TABLES

TABLE 1
Screening Evaluation of Mitigation Actions, Control Technologies, and Process Options

Mitigation Response Action	Control Technology	Process Option	Effectiveness	Implementability	Cost	Evaluation Decision
1. Groundwater Control	1.1 Groundwater Pumping	1.1.1 Vertical wells proximal to the interceptor wellfield	Potentially effective in short-term, potentially ineffective in long-term because well capacity will continue to decrease as saturated thickness decreases, resulting in diminished well yields and capture over time	Readily implementable on PDSI property	High	Retain for alternative development
		1.1.2 Vertical wells distal from the interceptor wellfield	Potentially effective in short- and long-term, wells east of the PDSTI where the aquifer is thicker and can sustain higher pumping rates from fewer wells to establish groundwater containment	Implementable pending permit and land access negotiation with ASLD or private parties	High	Retain for alternative development
		1.1.3 Horizontal wells	Ineffective for this application; most horizontal wells are shallow (< 100 feet deep), there are potential problems installing a horizontal well on an irregular bedrock surface in such a way as to maintain the saturated thickness for pumping	Not implementable due to technical infeasibility given site-specific conditions	High	Ineffective and not implementable, not considered further
		1.1.4 Ranney (collector) wells	Ineffective for this application, Ranney wells and other types of collector wells are typically installed to depths of 150 feet or less	Not implementable due to technical infeasibility given site-specific conditions	High	Ineffective and not implementable, not considered further
	1.2 Groundwater Barriers	1.2.1 Physical Barriers	Ineffective for this application, physical barriers are difficult to install to depths greater that 150 feet	Not implementable due to technical infeasibility given site-specific conditions	High	Ineffective and not implementable, not considered further
		1.2.2 Hydraulic barrier using injection wells	Potentially effective, a hydraulic barrier can be created by injecting low-sulfate water at the interceptor wellfield	Readily implementable on PDSI property	High	Retain for alternative development
		1.2.3 Hydraulic barrier using infiltration	Potentially effective, a hydraulic barrier can be created by infiltration ponds or infiltration gallery but would take a long time to reach steady state, is difficult to test and control, and may be influenced by perching	Infiltration gallery is potentially implementable on PDSI land, Infiltration ponds may require access to ASLD land	Moderate	Rejected from further consideration because option is potentially not as effective or controllable as a hydraulic barrier using injection wells
2. Water Treatment	2.1 In-Situ Treatment	2.1 Inject reagents for chemical precipitation or chemical or biological reduction of sulfate	Potentially ineffective due to difficulty of attaining uniform treatment and potential well and aquifer clogging	Not implementable due to technical infeasibility	High	Ineffective and not implementable, not considered further
	2.2 Ex-Situ Treatment	2.2 Treatment by membrane process (reverse osmosis, nanofiltration, electrodialysis reversal)	Effective; reverse osmosis or nanofiltration identified as the most feasible treatment technologies. Treatment expensive and produces a brine waste although retained as option for water treatment if needed	Implementable	High	Retain for alternative development
3. Water Management	3.1 Mine Use	3.1 Pump to mine without treatment	Effective pending water need in the mining operation	Implementable	Low	Retain for alternative development
	3.2 Discharge to Surface	3.2 Water treatment to meet surface discharge standards	Effective, water treatment by membrane process can effectively treat water to surface discharge standards	Implementable, but not preferred due to higher cost than mine use	High	Effective, but not retained for alternative development due to high cost
	3.3 Use as Drinking Water	3.3 Water treatment to meet drinking water standards	Effective; water treatment by membrane process can effectively treat water to drinking water standards	Implementable, but not preferred due to higher cost than mine use	High	Effective, but not retained for alternative development due to high cost

Option Retained (shaded rows)

TABLE 2
Mitigation Alternatives Cost Comparison Summary

Alternative	Pre-Construction Capital	Construction Capital	Total Capital Costs	Annual O&M	25 Year O&M Total	25 Year NPV [1]
1	$108,000	$7,824,000	$7,932,000	$340,000	$16,444,000	$11,737,000
2A	$265,000	$7,744,000	$8,009,000	$1,868,000	$54,702,000	$30,750,000
2B	$278,000	$7,900,000	$8,178,000	$875,000	$30,060,000	$18,603,000
3	$600,000	$6,393,000	$6,993,000	$1,582,000	$46,537,000	$26,241,000

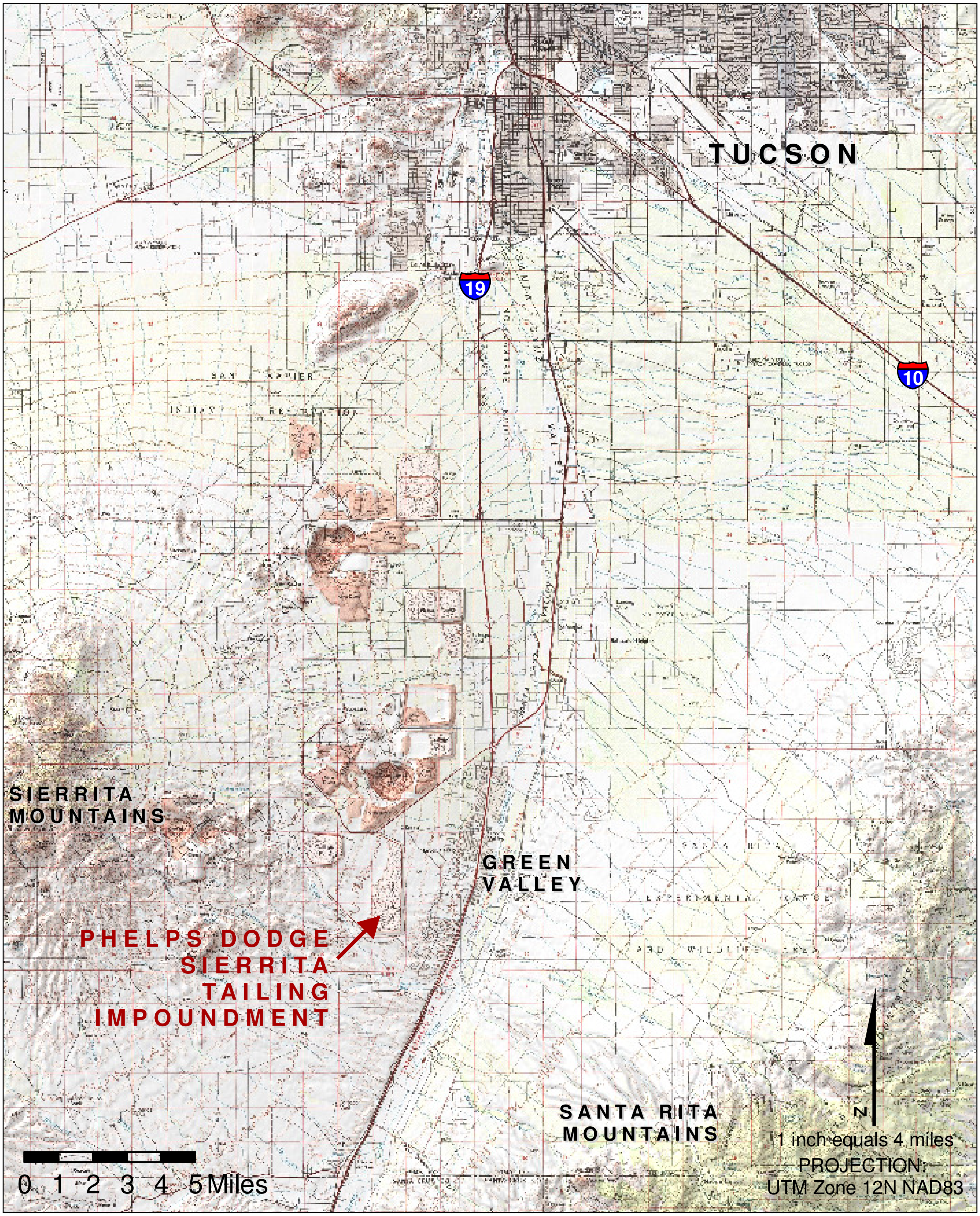
Note:
[1] *NPV = Net Present Value calculated over 25 years at 7.8% discount rate minus a 2.25% escalation rate*

TABLE 3
Comparison of Mitigation Alternatives

ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST (Millions of Dollars)	
			Total Capital	25-year NPV[1]
1. Expanded Pumping at Interceptor Wellfield	Poor - 80% short-term capture and declining effectiveness over time	Good - all work on PDSI property, Lead time of 12 to 18 months for design and construction	7.9	11.7
2A. New Wellfield 2,500 feet East of PDSTI	Good - High percentage capture expected, no long-term concerns	Good - but long lead time of 26 to 30 months for work on ASLD property	8.0	30.8
2B. New Wellfield 4,700 feet East of PDSTI	Good - High percentage capture expected, no long-term concerns	Good - lead time of 12 to 16 months for design and construction	8.2	18.6
3. Enhanced Capture at Interceptor Wellfield Using Injection Wells	Moderate - High percentage capture possible, but complicated design and potential for declining effectiveness over time	Moderate to Good - All work on PDSI property, Lead time of 18 to 24 months for design, pilot test, and construction	7.0	26.2

Note
[1] *NPV = Net Present Value calculated over 25 years at a 7.8 percent discount rate minus a 2.25 percent escalation rate*

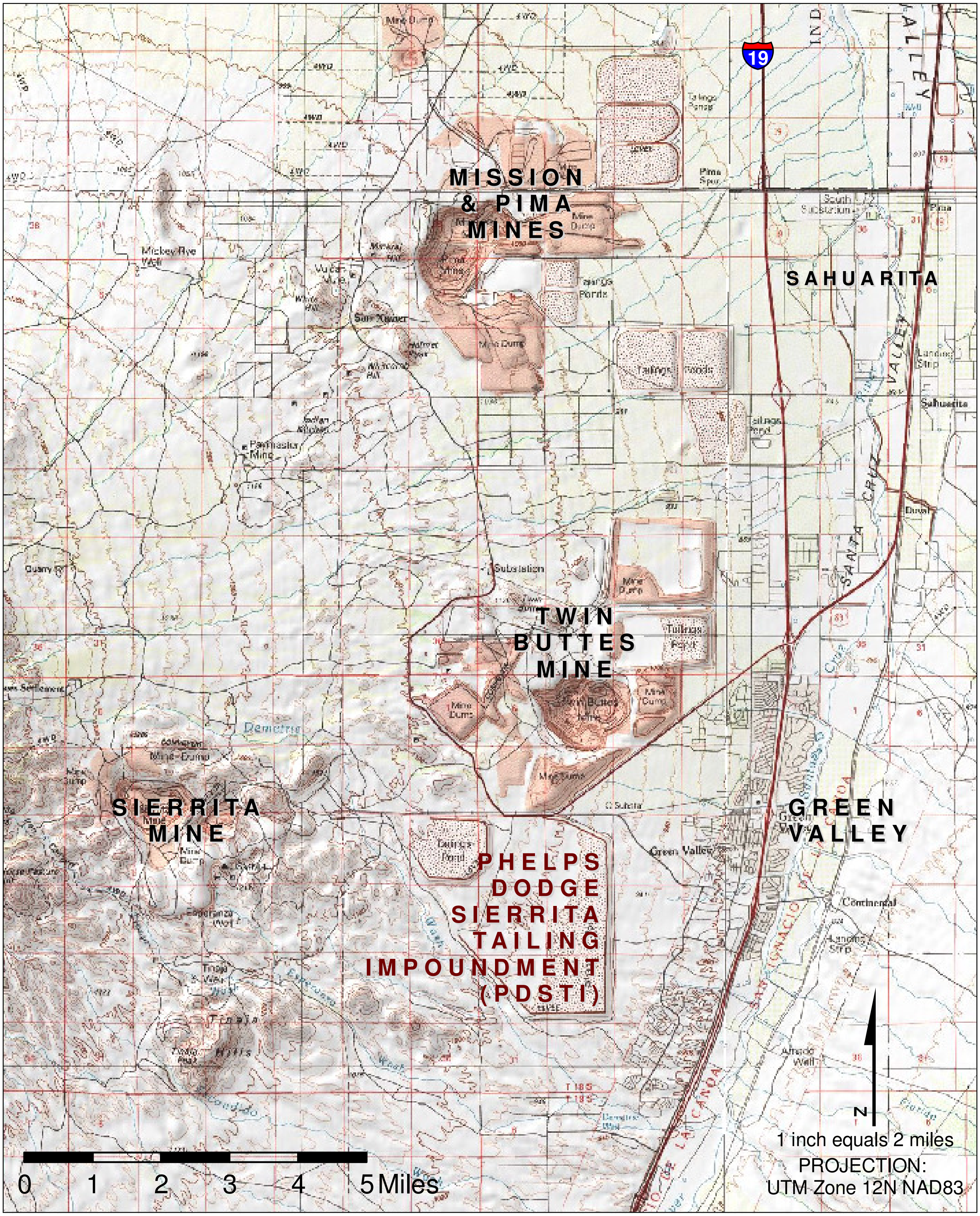
FIGURES



HYDRO GEO CHEM, INC.

REGIONAL LOCATION MAP

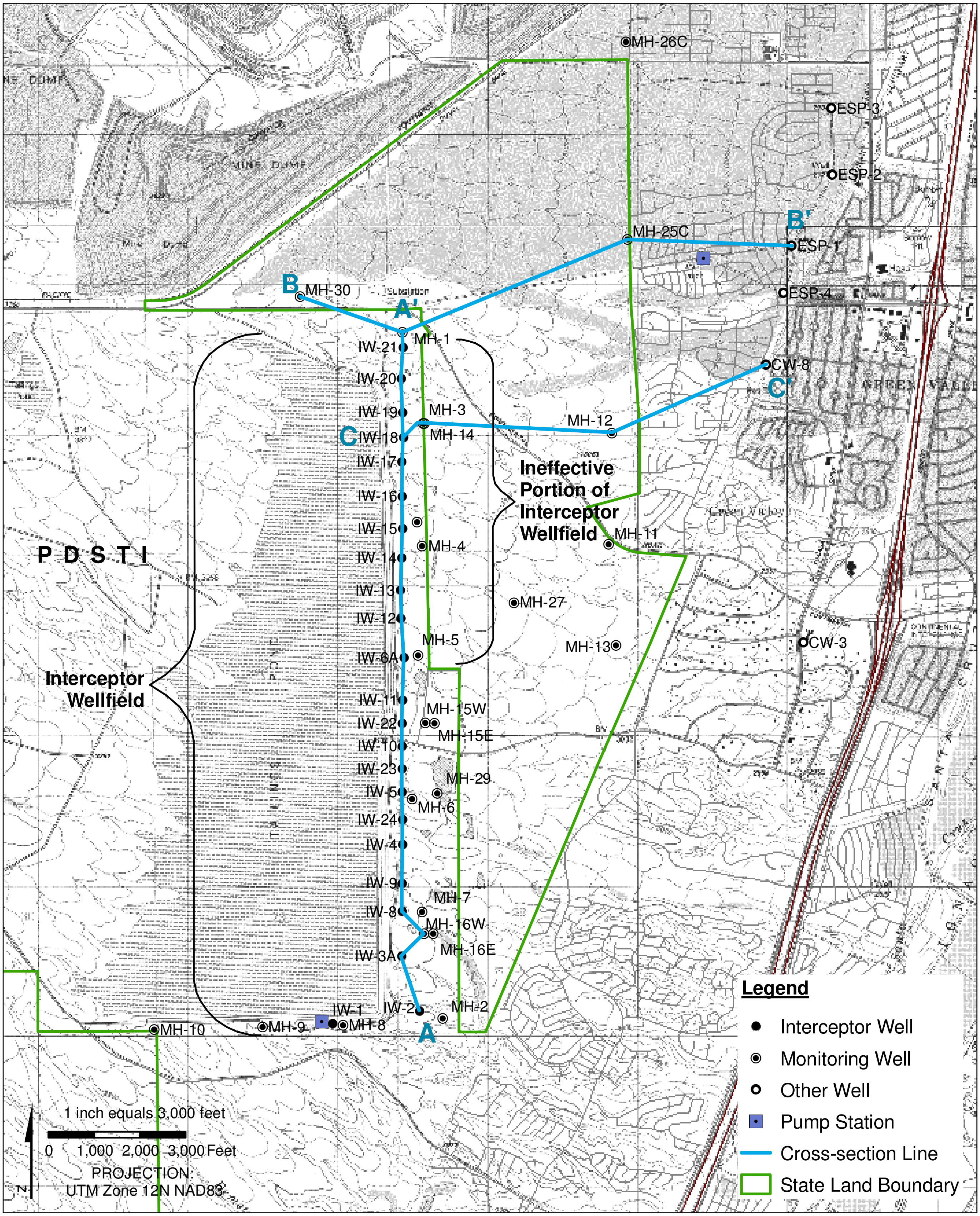
Approved	Date	Author	Date	File Name	Figure
MWK	11/13/07	RAM	11/13/07	7830032G	1



HYDRO GEO CHEM, INC.

