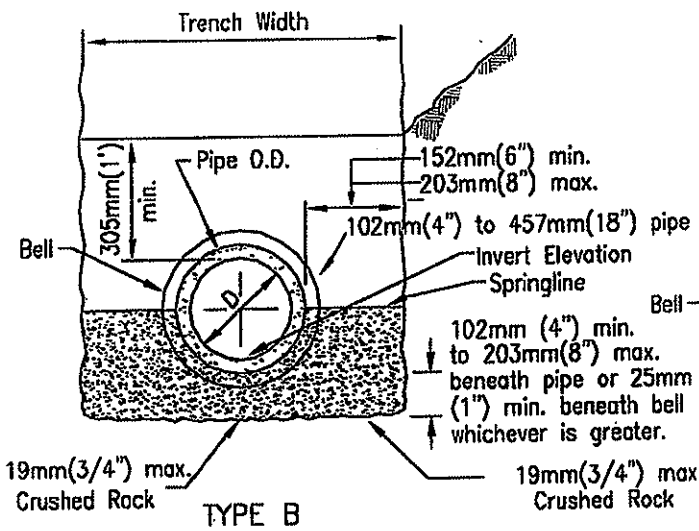
Selected Chemical Analyses Results

Plate C-3

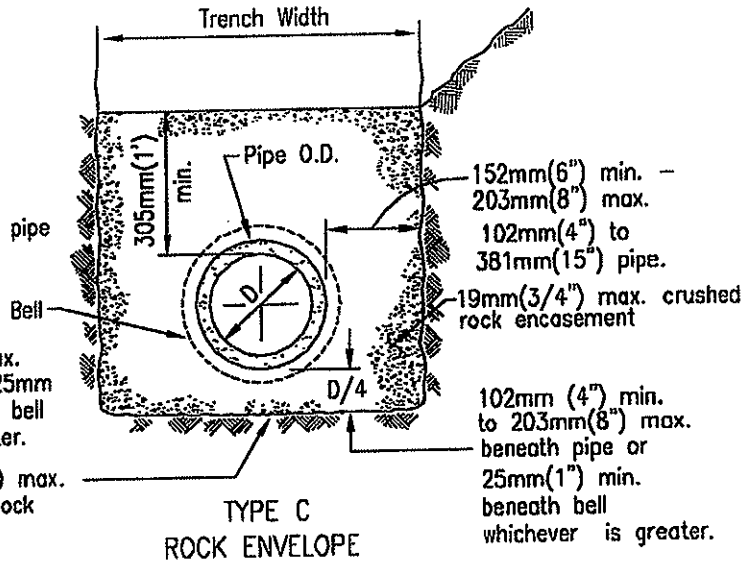
APPENDIX D



TYPE A
STANDARD INSTALLATION



TYPE B
ROCK TO SPRINGLINE



TYPE C
ROCK ENVELOPE

NOTES

1. For trenching in improved streets, see Standard Drawings G-24 or G-25 for trench resurfacing.
2. (*) indicates minimum relative compaction.
3. Minimum depth of cover from the top of pipe to finish grade for all sanitary sewer installations shall be 914mm(3') For cover less than 914mm(3'), see Standard Drawing S-7 for concrete encasement.
4. See Type A installation for details not shown for Types B and C.

Revision	By	Approved	Date
ORIGINAL		A.Kercheval	12/75
Add Metric		T. Stanton	03/03

SAN DIEGO REGIONAL STANDARD DRAWING

PIPE BEDDING AND TRENCH BACKFILL FOR SEWERS

RECOMMENDED BY THE SAN DIEGO REGIONAL STANDARDS COMMITTEE

T. Stanton 3/01/2003

Chairperson R.C.E. 19246 Date

DRAWING NUMBER **S-4**

APPENDIX E

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APPENDIX E

State of California—Health and Human Services Agency
Department of Health Services

California
Department of
Health Services

SANDRA SHEWRY
Director

ARNOLD SCHWARZENEGGER
Governor

February 7, 2007

Mr. John Jordan
General Manager
Heber Public Utility District
1078 Dogwood, #103
Heber, CA 92249

HEBER PUBLIC UTILITY DISTRICT – SYSTEM NUMBER 1310007
Reliable Raw Water Transmission Pipeline

Dear Mr. Jordan:

The Department has reviewed the Reliable Raw Water Transmission Pipeline project for Heber Public Utility District (HPUD). The Department has considered and approved the project as a reliable raw water supply and therefore agrees if it is built no additional raw water ponds are required to meet capacity requirements. Any significant delays or cancellation to the project should be reported to the Department.

If you have any questions regarding this letter, please contact Mike Stewart at (619) 525-4159.

Sincerely,

Brian Bernados

Brian Bernados, P.E.
District Engineer

cc: Imperial County Environmental Health Services

Juny Marmolejo, The Holt Group
1561 South 4th Street
El Centro CA 92243

H:\Systems\Heber Public Utility District\comm\20070207 Heber PUD Pipeline approval.doc