PDSTI AND GREEN VALLEY

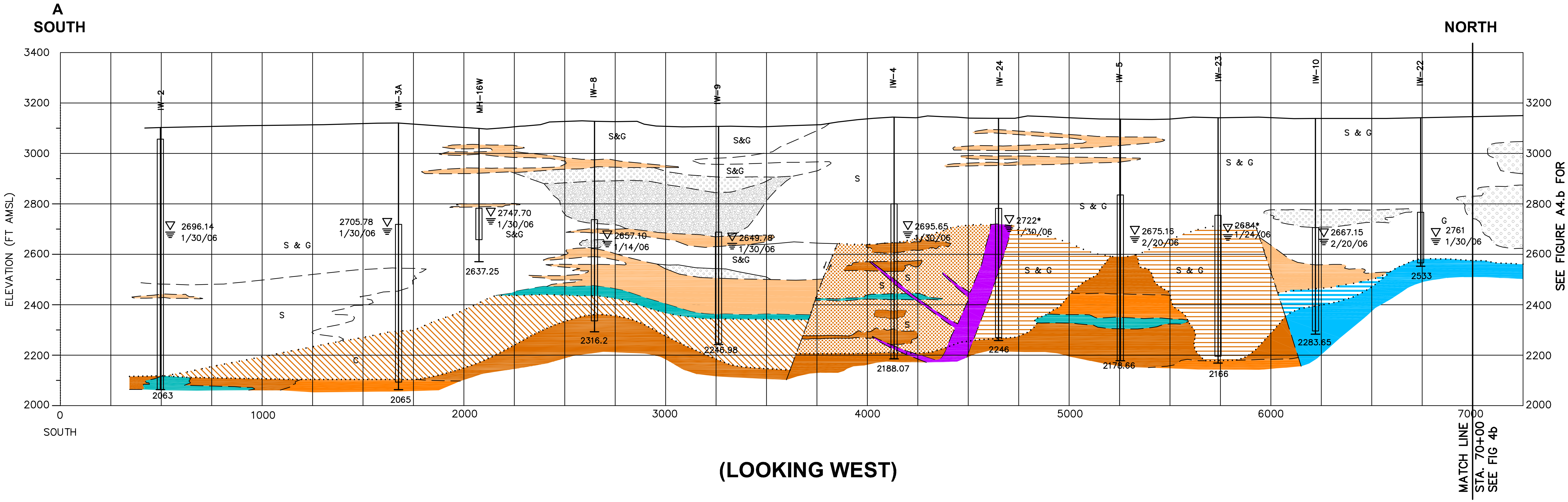
Approved	Date	Author	Date	File Name	Figure
MWK	11/13/07	RAM	11/13/07	7830018G	2



HYDRO GEO CHEM, INC.

INTERCEPTOR WELLFIELD AND CROSS-SECTION LOCATION MAP

Approved	Date	Author	Date	File Name	Figure
MWK	11/13/07	RAM	11/13/07	7830028G	3



(LOOKING WEST)

LEGEND

BASIN FILL

- C — CLAY
- S&G — SAND & GRAVEL
- S — SAND
- G — GRAVEL
- SAND, GRAVEL & BOULDERS
- LOGGED AS "HARD ROCK" OR "ROCK AND SAND"
- SANDY CLAY, CLAYEY LAYERS
- .... TOP OF BEDROCK
- . . . . TOP OF DEMETRIE VOLCANICS AND ANGELICA ARKOSE

BEDROCK COMPLEX

- EARLY TERTIARY GRANODIORITE/MONZONITE FRACTURED TO SAND & GRAVEL

Cretaceous Demetrie Volcanics:

- CLASTIC INTERBED, SANDSTONE, SILTSTONE AND ARKOSE
- VOLCANICS ALTERED AND FRACTURED TO CLAY RICH MATERIAL
- VOLCANICS ALTERED AND FRACTURED TO SAND-SIZE MATERIAL
- VOLCANICS ALTERED AND FRACTURED TO SAND & GRAVEL-SIZE MATERIAL
- ANDESITE & DACITE
- RHYOLITE

- CRETACEOUS ANGELICA ARKOSE ALTERED AND FRACTURED TO GRAVEL, SAND & CLAY
- CRETACEOUS ANGELICA ARKOSE

IW-6A — WELL ID
WELL
WATER LEVEL (DATE)
SCREEN

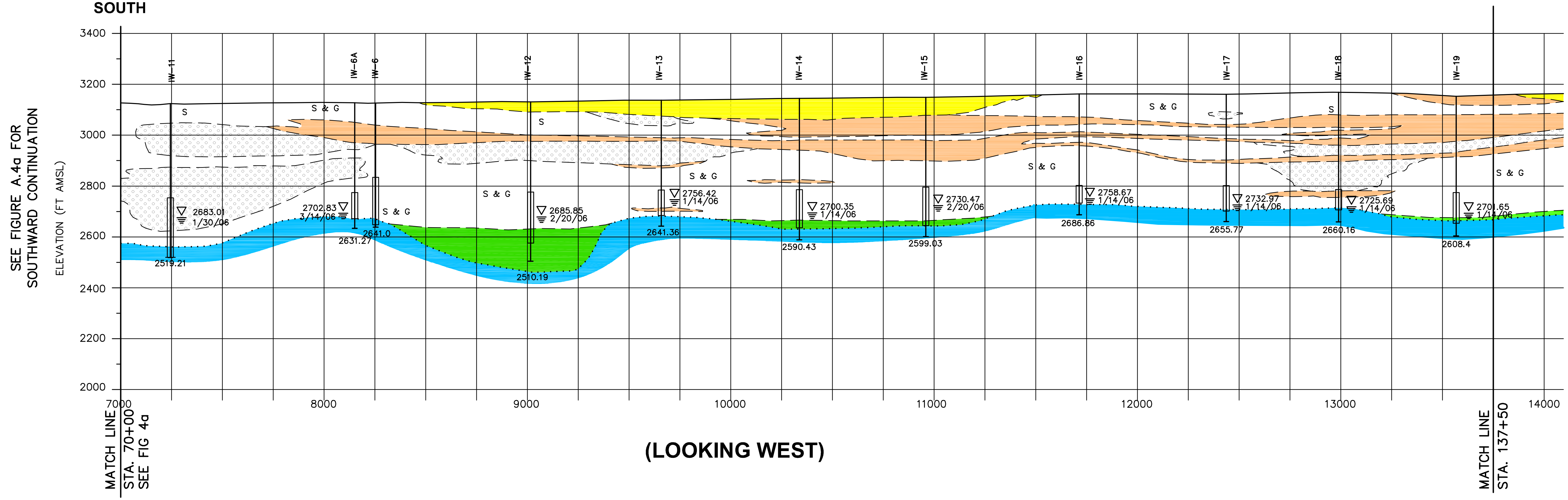
0 250 500 1000
SCALE IN FEET

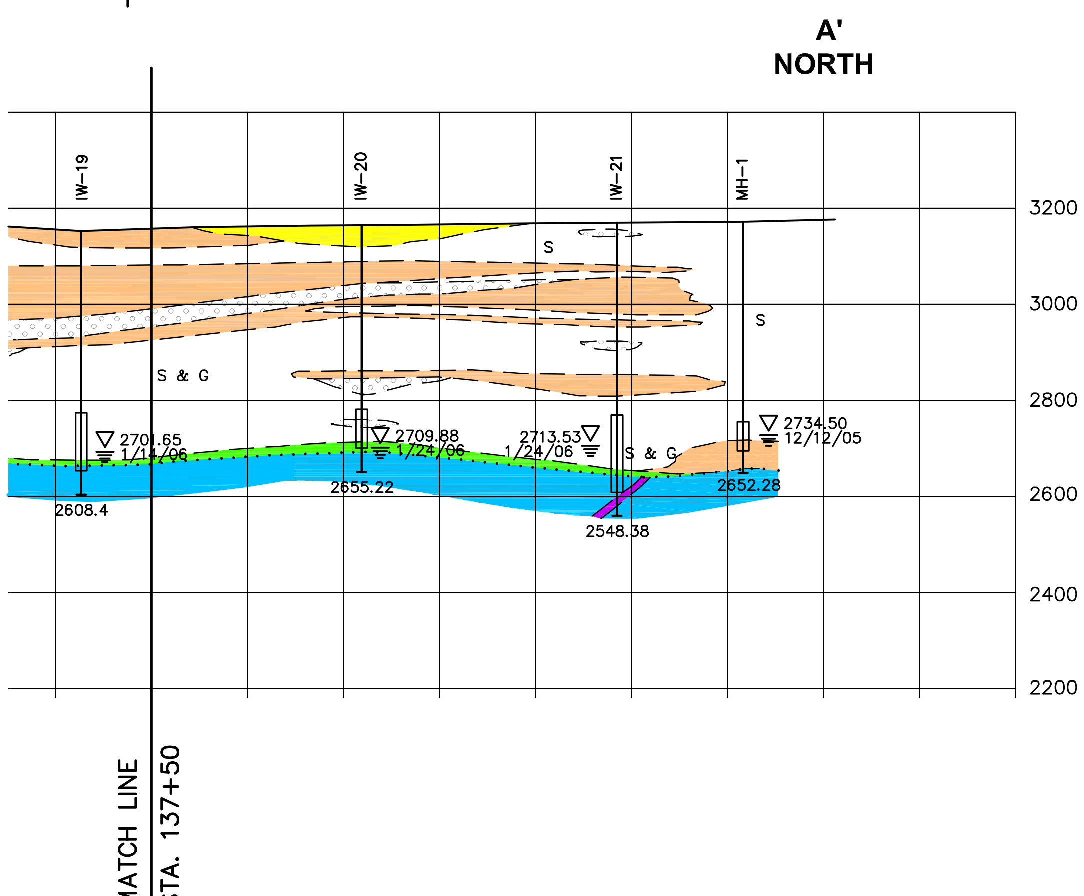
*Water level has been estimated.

HYDRO GEO CHEM, INC.

A - A' GEOLOGIC CROSS SECTION
SHEET 1 OF 2
SIERRITA TAILING IMPOUNDMENT AREA

Approved	Date	Revised	Date	Reference:	FIG.
KW	8/8/06			7830027A	4a





LEGEND

BASIN FILL

- CALICHE CEMENTED GRAVEL, SAND, SILT AND CLAY
- S — SAND
- S&G — SAND & GRAVEL, INCLUDES INTERVALS LOGGED AS SANDY GRAVEL AND GRAVELLY SAND
- SAND & GRAVEL WITH COBBLES AND INTERVALS LOGGED AS UNIDENTIFIED ROCK
- SILT AND SANDY CLAY, CLAY
- OLIGOCENE PANTANO FORMATION

BEDROCK COMPLEX

- EARLY TERTIARY QUARTZ MONZONITE
- CRETACEOUS ANGELICA ARKOSE
- TOP OF BEDROCK

IW-6A — WELL ID

WELL

WATER LEVEL (DATE)

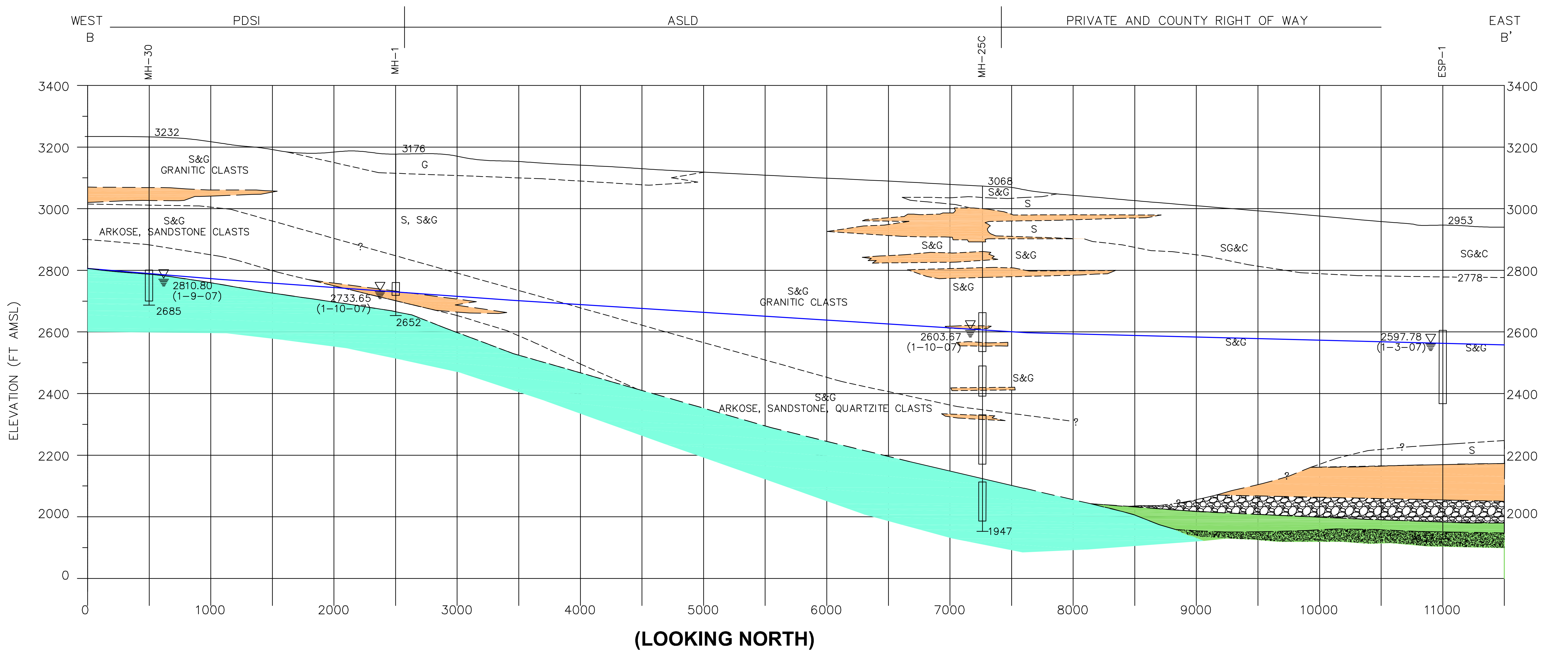
SCREEN

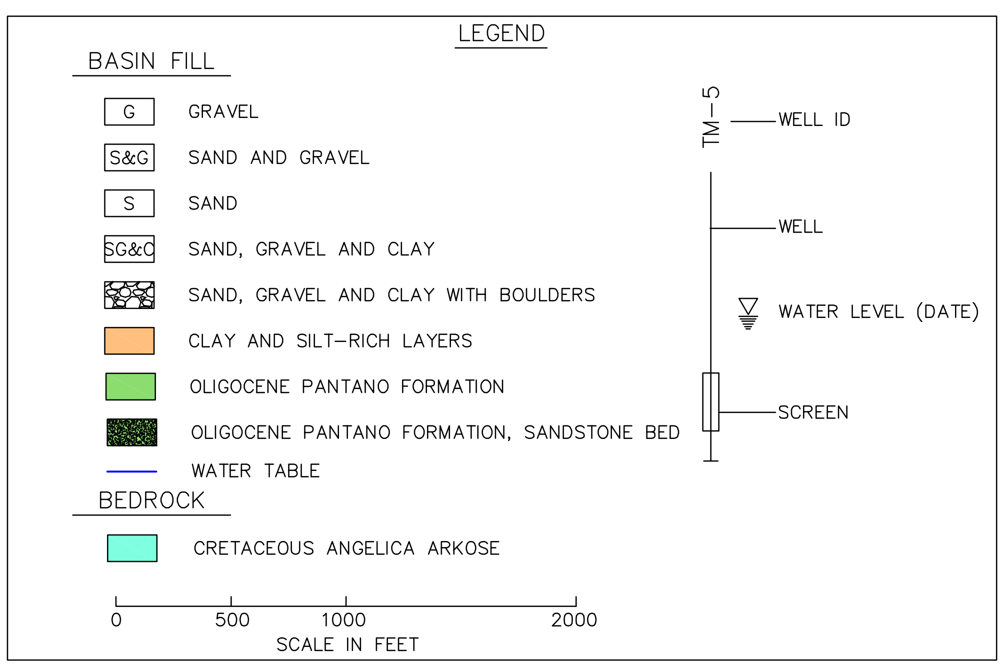
0 250 500 1000
SCALE IN FEET

HYDRO GEO CHEM, INC.

A - A' GEOLOGIC CROSS SECTION
SHEET 2 OF 2
SIERRITA TAILING IMPOUNDMENT AREA

Approved	Date	Revised	Date	Reference:	FIG.
KW	8/8/06			7830026A	4b

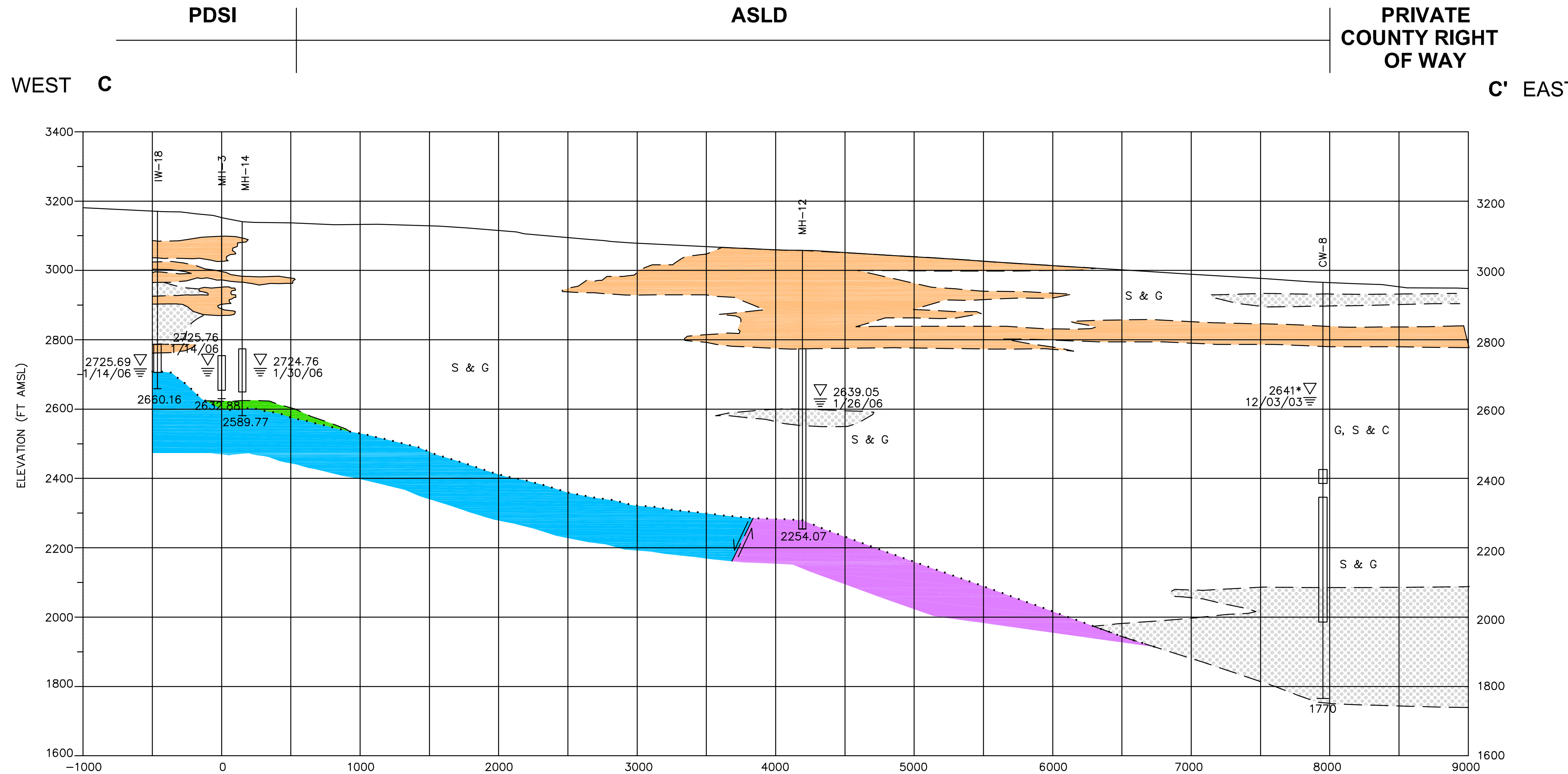




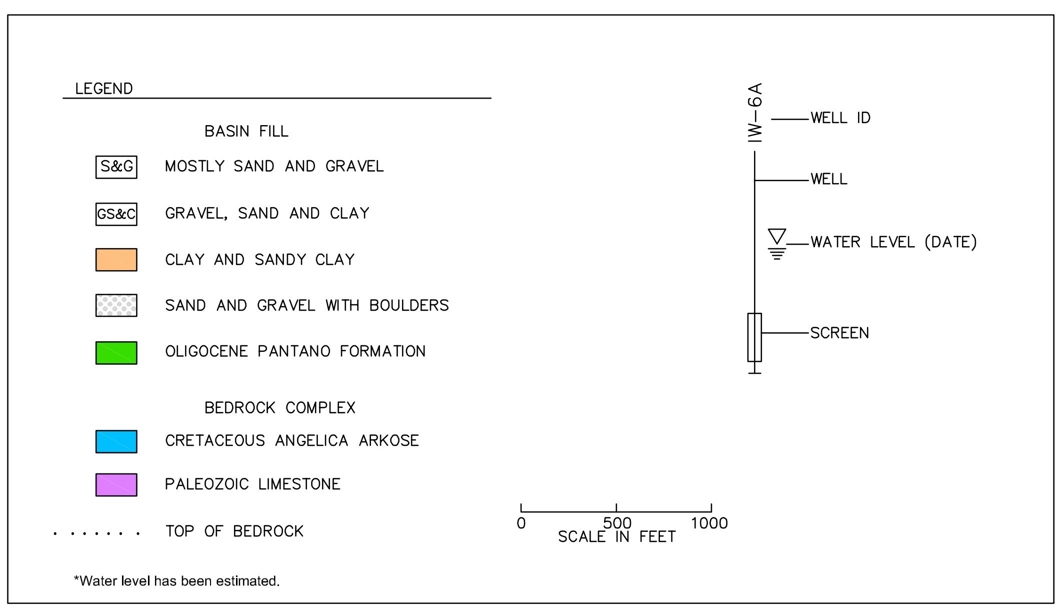
HYDRO GEO CHEM, INC.

B-B' GEOLOGIC CROSS SECTION
SIERRITA TAILING IMPOUNDMENT AREA

Approved	Date	Revised	Date	Reference:	FIG.
DRS	5/1/07			7830110A	5



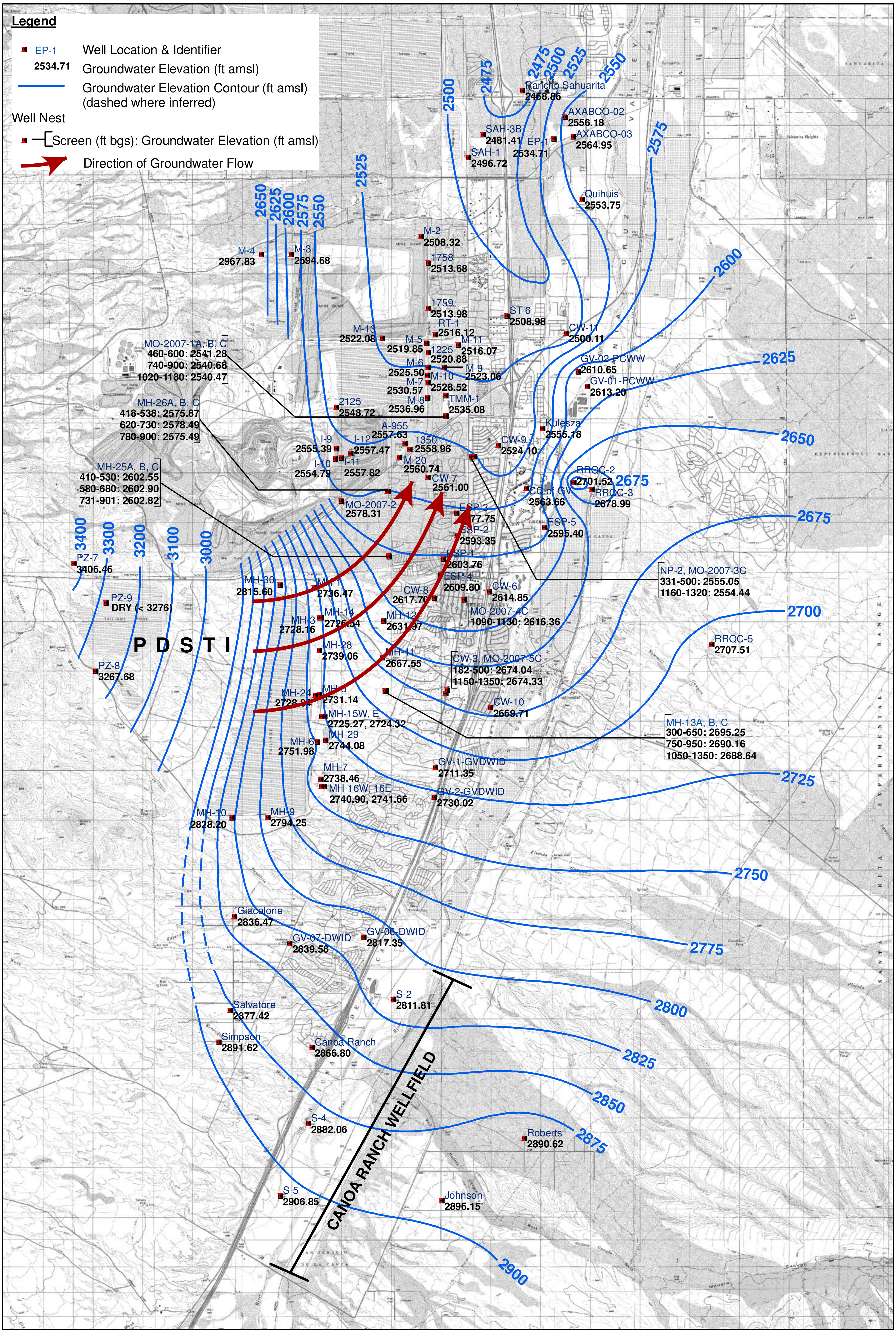
(LOOKING NORTH)



HYDRO GEO CHEM, INC.

C - C' GEOLOGIC CROSS SECTION
SIERRITA TAILING IMPOUNDMENT AREA

Approved	Date		Date	File Name	Figure
DRS	05/02/07			7830114A	6



1 inch equals 6,000 feet

0 3,000 6,000 Feet

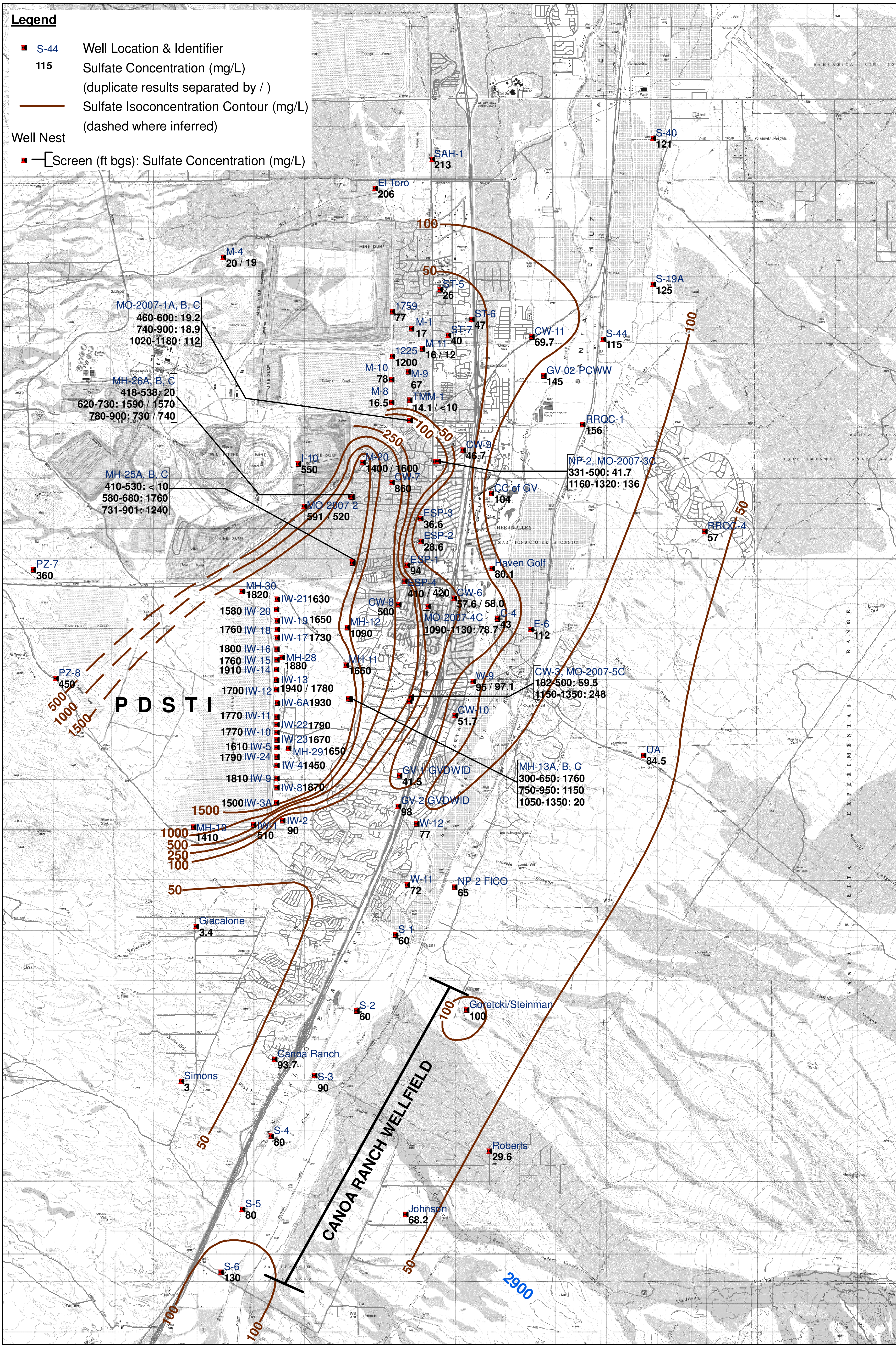
PROJECTION:
UTM Zone 12N NAD83

N

HYDRO GEO CHEM, INC.

GROUNDWATER ELEVATIONS FOR JULY THROUGH AUGUST 2007

Approved	Date	Author	Date	File Name	Figure
JRN	09/26/07	RAM	09/26/07	7830103G	7



1 inch equals 6,000 feet

0 3,000 6,000 Feet

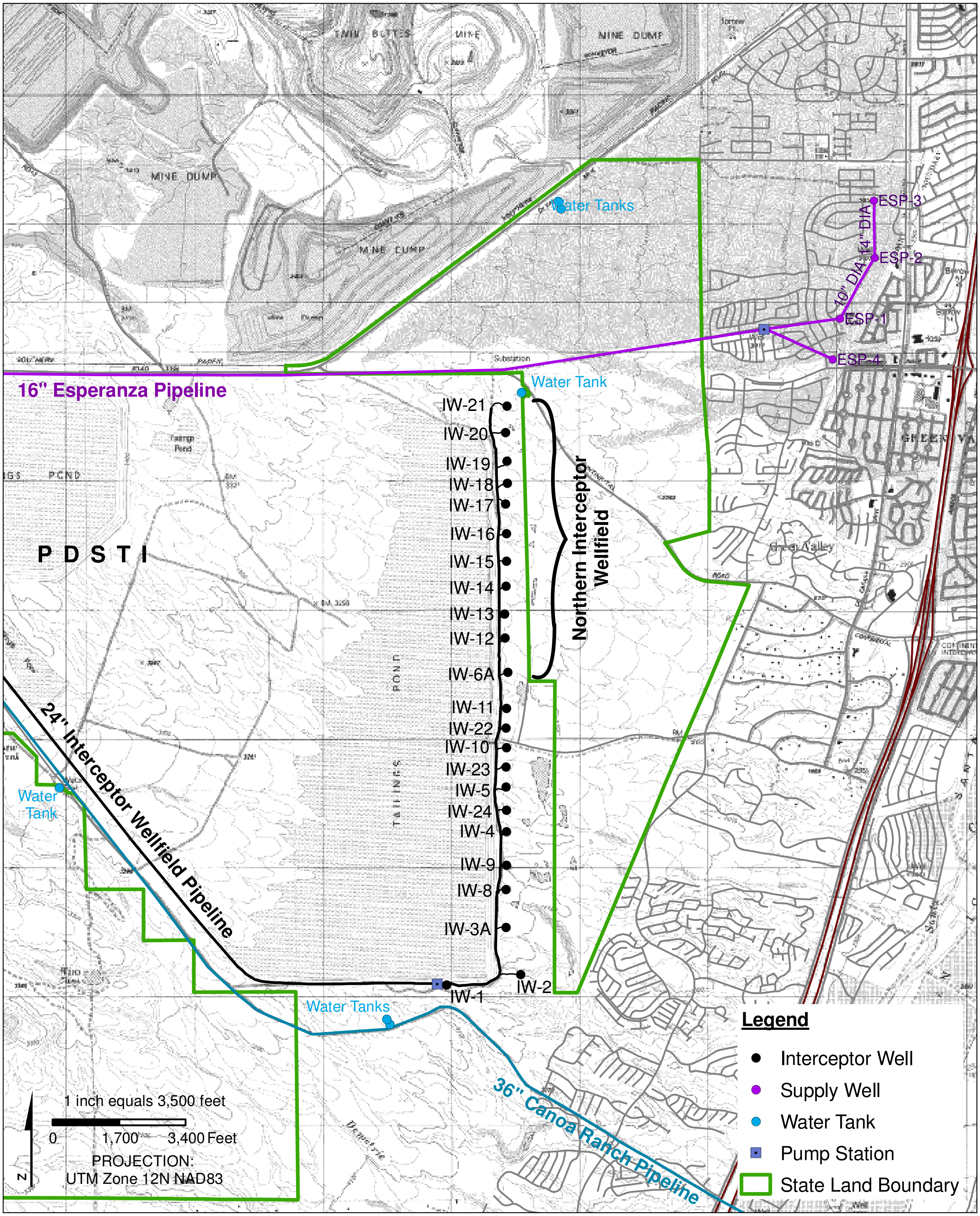
PROJECTION:
UTM Zone 12N NAD83

N

HYDRO GEO CHEM, INC.

SULFATE CONCENTRATIONS IN GROUNDWATER SAMPLES COLLECTED IN JULY THROUGH AUGUST 2007

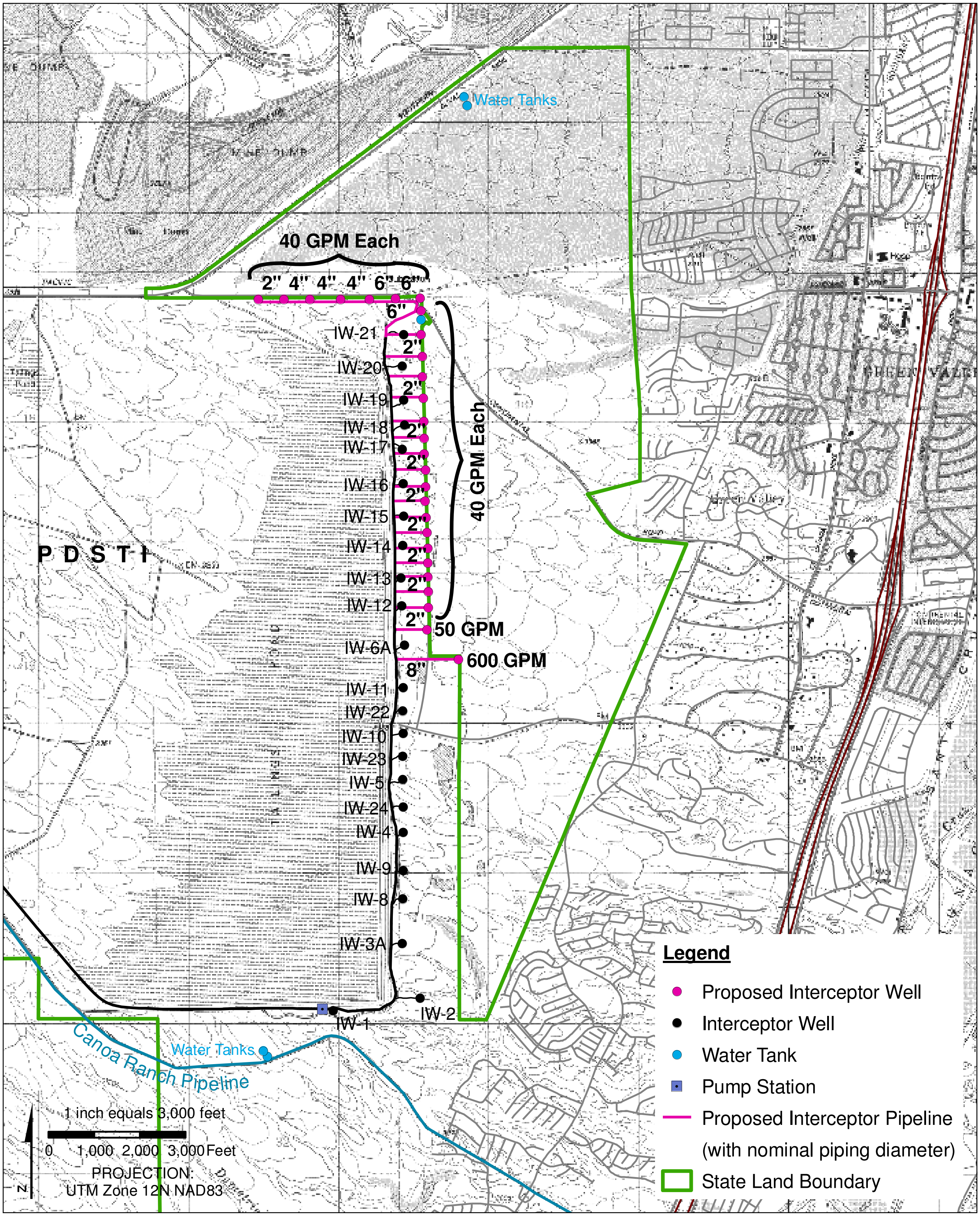
Approved	Date	Author	Date	File Name	Figure
DRS	09/26/07	RAM	09/26/07	7830133G	8



HYDRO GEO CHEM, INC.

INTERCEPTOR WELLFIELD WELL LOCATION AND PIPING LAYOUT

Approved	Date	Author	Date	File Name	Figure
MWK	11/13/07	RAM	11/13/07	7830031G	9



HYDRO GEO CHEM, INC.

ALTERNATIVE 1
EXTRACTION FACILITIES LAYOUT

Approved	Date	Author	Date	File Name	Figure
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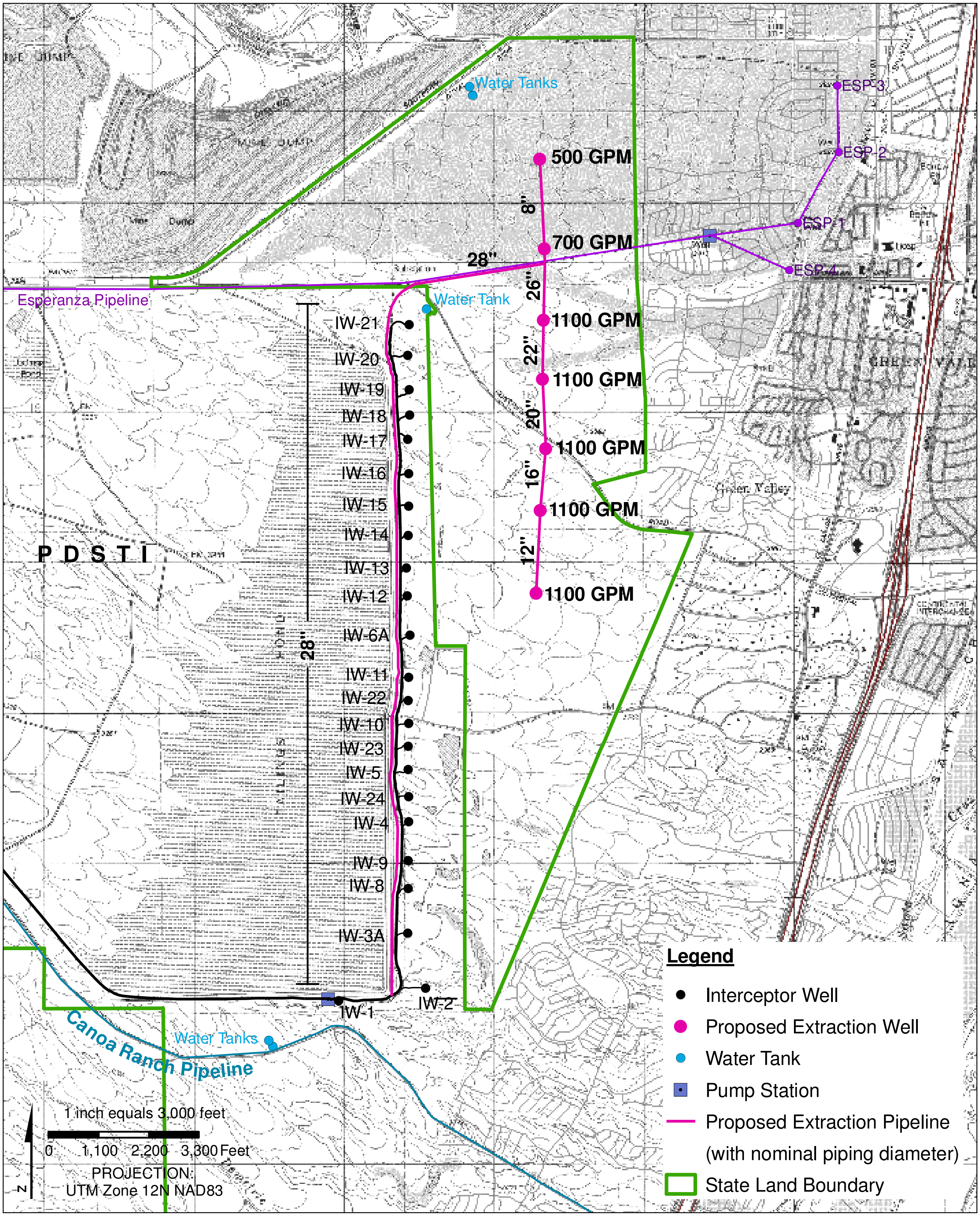

HYDRO GEO CHEM, INC.

ALTERNATIVE 2A
EXTRACTION FACILITIES LAYOUT

Approved	Date	Author	Date	File Name	Figure
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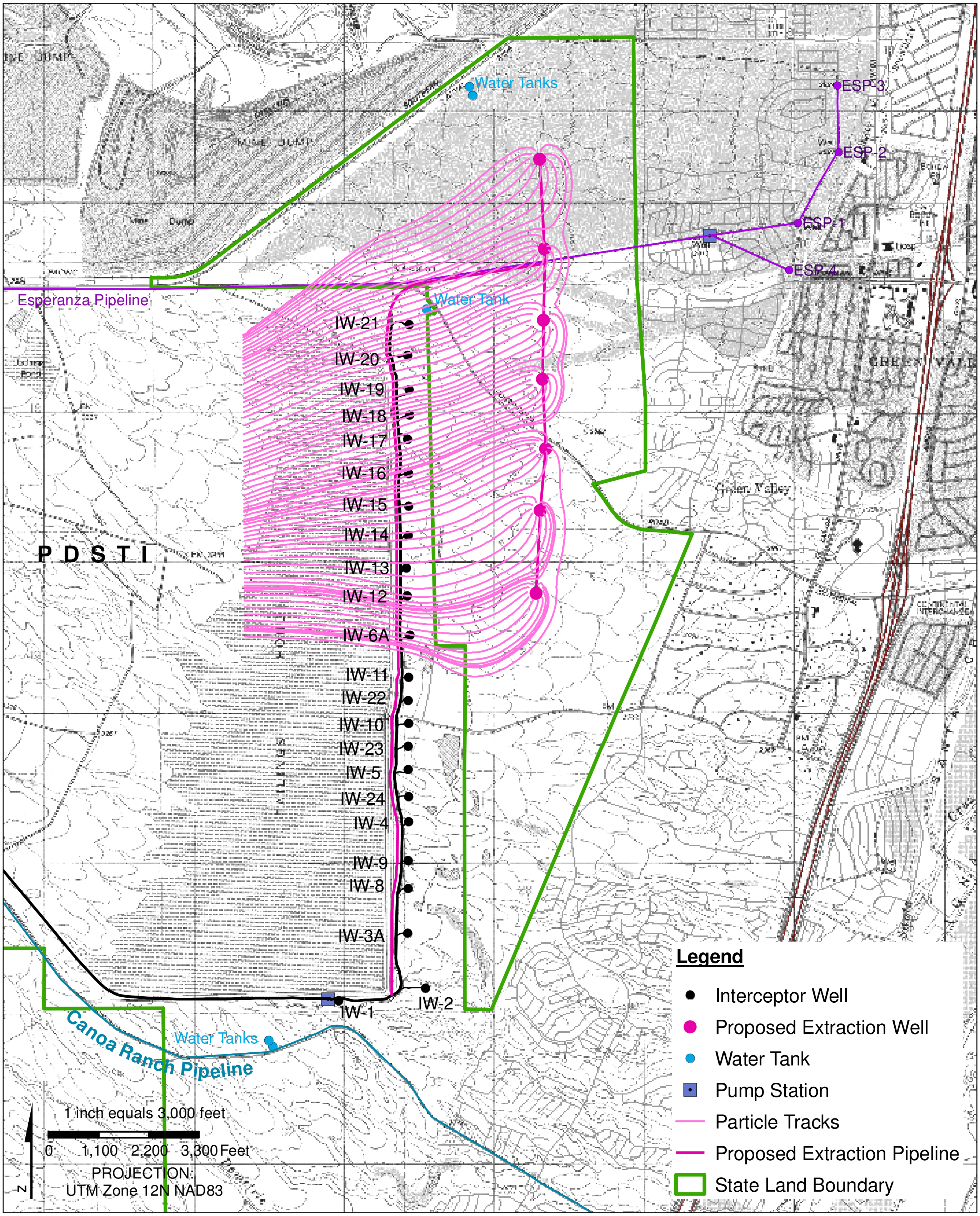

HYDRO GEO CHEM, INC.

ALTERNATIVE 2A
SIMULATED GROUNDWATER CAPTURE

Approved	Date	Author	Date	File Name	Figure
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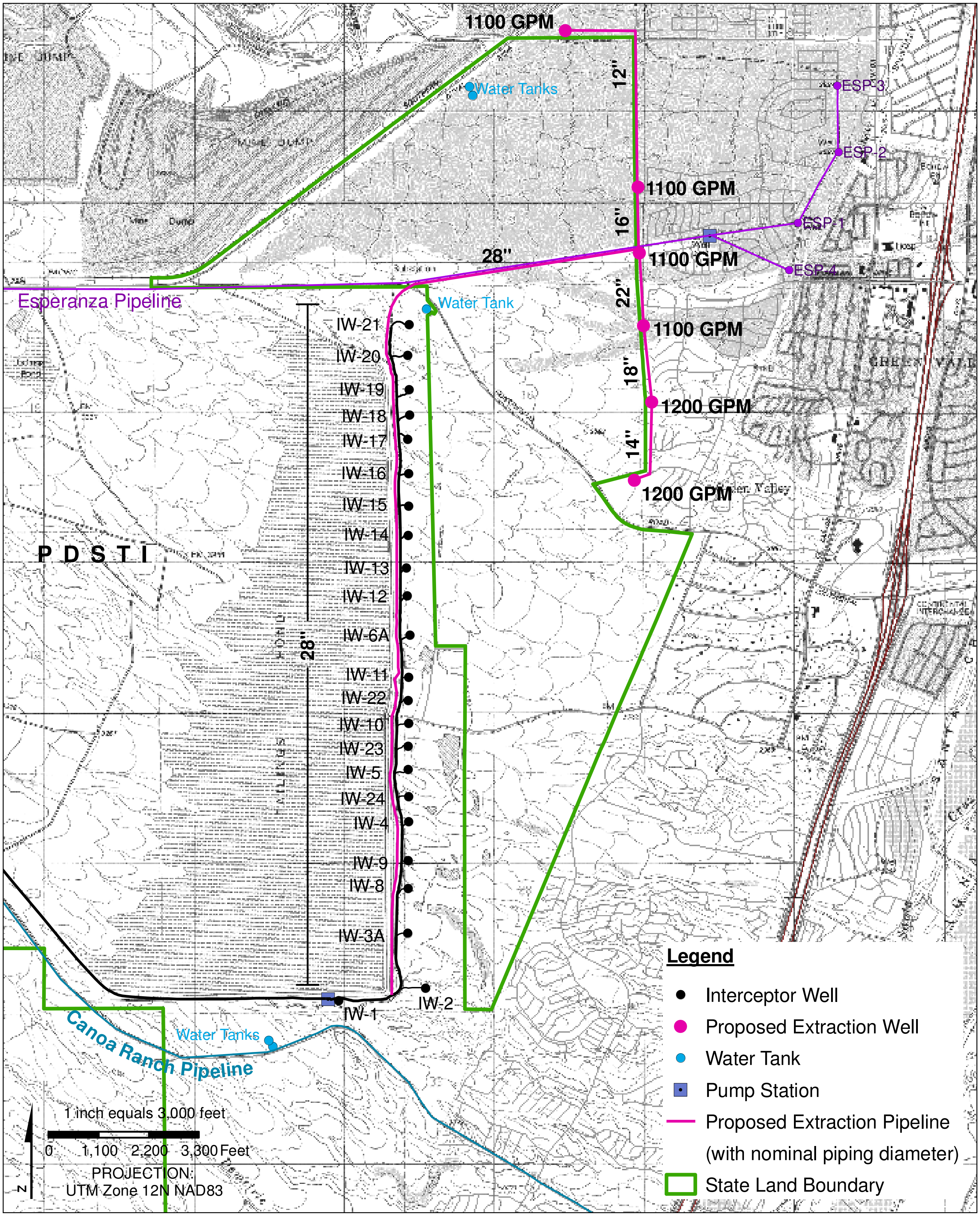

HYDRO GEO CHEM, INC.

ALTERNATIVE 2B
EXTRACTION FACILITIES LAYOUT

Approved	Date	Author	Date	File Name	Figure
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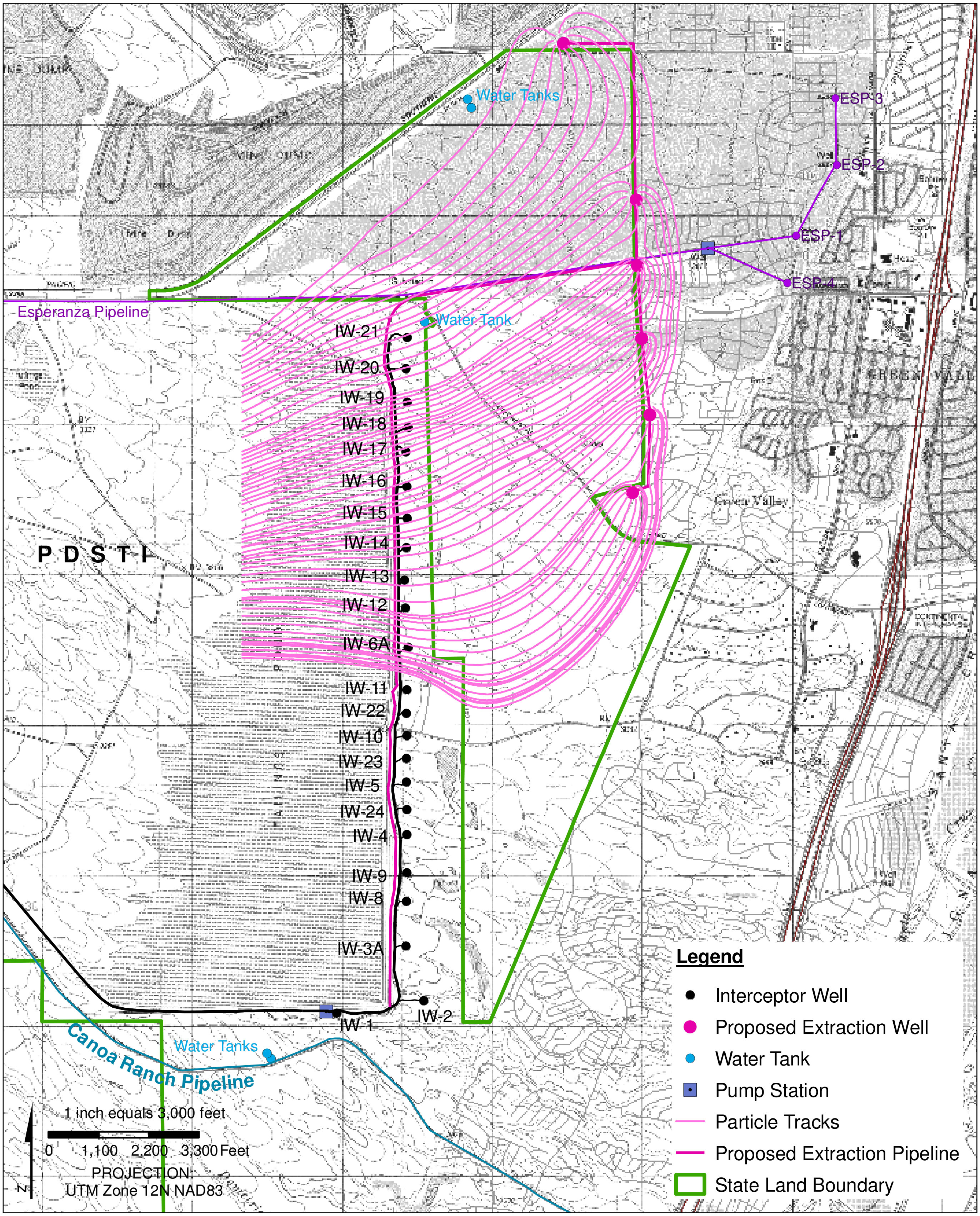

HYDRO GEO CHEM, INC.

ALTERNATIVE 2B
SIMULATED GROUNDWATER CAPTURE

Approved	Date	Author	Date	File Name	Figure
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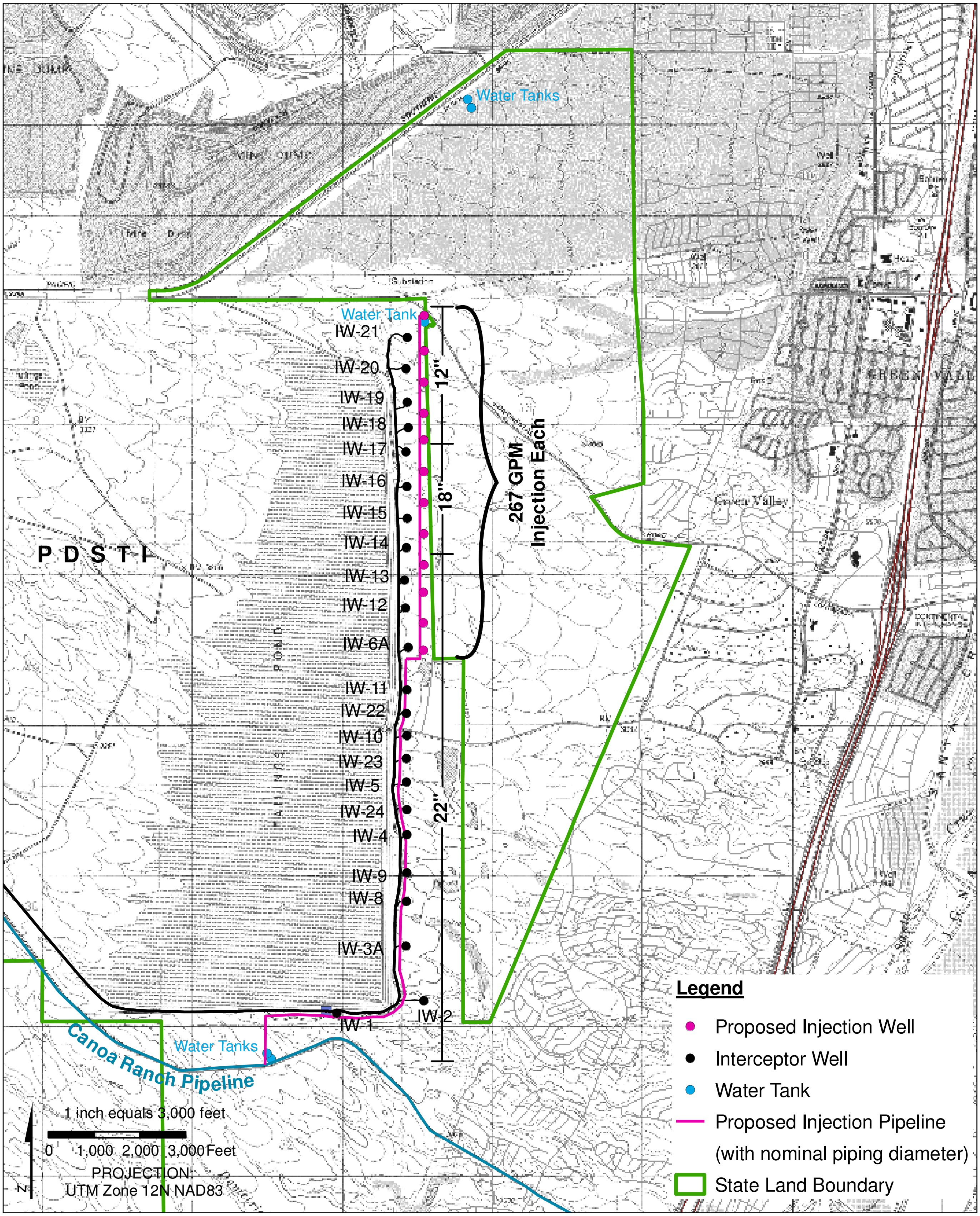
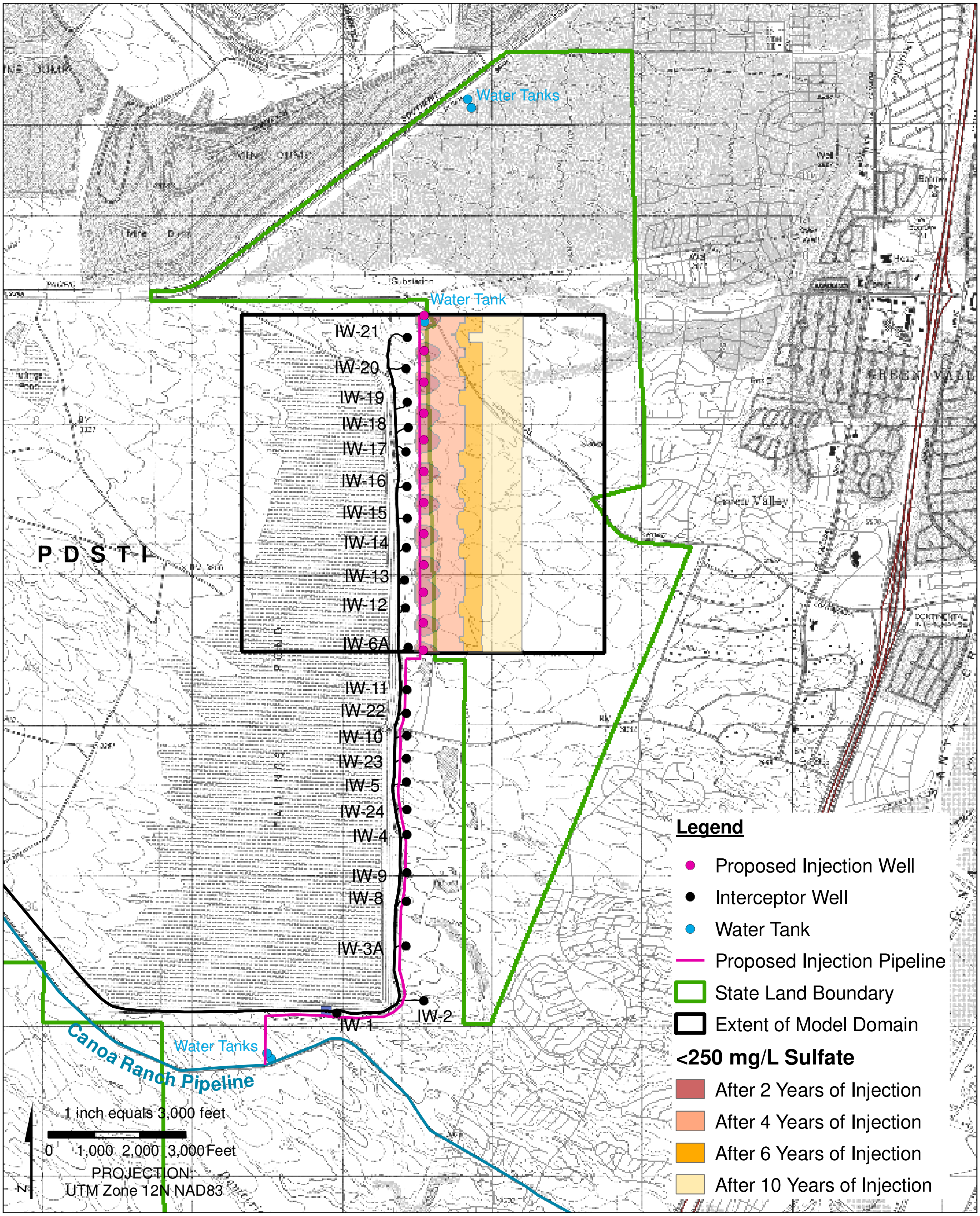


HYDRO GEO CHEM, INC.

ALTERNATIVE 3
INJECTION FACILITIES LAYOUT

Approved	Date	Author	Date	File Name	Figure
MWK	11/13/07	RAM	11/13/07	7830024G	15



HYDRO GEO CHEM, INC.

ALTERNATIVE 3
SIMULATED INJECTION

Approved	Date	Author	Date	File Name	Figure
MWK	11/13/07	RAM	11/13/07	7830025G	16

APPENDIX A

RESULTS OF EVALUATION OF ADDITIONAL INTERCEPTOR WELLS FOR IMPROVEMENT OF TAILING SEEPAGE CAPTURE
(Report Prepared by Errol L. Montgomery & Associates, November 19, 2007)

ERROL L. MONTGOMERY & ASSOCIATES, INC.
CONSULTANTS IN HYDROGEOLOGY

1550 East Prince Road
Tucson, Arizona 85719
(520) 881-4912
(520) 881-1609 FAX
www.elmontgomery.com

November 19, 2007

Ned Hall
PHELPS DODGE SIERRITA, INC.
6200 W. Duval Mine Road
P.O. Box 527
Green Valley, AZ 85622

SUBJECT: RESULTS OF EVALUATION OF ADDITIONAL INTERCEPTOR WELLS FOR IMPROVEMENT OF TAILING SEEPAGE CAPTURE, PHELPS DODGE SIERRITA, INC., PIMA COUNTY, ARIZONA

Dear Ned:

Montgomery & Associates (M&A) has evaluated two potential options for installation of additional interceptor wells to improve capture of seepage from the Phelps Dodge Sierrita, Inc. (PDSI) tailing impoundment. **Option 1** includes the potential installation of additional wells in the middle part of the interceptor wellfield. **Option 2** includes the potential installation of additional wells in the north part of the wellfield. The evaluation is based on previous preliminary groundwater modeling studies of tailing seepage capture conducted by M&A, and our knowledge of the hydrogeologic conditions in the Sierrita tailing impoundment area. Results of the evaluation are summarized below. For reference, **Figure 1** is a location map showing the PDSI tailing impoundment, property boundaries, potential additional interceptor wells, and north, middle, and south parts of the existing interceptor wellfield.

Option 1: Install Additional Interceptor Wells in the Middle Part of the Interceptor Wellfield

The effectiveness of the middle part of the interceptor wellfield could be improved by installing two additional interceptor wells east from IW-6A **(Figure 1)**. The two wells east from IW-6A are identified as IW-M1, located approximately 600 feet northeast from IW-6A, and IW-M2 located approximately 1,200 feet east-southeast from IW-6A.

IW-M1 and IW-M2

Wells IW-M1 and IW-M2 would increase tailing seepage capture in the vicinity of IW-6A. Model results indicate that there is currently a potential for some of the tailing seepage in this area to migrate past IW-6A. Installation of these wells would increase the effectiveness of the middle part of the wellfield. General construction data for the wells IW-M1 and IW-M2 are summarized below:

Well Name	Approximate Depth (feet)	Casing Diameter (inches)	Pump	Estimated Pumping Rate (gpm*)
IW-M1	550	12	Electric Submersible	50
IW-M2	700	12	Electric Submersible	600

* gpm – gallons per minute

In addition to construction and equipping of the new wells, hydrogeologic professional services associated with well installation would include preparation of well technical specifications, permitting, supervision of construction, aquifer testing, data analysis, and preparation of a summary report. Approximate combined costs for IW-M1 and IW-M2 construction and equipping, associated professional services, and operation and maintenance for 1 year are summarized below:

Construction & Equipping	Professional Services	1-yr Operation and Maintenance
$450,000	$60,000	$114,000

Note: Costs are for two wells; IW-M1 and IW-M2

Assumptions for the above estimated costs include:

- Per well construction cost of $162,000, based on previous interceptor well construction by M&A,
- Driller mobilization cost of $35,000,
- Per well equipping cost of $45,000,
- Middle part of interceptor wellfield accounted for approximately 40 percent of the estimated $1 million 2006 operating and maintenance (O&M) costs for the entire wellfield,

- Per well annual O&M cost of $57,000, assuming a single middle well accounts for 5.7 percent of the $1 million O&M costs (note: well IW-12 is included as part of the middle wellfield for the above calculations).

Above costs do not include periodic well rehabilitation and equipment replacement, which is anticipated to occur every 5 years, based on past experience with the interceptor wellfield. Estimated rehabilitation and equipment replacement cost for wells IW-M1 and IW-M2 is $45,000, per well.

Option 2: Install Additional Interceptor Wells in the North Part of the Interceptor Wellfield

Model results indicate that approximately thirty new interceptor wells would be required in the north part of the interceptor wellfield to substantially improve capture of tailing seepage. These wells would be installed along the PDSI property boundary, as shown on **Figure 1**. The proposed wells along the PDSI property boundary would replace the existing north wellfield. Aquifer saturated thickness along the property boundary is approximately 20 to 80 feet larger than along the existing north wellfield. Approximately 25 of the wells would initially be installed, identified as IW-N wells (**Figure 1**), augmented in subsequent years by installation of approximately five additional wells (not shown on **Figure 1**). The five additional wells would be located in areas where saturated thicknesses decrease due to interceptor well pumping, causing a reduction in the effectiveness of the IW-N wells.

Preliminary modeling results indicate this new configuration for the north part of the wellfield could result in approximately 80 percent of tailing seepage capture along the north part of the wellfield, including along the north edge of the tailing impoundment. The current estimate for tailing seepage capture along the existing north part of the wellfield is approximately 35 percent. General construction data for the proposed wells are summarized as follows:

Well Name	Average Depth (feet)	Casing Diameter (inches)	Pump	Estimated Pumping Rate (gpm)
IW-N	550	8	Electric Submersible	20 to 40

In addition to construction and equipping of the new wells, hydrogeologic professional services associated with well installation would include preparation of well technical specifications, permitting, supervision of construction, aquifer testing, data analysis, and preparation of a summary report. For the 30 IW-N wells, approximate combined costs for construction and equipping, associated professional services, and operation and maintenance for a 1-year period are summarized below:

Construction & Equipping	Professional Services	1-yr Operation and Maintenance
$4,200,000	$750,000	$440,000[a]

Note: Costs are for 30 wells.

[a] Costs reduced by approximately one-third to account for cessation of operations and maintenance for existing north wellfield

Assumptions for the above estimated costs include:

- Per well construction cost of $104,000, based on previous interceptor well construction by M&A,
- Driller mobilization cost of $35,000,
- Per well equipping cost of $35,000,
- North part of interceptor wellfield accounted for approximately 20 percent of the estimated $1 million 2006 O&M costs for the entire wellfield,
- Per well annual O&M cost of $22,000, assuming a single middle well accounts for 2.2 percent of the $1 million O&M costs (note: well IW-12 is not included as part of the north wellfield for the above calculations),
- Assume existing north wellfield will cease operation, resulting in an O&M cost offset for approximately one-third of the proposed IW-N wells.

Above costs do not include periodic well rehabilitation and equipment replacement and do not include installation of a new pipeline to collect water from the proposed IW-N wells. Well rehabilitation and equipment replacement is anticipated to occur every 5 years, based on past experience with the interceptor wellfield. Estimated rehabilitation and equipment replacement cost for the proposed IW-N wells is $35,000, per well. We recommend PDSI personnel be contacted for determining costs for the collection pipeline, which may vary substantially based on PDSI preferences for type of pipe and setup of the system.

Summary

Additional study is required to finalize these proposed interceptor well locations, construction, and costs; however, we believe the information summarized here should be adequate for purposes of evaluating options for additional interceptor wells.

If you have questions or require further information, please contact us.

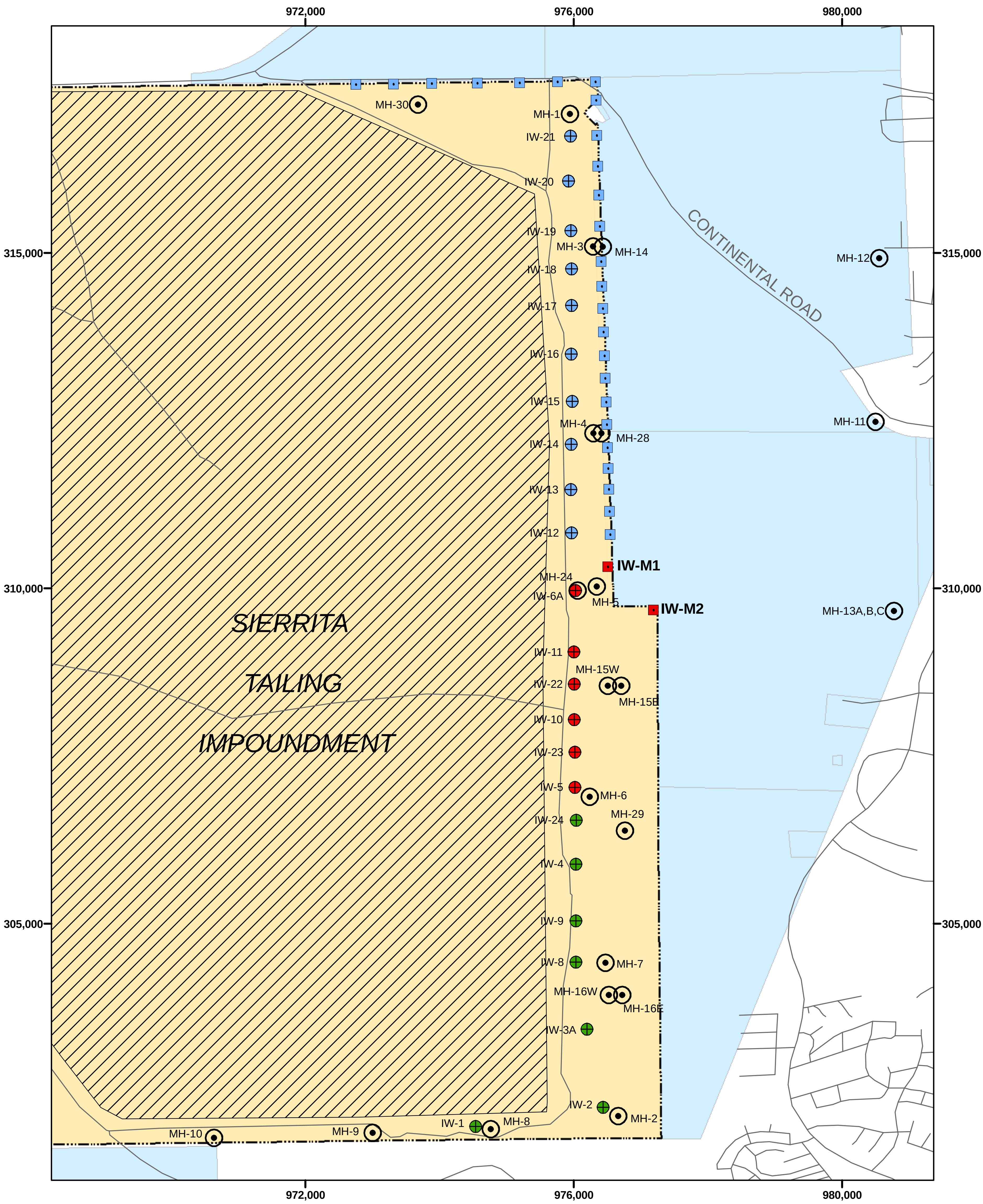
Sincerely,

ERROL L. MONTGOMERY & ASSOCIATES, INC.

Hale W. Barter

Attachment

SENT VIA EMAIL



EXPLANATION

IW-15 Existing Interceptor Well and Identifier, North Part of Wellfield

IW-10 Existing Interceptor Well and Identifier, Middle Part of Wellfield

IW-8 Existing Interceptor Well and Identifier, South Part of Wellfield

MH-6 Existing Monitor Well and Identifier

Proposed New North Interceptor Well (IW-N)

IW-M1 Proposed New Middle Interceptor Well and Identifier

Land Ownership

Private Land

State Trust Land

Phelps Dodge Sierrita Land

Tailing Impoundment

Sierrita Property Boundary

0 1,000 2,000

Feet

N

phelps dodge Sierrita Inc.

LOCATION MAP

ERROL L. MONTGOMERY & ASSOCIATES, INC. 2007

CONSULTANTS IN HYDROGEOLOGY

TUCSON, ARIZONA

FIGURE 1

GIS-Tuc\546.39\ProposedInterceptorWells_Rev1.mxd 16Nov2007 State Plane NAD83 Arizona Central, Feet

APPENDIX B

COST COMPARISON OF WATER SOURCES FOR INJECTION

TABLE OF CONTENTS

TABLE

1. INTRODUCTION

Three low sulfate water sources were evaluated as potential feed for a line of injection wells on Phelps Dodge Sierrita Inc. (PDSI) property downgradient of the northern portion of the interceptor wellfield: treated interceptor wellfield water, Community Water Company of Green Valley (CWC), and Canoa Ranch water supply. Preliminary cost estimates were developed for the three water supply options to identify order of magnitude costs. The cost estimates capture the relative costs of the options by evaluating the major system costs, but do not detail all potential costs.

1.1 Treated Interceptor Wellfield Water

Use of treated interceptor wellfield water would require the construction and operation of a water treatment facility at which water from the interceptor wellfield could be treated for reinjection. The estimated project costs for treated interceptor wellfield water included capital and operation and maintenance (O&M) costs.

Capital cost included the construction and operation of a reverse osmosis (RO) water treatment facility and a pump/pipeline system for conveying concentrate residual to the mine for storage or use. Annual O&M costs include electrical power and equipment servicing. In addition, an Arizona Department of Water Resources (ADWR) groundwater pumping fee of $3.10 per acre-foot is included for pumping the source water.

The following assumptions were used to estimate costs:

- RO treatment facility and O&M Costs [1];
- Groundwater pumping at 3,200 gallons per minute (gpm);
- ADWR groundwater pumping fee at $3.10 per acre-foot [2];
- NPV includes capital costs in first year of project; and
- Treatment plant is located at injection wellfield.

Water treatment capital costs for the RO treatment facility and piping of concentrate to mine were estimated at $12,300,000 (Table B.1). O&M costs for the water treatment facility and water fees were estimated at $1,025,000 annually. The estimate of the 25-year NPV that included the construction and operation of a water treatment facility and concentrate management is $24,438,000.

1.2 Community Water Company of Green Valley

Use of CWC water would require buying water from CWC and routing it to the injection well pipeline from CWC's Reservoir No. 2 at the north end of the interceptor wellfield. This water source was evaluated conceptually as it is uncertain whether CWC would be interested or allowed to provide a water supply for recharge. The estimated project costs for CWC water included capital and O&M costs.

Capital costs included injection piping materials and installation. Annual O&M costs included CWC water use charges.

[1] Reverse osmosis treatment and concentrate pipeline conveyance costs from Brown and Caldwell's *Evaluation of Potential Interim Actions to Mitigate Sulfate in Drinking Water Supplies in the Vicinity of the Phelps Dodge Sierrita Tailings Impoundment*. December 21, 2006. Included as Appendix A, Hydro Geo Chem, Inc. 2006. *Interim Action Identification Technical Memorandum for Mitigation Order on Consent Docket No. P-50-06, Pima County, Arizona.* December 22, 2006.
[2] Section 4.2.1 of main text

The following assumptions were used to estimate costs:

- CWC water use charges \$1.82 per 1000 gallons (1 to 1,250,000 gallons) [3];
- CWC water use charges \$2.20 per 1000 gallons (over 1,250,000 gallons) [3];
- New injection pipeline from water tank location to injection well field;
- Upper injection rate of 3200 gpm;
- High Density Polyethylene (HDPE) pipeline costs \$110 per foot [4];
- NPV includes capital costs in first year of project.

Capital costs for the pipeline construction were estimated at \$805,750 (Table B.1). O&M costs involving the purchase of CWC water were estimated at \$3,700,000 annually. The estimate of the 25-year NPV that included the construction of an injection pipeline and purchase of CWC water were \$46,885,000.

1.3 Canoa Ranch

PDSI's Canoa Ranch wells supply fresh water to the mine from a pipeline that passes along the south side of the tailings impoundment. Using Canoa Ranch water for injection supply would require constructing a 3.5-mile pipeline from the Canoa Ranch pipeline to the injection wellfield.

The estimated project costs for the Canoa Ranch Pipeline included pre-construction costs; capital costs and O&M costs. The estimated pre-construction costs included a minor amount of

[3] Community Water Company of Green Valley Approved Rate Notice, Effective March 2007

[4] Construction costs from Brown and Caldwell's *Evaluation of Potential Interim Actions to Mitigate Sulfate in Drinking Water Supplies in the Vicinity of the Phelps Dodge Sierrita Tailings Impoundment.* December 21, 2006. Included as Appendix A, Hydro Geo Chem, Inc. 2006. *Interim Action Identification Technical Memorandum for Mitigation Order on Consent Docket No. P-50-06, Pima County, Arizona.* December 22, 2006. HDPE pipe cost estimate from ISCO Industries, LLC.

Section 404 surveying and permitting associated with piping runs and right of way access[5]. Capital costs included piping materials and installation. Annual O&M costs included Farmers Investment Company (FICO) pumpage fee and an ADWR water rights fee of $3.10 per acre-foot for pumping the source water.

The following assumptions were used to estimate Canoa Ranch costs:

- Utilization of existing Canoa Ranch pipeline as source of injection water;
- FICO pumpage fee ($420,000 flat fee) [6];
- ADWR groundwater pumping fee at $3.10 per acre-foot [2];
- Upper injection rate of 3200 gpm;
- New injection pipeline from Canoa Ranch pipeline location to injection well field;
- HDPE pipeline costs $110 per foot [4];
- NPV's include capital costs in first year of project.

Pre-construction and capital costs for the pipeline construction were estimated at $2,066,500 (Table B.1). O&M costs involving the purchase of FICO water were estimated at $436,000 annually. The estimate of the 25-year NPV that included the construction of an injection pipeline and purchase of FICO water were $7,394,000.

[5] Salmon, Lewis & Weldon, PLC. Memorandum to Ned Hall (PDSI) regarding invoiced costs to complete CWC Well Number 10.
[6] FICO pumpage fee provided by PDSI personnel

TABLE

TABLE B.1
Cost Comparison of Water Sources for Injection

TREATED INTERCEPTOR WELLFIELD WATER

Construction/Capital Costs:						
RO Treatment (3000 gpm) (B&C, 2006, Table 7) [1]				6,900,000		
Piping and Pumps to Convey Concentrate to Mine (B&C, 2006, Table C-2) [1]				5,400,000		
				12,300,000	$	12,300,000
Annual Operation & Maintenance:						
Annual Operation & Maintenance (B&C, 2006, Table 8) [1]				1,009,152		
ADWR Groundwater Pumping Fee	5,162	acre feet @	3.1	16,002		
(see Section 4.2.1 of main text)				1,025,154	$	1,025,154
				Capital Costs:	**$**	**12,300,000**
				Annual Operation, Maintenance Costs:	**$**	**1,025,154**
				25 Year Net Present Value =		**$24,438,407**

discount rate= 5.5%

COMMUNITY WATER COMPANY OF GREEN VALLEY

Construction/Capital Costs:						
Piping & Installation	7,325	feet @	110	805,750		
				805,750	$	805,750
Annual Operation & Maintenance:						
CWC Water Use Charges (1 to 1,250,000 gallons)	1,250,000	/ 1000 gallons @	1.82	2,275		
CWC Water Use Charges (Over 1,250,000 gallons)	1,680,670,000	/ 1000 gallons @	2.20	3,697,474		
				3,699,749	$	3,699,749
				Capital Costs:	**$**	**805,750**
				Annual Operation, Maintenance Costs:	**$**	**3,699,749**
				25 Year Net Present Value =		**$46,885,057**

discount rate= 5.5%

CANOA RANCH

Permitting, Surveying:						
404 Survey				2,500		
404 Permitting				2,500		
ROW Access				10,000		
				15,000	$	15,000
Construction/Capital Costs:						
Piping & Installation	18,650	feet @	110	2,051,500		
				2,051,500	$	2,051,500
Annual Operation & Maintenance:						
FICO Pumpage Fee (see Section 4.2.1 of main text)				420,000		
ADWR Groundwater Pumping Fee	5,162	acre feet @	3.1	16,002		
(see Section 4.2.1 of main text)				436,002	$	436,002
				Pre-Construction Cost:	**$**	**15,000**
				Capital Costs:	**$**	**2,051,500**
				Annual Operation, Maintenance Costs:	**$**	**436,002**
				25 Year Net Present Value =		**$7,394,000**

discount rate= 5.5%

[1] Brown and Caldwell, (B&C) 2006. *Evaluation of Potential Interim Actions to Mitigate Sulfate in Drinking Water Supplies in the Vicinity of the Phelps Dodge Sierrita Tailings Impoundment.* December 21.

RO = Reverse Osmosis
ADWR = Arizona Department of Water Resources
CWC = Community Water Company of Green Valley
ROW = Right of Way
FICO = Farmers Investment Company

APPENDIX C

SUMMARY OF 2006 INTERCEPTOR WELLFIELD OPERATION AND MAINTENANCE COST

APPENDIX C
Summary of 2006 Interceptor Wellfield Operation and Maintenance Cost

Total Labor-	$114,052
Operating Supplies-	$34,821
Total Operating Labor & Supplies-	**$148,873**
Repair/Replace Equipment, Materials, Instruments-	$97,357
Well & Pump Repair/ Replacement-	$325,447
Additional Fabrication-	$75,039
M&R Labor and Equipment-	$209,822
Total Materials, Equipment, Labor Repair/Replacement-	**$707,664**
Electrical Power-	$727,361
Hydrogeologic Consulting-	$56,110
TOTAL-	**$1,640,008**

Notes:
Basis = 21 wells

APPENDIX D

DETAILED COST SUMMARY OF MITIGATION ALTERNATIVES

MITIGATION ALTERNATIVE 1
ESTIMATE OF COSTS

Alternative 1: Replacement Northern IWF Wells (1850 gpm total)

Permitting, Surveying:							
	Project Management	40	hours @	140	5,600		
	Well Drilling Permits	44	each @	150	6,600		
	404 Survey				2,500		
	404 Permitting				6,500		
					21,200	$	21,200
Engineering:							
	Principal	80	hours @	140	11,200		
	Associate	150	hours @	110	16,500		
	Project Professional II	475	hours @	85	40,375		
	Staff Professional II	150	hours @	65	9,750		
	Technician II	50	hours @	50	2,500		
	CAD/Draftsperson	85	hours @	55	4,675		
	Technical Editor	20	hours @	50	1,000		
	Word Processing/Data Entry	20	hours @	40	800		
					86,800	$	86,800
Construction/Capital Costs:							
Well Drilling & Construction:							
	Drill Rig Mob-demob				35,000		
	Extraction Well Construction; 12 inch casing	1,250	feet @	260	325,000		
	Extraction Well Construction; 8 inch casing	16,500	feet @	190	3,135,000		
	Observation Well Construction; 4 inch casing	12	each @	53000	636,000		
	Well Development/Testing	32	each @	11500	368,000		
	Rig Takedown/Setup	31	each @	3500	108,500		
	Field Geologist	1,660	each @	75	124,500		
Pump Assembly & Installation:							
	Submersible Pump w/ Drop pipe	32	each @	40000	1,280,000		
	Wellhead Fabrication	32	each @	4200	134,400		
	Pump Installation	32	each @	3600	115,200		
Electrical Equipment & Installation:							
	Replacement Motors	2	each @	25000	50,000		
	Power Supply & Distribution	32	each @	4500	144,000		
	Transformer Sets	utilize exisiting pole mounts			0		
	Wellhead Instrumentation	32	each @	9000	288,000		
	Telemetry/Data Acquisition	32	each @	6500	208,000		
	Wellhead Electrical	32	each @	8500	272,000		
Effluent Piping & Installation:							
	2 inch HDPE, SDR-11 (distribution)	15,800	feet @	7.4	116,920		
	4 inch HDPE, SDR-15.5 (header)	2,800	feet @	9.83	27,524		
	6 inch HDPE, SDR-15.5 (header)	2,800	feet @	12.65	35,420		
	8 inch HDPE, SDR-15.5 (IW-M2 distribution)	1,300	feet @	16.16	21,008		
Miscellaneous:							
	Header Tie-Ins	1	each @	3500	3,500		
	Distribution Piping Tie-Ins	32	each @	1500	48,000		
	Air Relief Valves	40	each @	1200	48,000		
	Drill Site Pads	32	each @	4850	155,200		
	Access Roads	2.4	miles @	5625	13,500		
	Construction Management	1,400	hours @	75	105,000		
	Project Management	100	hours @	140	14,000		
	Operation & Maintenance Manual				3,500		
	As-Build Documentation				8,500		
					7,823,672	$	7,823,672
Annual Operation & Maintenance:		*base rate*		*factor*			
	Labor	114,000	factor @	1.52	173,280		
	Supplies	35,000	factor @	1.52	53,200		
	Well Field Electrical Power	2,400,000	Kw hours @	0.07	168,000		
	Pumping Station Electrical Power	1,600,000	Kw hours @	0.07	112,000		
	Service Vehicle	12	months	720	8,640		
	Northern Inter. Well Field Retirement Saving				-169,010		
	Canoa Ranch Water Use Savings	3,250,000		-1850	-210,294		
	Hydrogeologic Consultant				68,000		
					203,816	$	203,816

MITIGATION ALTERNATIVE 1
ESTIMATE OF COSTS

Alternative 1: Replacement Northern IWF Wells (1850 gpm total)

Annual Repair/Replacement:

M&R Labor/Equipment	210,000	factor @	0.31	65,100	
Pipeline/Headers	75,000	factor @	0.31	23,250	
Well/Pump/Motor	325,000	factor @	0.31	100,750	
Replacement Materials/Instruments	97,000	factor @	0.31	30,070	
Northern Inter. Well Field Retirement Saving	673,000		-0.13	-87,490	
Shipping				5,000	
				136,680	$136,680

Alternative 1:

Pre-Construction Cost:	**$**	**108,000**
Construction Capital Costs:	**$**	**7,823,672**
Annual Operation, Maintenance, Repair, Replacement Costs (years 1-25):	**$**	**340,496**
Total Pre-Construction, Capital, O&M, Repair, Replacement Costs (years 1-25):	**$**	**16,444,069**
25 Year Net Present Value =		**$11,737,205**

Notes: *The following assumptions were used to estimate Alternative 1 costs:*

- *Utilization of existing northern IWF header;*
- *Retirement of existing northern IWF wells and utilization of existing pole/pad mounted transformers;*
- *Annual O&M costs include savings associated with retirement of the IFW;*
- *No well abandonment assumed;*
- *Total flow of replacement IWF wells is equal to 1,850 gpm;*
- *FICO water use charges do not apply;*
- *Minimal upgrades to pumps/motors will be required in southern IWF;*
- *No additional 24,900V power distribution required;*
- *All new piping runs at grade, not trenched;*
- *All new pipe is IPS 4710 HDPE;*
- *New extraction wells no larger than 8-inch cased;*
- *Telemetry at all new well heads with well field shutdown interlock with pumping station and remote start/stop;*
- *Electrical power costs equal to $0.07 per Kwh;*
- *O&M costs are proportional to 2006 IWF O&M costs;*
- *Annual O&M costs include remedial pumpage offset of Canoa Ranch water costs;*
- *Water treatment of groundwater discharge may be required after 25 years;*
- *NPV's include capital costs in first year of project; and*
- *NPV's are calculated using a 7.8% discount rate minus a 2.25% escalation rate.*

MITIGATION ALTERNATIVE 2A
ESTIMATE OF COSTS

Alternative 2A: Replacement Well Field (6700 gpm total)

Land Access, Permitting, Surveying:							
	Project Management	102	hours @	140	14,280		
	Archeological Survey				25,000		
	Endangered Species Survey				45,000		
	Well Drilling Permits	13	each @	150	1,950		
	404 Survey				12,000		
	404 Permitting				30,000		
	Access Lease				50,000		
					178,230	$	178,230
Engineering:							
	Principal	82	hours @	140	11,480		
	Associate	154	hours @	110	16,940		
	Project Professional II	458	hours @	85	38,930		
	Staff Professional II	154	hours @	65	10,010		
	Technician II	52	hours @	50	2,600		
	CAD/Draftsperson	83	hours @	55	4,565		
	Technical Editor	21	hours @	50	1,050		
	Word Processing/Data Entry	21	hours @	40	840		
					86,415	$	86,415
Construction/Capital Costs:							
Well Drilling & Construction:							
	Drill Rig Mob-demob				80,000		
	Extraction Well Construction; 16 inch casing	4,837	feet @	400	1,934,800		
	Observation Well Construction; 4 inch casing	6	each @	53000	318,000		
	Well Development/Testing	7	each @	56000	392,000		
	Rig Takedown/Setup	6	each @	12300	73,800		
	Field Geologist	1,120	each @	75	84,000		
700-1000 GPM Pump Assemblies & Installation:							
	Bowl Assembly; 11 stage	6	each @	9900	59,400		
	Discharge Head; 20"x12" Type F	6	each @	17000	102,000		
	Driver; 350HP, 460V, 389 FLA	6	each @	25000	150,000		
	Lineshaft Assembly	6	each @	67000	402,000		
	Oil Drum/Stand/Solenoid; 55 gal	6	each @	2300	13,800		
	Wellhead Fabrication	6	each @	4200	25,200		
	Pump Installation	6	each @	8000	48,000		
500 GPM Pump Assembly & Installation:							
	Bowl Assembly	1	each @	7500	7,500		
	Discharge Head	1	each @	15000	15,000		
	Driver; 200 HP, 460V	1	each @	20000	20,000		
	Lineshaft Assembly	1	each @	67000	67,000		
	Oil Drum/Stand/Solenoid; 55 gal	1	each @	2300	2,300		
	Wellhead Fabrication	1	each @	4200	4,200		
	Pump Installation	1	each @	8000	8,000		
Electrical Equipment & Installation:							
	Replacement Motors	3	each @	25000	75,000		
	Power Supply & Distribution; 24,900 V	12,500	feet @	21	262,500		
	Transformer Sets; 500 kVA	7	each @	25000	175,000		
	Wellhead Instrumentation	7	each @	11500	80,500		
	Telemetry/Data Acquisition	7	each @	6500	45,500		
	Sound Reduction Enclosure	0	each @	5000	0		
	Wellhead Electrical w/ soft starts	7	each @	50000	350,000		
Effluent Piping & Installation:							
	8 inch HDPE, SDR-13.5	1,975	feet @	18.56	36,656		
	12 inch HDPE, SDR-13.5	2,150	feet @	30.67	65,941		
	16 inch HDPE, SDR-13.5	1,350	feet @	43.84	59,184		
	20 inch HDPE, SDR-13.5	1,525	feet @	62.5	95,313		
	22 inch HDPE, SDR-13.5	3,350	feet @	73.17	245,120		
	26 inch HDPE, SDR-13.5	1,200	feet @	97.39	116,868		
	28 inch HDPE, SDR-13.5	18,800	feet @	109.03	2,049,764		
	12 inch HDPE, SDR-11 (distribution)	350	feet @	34.44	12,054		
	Trenching and Backfilling	10,000	feet @	4	40,000		
Miscellaneous:							
	Header Tie-Ins	1	each @	8800	8,800		
	Distribution Piping Tie-Ins	7	each @	1650	11,550		
	Air Relief Valves	36	each @	1200	43,200		
	Drill Site Pads	7	each @	4850	33,950		

MITIGATION ALTERNATIVE 2A
ESTIMATE OF COSTS

Alternative 2A: Replacement Well Field (6700 gpm total)							
	Access Roads	2.1	miles @	5625	11,813		
	Pipeline Road Crossing	2	each @	8800	17,600		
	Construction Management	960	hours @	75	72,000		
	Project Management	120	hours @	140	16,800		
	Operation & Maintenance Manual				3,500		
	As-Built Documentation				8,500		
					7,744,111	$	7,744,111
Annual Operation & Maintenance:		*base rate*		*factor*			
	Labor	114,000	factor @	0.34	38,760		
	Supplies	35,000	factor @	0.34	11,900		
	Electrical Power	11,000,000	Kw hours @	0.07	770,000		
	Pumping Station Electrical Power	6,100,000	Kw hours @	0.07	427,000		
	State Land Lease	1	year @	20000	20,000		
	State Water Use Fee	10,800	ac-ft @	85	918,000		
	Service Vehicle	12	months	720	8,640		
	Northern Inter. Well Field Retirement Saving				-28,130		
	Canoa Ranch Water Use Savings	3,250,000		-6700	-1,137,500		
	Hydrogeologic Consultant				56,000		
					1,084,670	$	1,084,670
Annual Repair/Replacement:							
	Labor/Materials/Equipment	210,000	factor @	1.11	233,100		
	Pipeline/Headers	75,000	factor @	1.11	83,250		
	Well/Pump/Motor	325,000	factor @	1.11	360,750		
	Replacement Materials/Instruments	97,000	factor @	1.11	107,670		
	Northern Inter. Well Field Retirement Saving	673,000		-0.01	-6,730		
	Shipping				5,000		
					783,040		$783,040

Alternative 2A:	**Pre-Construction Cost:**	**$**	**264,645**
	Construction Capital Costs:	**$**	**7,744,111**
	Annual Operation, Maintenance, Repair, Replacement Costs (years 1-25):	**$**	**1,867,710**
	Total Pre-Construction, Capital, O&M, Repair, Replacement Costs (years 1-25):	**$**	**54,701,506**
	25 Year Net Present Value =		**$30,749,688**

Notes: *The following assumptions were used to estimate costs for Alternative 2A:*

- *All new pipe for header back to existing 28-inch transition;*
- *No relocation or reuse of any existing piping;*
- *No parallel utilization of existing northern IWF header;*
- *Retirement of existing northern IWF wells;*
- *Annual O&M costs include savings associated with retirement of the IFW;*
- *No well abandonment assumed;*
- *FICO water use charges do not apply;*
- *Total flow of replacement wellfield is equal to 6,700 gpm;*
- *Minimal upgrades to pumps/motors will be required in southern IWF;*
- *Additional 24,900V power distribution required;*
- *TRICO has sufficient power available at their Green Valley substation;*
- *All new piping runs on State property will require burial;*
- *All new pipe is IPS 4710 HDPE;*
- *New extraction wells no larger than 16-inch cased;*
- *Telemetry at all new well heads with well field shutdown interlock with pumping station and remote start/stop;*
- *Electrical power costs equal to $0.07 per Kwh;*
- *State Land lease costs equal to $20,000 per year;*
- *State Land water use fee equal to $85 per acre-foot;*
- *O&M costs are proportional to 2006 IWF O&M costs;*
- *Annual O&M costs include remedial pumpage offset of Canoa Ranch water costs;*
- *NPV's include capital costs in first year of project; and*
- *NPV's are calculated using a 7.8% discount rate minus a 2.25% escalation rate.*

MITIGATION ALTERNATIVE 2B
ESTIMATE OF COSTS

Alternative 2B: Replacement Well Field (6800 gpm total)

Land Access, Permitting, Surveying:							
	Project Management	102	hours @	140	14,280		
	Archeological Survey				25,000		
	Endangered Species Survey				45,000		
	Well Drilling Permits	13	each @	150	1,950		
	404 Survey				12,000		
	404 Permitting				30,000		
	Access Lease				50,000		
					178,230	$	178,230
Engineering:							
	Principal	94	hours @	140	13,160		
	Associate	177	hours @	110	19,470		
	Project Professional II	527	hours @	85	44,795		
	Staff Professional II	177	hours @	65	11,505		
	Technician II	60	hours @	50	3,000		
	CAD/Draftsperson	95	hours @	55	5,225		
	Technical Editor	24	hours @	50	1,200		
	Word Processing/Data Entry	24	hours @	40	960		
					99,315	$	99,315
Construction/Capital Costs:							
Well Drilling & Construction:							
	Drill Rig Mob-demob				80,000		
	Extraction Well Construction; 16 inch casing	5,120	feet @	400	2,048,000		
	Observation Well Construction; 4 inch casing	6	each @	53000	318,000		
	Well Development/Testing	6	each @	56000	336,000		
	Rig Takedown/Setup	5	each @	12300	61,500		
	Field Geologist	960	each @	75	72,000		
Pump Assembly & Installation:							
	Bowl Assembly; 11 stage	6	each @	9900	59,400		
	Discharge Head; 20"x12" Type F	6	each @	17000	102,000		
	Driver; 350HP, 460V, 389 FLA	6	each @	25000	150,000		
	Lineshaft Assembly	6	each @	67000	402,000		
	Oil Drum/Stand/Solenoid; 55 gal	6	each @	2300	13,800		
	Wellhead Fabrication	6	each @	4200	25,200		
	Pump Installation	6	each @	8000	48,000		
Electrical Equipment & Installation:							
	Replacement Motors	3	each @	25000	75,000		
	Power Supply & Distribution	17,000	feet @	21	357,000		
	Transformer Sets; 500 kVA	6	each @	25000	150,000		
	Wellhead Instrumentation	6	each @	11500	69,000		
	Telemetry/Data Acquisition	6	each @	6500	39,000		
	Sound Reduction Enclosure	6	each @	5000	30,000		
	Wellhead Electrical w/ soft starts	6	each @	52000	312,000		
Effluent Piping & Installation:							
	12 inch HDPE, SDR-13.5	4,930	feet @	30.67	151,203		
	14 inch HDPE, SDR-13.5	1,943	feet @	35.82	69,598		
	16 inch HDPE, SDR-13.5	1,449	feet @	43.84	63,524		
	18 inch HDPE, SDR-13.5	1,667	feet @	53.23	88,734		
	22 inch HDPE, SDR-13.5	3,671	feet @	73.17	268,607		
	28 inch HDPE, SDR-13.5	20,400	feet @	109.03	2,224,212		
	12 inch HDPE, SDR-11 (distribution)	300	feet @	34.44	10,332		
	Trenching and Backfilling	12,000	feet @	4	48,000		
Miscellaneous:							
	Header Tie-Ins	1	each @	8800	8,800		
	Distribution Piping Tie-Ins	6	each @	1650	9,900		
	Air Relief Valves	42	each @	1200	50,400		
	Drill Site Pads	6	each @	4850	29,100		
	Access Roads	2.5	miles @	5625	14,063		
	Pipeline Road Crossing	2	each @	8800	17,600		
	Construction Management	933	hours @	75	69,975		
	Project Management	117	hours @	140	16,380		
	Operation & Maintenance Manual				3,500		
	As-Built Documentation				8,500		
					7,900,329	$	7,900,329

MITIGATION ALTERNATIVE 2B
ESTIMATE OF COSTS

Alternative 2B: Replacement Well Field (6800 gpm total)

Annual Operation & Maintenance:		*base rate*		*factor*			
	Labor	114,000	factor @	0.29	33,060		
	Supplies	35,000	factor @	0.29	10,150		
	Electrical Power	10,300,000	Kw hours @	0.07	721,000		
	Pumping Station Electrical Power	6,200,000	Kw hours @	0.07	434,000		
	Service Vehicle	12	months	720	8,640		
	Northern Inter. Well Field Retirement Saving				-28,130		
	Canoa Ranch Water Use Savings	3,250,000		-6800	-1,156,618		
	Hydrologic Consultant				56,000		
					78,102	$	78,102
Annual Repair/Replacement:							
	Labor/Materials/Equipment	210,000	factor @	1.13	237,300		
	Pipeline/Headers	75,000	factor @	1.13	84,750		
	Well/Pump/Motor	325,000	factor @	1.13	367,250		
	Replacement Materials/Instruments	97,000	factor @	1.13	109,610		
	Northern Inter. Well Field Retirement Saving	673,000		-0.01	-6,730		
	Shipping				5,000		
					797,180		$797,180

Alternative 2B:	**Pre-Construction Cost:**	**$**	**277,545**
	Construction Capital Costs:	**$**	**7,900,329**
	Annual Operation, Maintenance, Repair, Replacement Costs (years 1-25):	**$**	**875,282**
	Total Pre-Construction, Capital, O&M, Repair, Replacement Costs (years 1-25):	**$**	**30,059,932**
	25 Year Net Present Value =		**$18,602,512**

Notes: *The following assumptions were used to estimate costs for Alternatives 2B:*

- *All new pipe for header back to existing 28-inch transition;*
- *No relocation or reuse of any existing piping;*
- *No parallel utilization of existing northern IWF header;*
- *Retirement of existing northern IWF wells;*
- *Annual O&M costs include savings associated with retirement of the IFW;*
- *No well abandonment assumed;*
- *FICO water use charges do not apply;*
- *Total flow of replacement wellfield is equal to 6800 gpm;*
- *Minimal upgrades to pumps/motors will be required in southern IWF;*
- *Additional 24,900V power distribution required;*
- *TRICO has sufficient power available at their Green Valley substation;*
- *All new piping runs on State property will require burial;*
- *All new pipe is IPS 4710 HDPE;*
- *New extraction wells no larger than 16-inch cased;*
- *Telemetry at all new well heads with well field shutdown interlock with pumping station and remote start/stop;*
- *Electrical power costs equal to $0.07 per Kwh;*
- *State Land lease costs equal to $20,000 per year;*
- *O&M costs are proportional to 2006 IWF O&M costs;*
- *Annual O&M costs include remedial pumpage offset of Canoa Ranch water costs;*
- *NPV's include capital costs in first year of project; and*
- *NPV's are calculated using a 7.8% discount rate minus a 2.25% escalation rate.*

MITIGATION ALTERNATIVE 3
ESTIMATE OF COSTS

Alternative 3: Injection Well Field (3000 gpm extraction, 3200 gpm injection)

Permitting, Surveying:							
	Project Management	40	hours @	140	5,600		
	UIC Permit				5,000		
	APP Permit				75,000		
	Well Drilling Permits	36	each @	150	5,400		
	404 Survey				5,000		
	404 Permitting				7,500		
	Injection Well Pilot Testing				300,000		
	Geochemical Modeling				100,000		
					503,500	$	503,500
Engineering:							
	Principal	100	hours @	140	14,000		
	Associate	250	hours @	110	27,500		
	Project Professional II	300	hours @	85	25,500		
	Staff Professional II	200	hours @	65	13,000		
	Technician II	100	hours @	50	5,000		
	CAD/Draftsperson	150	hours @	55	8,250		
	Technical Editor	40	hours @	50	2,000		
	Word Processing/Data Entry	40	hours @	40	1,600		
					96,850	$	96,850
Construction/Capital Costs:							
Well Drilling & Construction:							
	Drill Rig Mob-demob				38,000		
	Injection Well Construction; 6 inch casing	13,200	feet @	145	1,914,000		
	Observation Well Construction; 4 inch casing	12	each @	53000	636,000		
	Well Development/Testing	24	each @	10500	252,000		
	Rig Takedown/Setup	23	each @	2800	64,400		
	Wellhead Fabrication	24	each @	3500	84,000		
	Field Geologist	1,350	each @	75	101,250		
Injection Assembly & Installation:							
	Drop Pipe w/ Valving	24	each @	45000	1,080,000		
	Duckbill Flow Restrictor						
Electrical Equipment & Installation:							
	Northern IWF Pump/Motor Replacement	5	each @	33000	165,000		
	Wellhead Instrumentation	24	each @	6000	144,000		
Effluent Piping & Installation:							
	14 inch HDPE, SDR-15.5	1,850	feet @	31.5	58,275		
	18 inch HDPE, SDR-15.5	1,380	feet @	44.9	61,962		
	20 inch HDPE, SDR-15.5	3,150	feet @	52.5	165,375		
Potable Water Piping & Installation:							
	10 inch HDPE, SDR-15.5 (distribution)	1,200	feet @	22.5	27,000		
	12 inch HDPE, SDR-13.5 (header)	2,950	feet @	29.8	87,910		
	18 inch HDPE, SDR-13.5 (header)	2,650	feet @	40	106,000		
	22 inch HDPE, SDR-11.0 (header)	11,900	feet @	87.5	1,041,250		
Conoa Pipeline Connection:							
	Canoa Pipeline Tie-Ins	1	each @	9500	9,500		
	Control Valve w/PLC	1	each @	20100	20,100		
	Backflow Preventor; DCV	1	each @	12000	12,000		
	Filtration System	1	each @	28000	28,000		
	Flow Meter	1	each @	8500	8,500		
	Telemetry/Data Acquisition	1	each @	6000	6,000		
	Electrical; 480V, 3 plex pole run	2,500	each @	10	25,000		
Miscellaneous:							
	Header Tie-Ins	24	each @	750	18,000		
	Air Relief Valves	28	each @	1200	33,600		
	Drill Site Pads	24	each @	4850	116,400		
	Access Roads	1.4	miles @	5625	7,875		
	Pipeline Road Crossing	1	each @	5400	5,400		
	Construction Management	550	hours @	75	41,250		
	Project Management	200	hours @	140	28,000		
	Operation & Maintenance Manual				2,500		
	As-Build Documentation				4,500		
					6,393,047	$	6,393,047
Annual Operation & Maintenance:		*base rate*		*factor*			

MITIGATION ALTERNATIVE 3
ESTIMATE OF COSTS

Alternative 3: Injection Well Field (3000 gpm extraction, 3200 gpm injection)

	Labor	114,000	factor @	1.14	129,960	
	Supplies	35,000	factor @	1.14	39,900	
	Electrical Power	4,800,000	Kw hours @	0.07	336,000	
	Pumping Station Electrical Power	2,400,000	Kw hours @	0.07	168,000	
	ADWR Groundwater Withdrawl Fee	5,166	acre-ft @	3.1	16,015	
	Service Vehicle	12	months	720	8,640	
	FICO Water Use Charges				420,000	
	Hydrogeologic Consultant				86,000	
					1,204,515	$ 1,204,515
Annual Repair/Replacement:						
	Labor/Equipment	210,000	factor @	0.53	111,300	
	Pipeline/Headers	75,000	factor @	0.53	39,750	
	Well/Pump/Motor	325,000	factor @	0.53	172,250	
	Replacement Materials/Instruments	97,000	factor @	0.53	51,410	
	Shipping				2,500	
					377,210	$377,210

Alternative 3:

Pre-Construction Cost:	**$ 600,350**
Construction Capital Costs:	**$ 6,393,047**
Annual Operation, Maintenance, Repair, Replacement Costs (years 1-25):	**$ 1,581,725**
Total Pre-Construction, Capital, O&M, Repair, Replacement Costs (years 1-25):	**$ 46,536,512**
25 Year Net Present Value =	**$26,241,125**

Notes: *The following assumptions were used to estimate Alternative 3 costs:*

- *Utilization of existing Canoa Ranch pipeline as source of injection water;*
- *Potable water supply cost equal to $3.10 per acre-foot;*
- *FICO water use charges apply over the entire project duration;*
- *New injection pipeline from water tank location to injection well field;*
- *A maximum of 24 injection wells;*
- *Total flow to injection wellfield is equal to 3,200 gpm;*
- *Need for pilot testing and chemical modeling;*
- *Continued operation of existing northern IWF;*
- *No power requirements at injection wellheads;*
- *No automated control or telemetry at injection wellheads;*
- *Battery powered magnetic flow meters at injection wellheads;*
- *No wellhead filtration or water treatment;*
- *Automated flow control with magnetic flow meter at Canoa Ranch Pipeline connection;*
- *Telemetry with remote flow control at Canoa Ranch Pipeline connection;*
- *Sufficient pressure exists in the Canoa Ranch Pipeline, and no pumping station is required;*
- *A double check-valve backflow preventor with particulate filtration is required at the Canoa Ranch pipeline connection;*
- *Utilization of existing infrastructure in north IWF to pump up to 3,000 gpm;*
- *Replacement of existing northern IWF groundwater extraction header;*
- *No cost savings associated with the non-retirement of the IRF;*
- *Minimal upgrades to pumps/motors will be required in southern IWF;*
- *No additional 24,900V power distribution required;*
- *All new piping runs at grade, not trenched;*
- *All new pipe is IPS 4710 HDPE;*
- *New injection wells no larger than 6-inch cased;*
- *Electrical power costs equal to $0.07 per Kwh;*
- *O&M costs are proportional to 2006 IWF O&M costs;*
- *Remedial pumpage does not offset Canoa Ranch water costs;*
- *NPV's include capital costs in first year of project; and*
- *NPV's are calculated using a 7.8% discount rate minus a 2.25% escalation rate.*