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Fax: (520) 791-2853

**FARMER'S INVESTMENT CO.
CAP WATER LINE
DESIGN CONCEPT REPORT**

FICO PROPERTY
Pima County, Arizona

Prepared for:



FARMER'S INVESTMENT CO.
1625 E. Sahuarita Road
Sahuarita, Arizona 85629

Prepared by:

Kimley-Horn and Associates, Inc.
7878 North 16th Street, Suite 300
Phoenix, Arizona 85020

191521002
October 2009
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**Kimley-Horn
and Associates, Inc.**

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1.0 INTRODUCTION

This Design Concept Report (Report) has been prepared for The Farmer's Investment Co. (FICO) to evaluate the benefits of providing a supplemental water source to FICO's property through the extension of an existing 36" Central Arizona Project/City of Tucson water line (CAP Line) located along the south side of Pima Mine Road. Currently the 36" line ends just east of the turnout for the Pima Mine Road Recharge Facility. It is anticipated that the proposed 36" line will connect to existing line and extend south to exit the Pima Mine Road right-of-way (R.O.W.), crossing under a section of Union Pacific railroad tracks and the railroad's R.O.W. The CAP line will then discharge into a small segment of open channel section, located within an easement on FICO Property. Pumps will be installed within the open channel section to deliver water for use by FICO. A line extending from the pumps will then be located within a proposed waterline easement, continuing east along FICO property, south of the southern R.O.W. line of Pima Mine Road and the railroad R.O.W., then south on FICO Property, parallel to the western R.O.W. line of Old Nogales Highway alignment terminating at the south side of East Sahuarita Road. For the purposes of this Report, the Study Area consists of the FICO property north of East Sahuarita Road. As part of the evaluation, both a gravity system and booster pump system were assessed. The gravity system was eliminated because it will not provide the consistency that FICO requires for irrigation of their farm.

1.1 General Description & Location

The FICO property consists of approximately 10.5 square miles (6,721 acres) and is located in southern Pima County, Arizona. (Figure 1 and Figure 2). The FICO property is comprised of two non-contiguous segments, both located east side of Interstate 19 (I-19). The Santa Cruz River is located within portions of both segments.

The FICO property is comprised of two farms – the "Continental Ranch" segment and the "Sahuarita Farms" segment. The Continental Ranch segment is approximately 1,644 acres in area and the Sahuarita Farms segment is approximately 5,077 acres in area, totaling 6,721 acres. The Sahuarita Farms segment, located north of East Sahuarita Road, comprises the Study Area. The majority of the FICO property is an active pecan orchard (Green Valley Pecan Company), irrigated by means of groundwater wells that discharge to a series of ditches, distributing water throughout the farm by flood irrigation. FICO has contracted with Kimley-Horn and Associates, Inc. to evaluate the feasibility of supplementing the Study Area water supply with Central Arizona Project (CAP) water.

The undeveloped areas within the study area consist of typical Sonoran Desert scrub. The dominant vegetation observed includes: mesquite trees, four wing saltbush, and various grass, forbs, and weedy species.

The Study Area lies within portions of the incorporated Town of Sahuarita and unincorporated portions of Pima County. In addition to agricultural-based business, the project vicinity generally consists of residential and light commercial land use to the north, undeveloped land to the east and south, and residential land use to the west. The FICO property and Study area is depicted in Figures 1 and 2; the Study Area is generally located within:

- 1 Township 16 South, Range 14 East, Section 31;
- 2 Township 17 South, Range 14 East, Sections 5-8;
- 3 Township 17 South, Range 13 East, Section 12.

1.2 Topographic Conditions

The ground surface elevation within the study area rises from approximately 2,662 feet above mean sea level (MSL) within the northern portion to 2,706 feet above MSL within the southern portion of the Study Area. The general drainage pattern for the area is primarily south to north.

1.3 Stakeholder Issues

The land surrounding the Study Area has experienced increased development activity in recent years; development activity is expected to continue in the future. There are significant improvements anticipated in the near future for Pima Mine Road, Old Nogales Highway, and East Sahuarita Road. These improvements will include road widening and utility installations within the R.O.W. There is concern that the location of a line within these roadway corridors will be limited or will require relocation as development occurs. Therefore, it is recommended that the proposed water line be located in an easement outside of the existing and proposed R.O.W. on FICO Property.

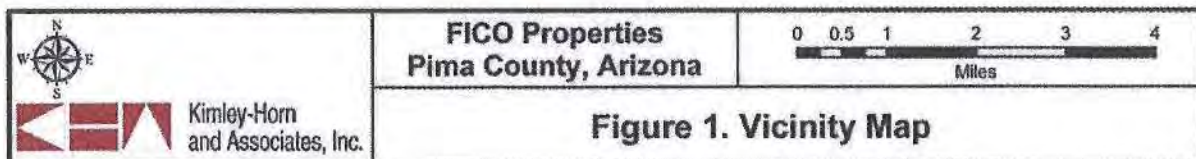
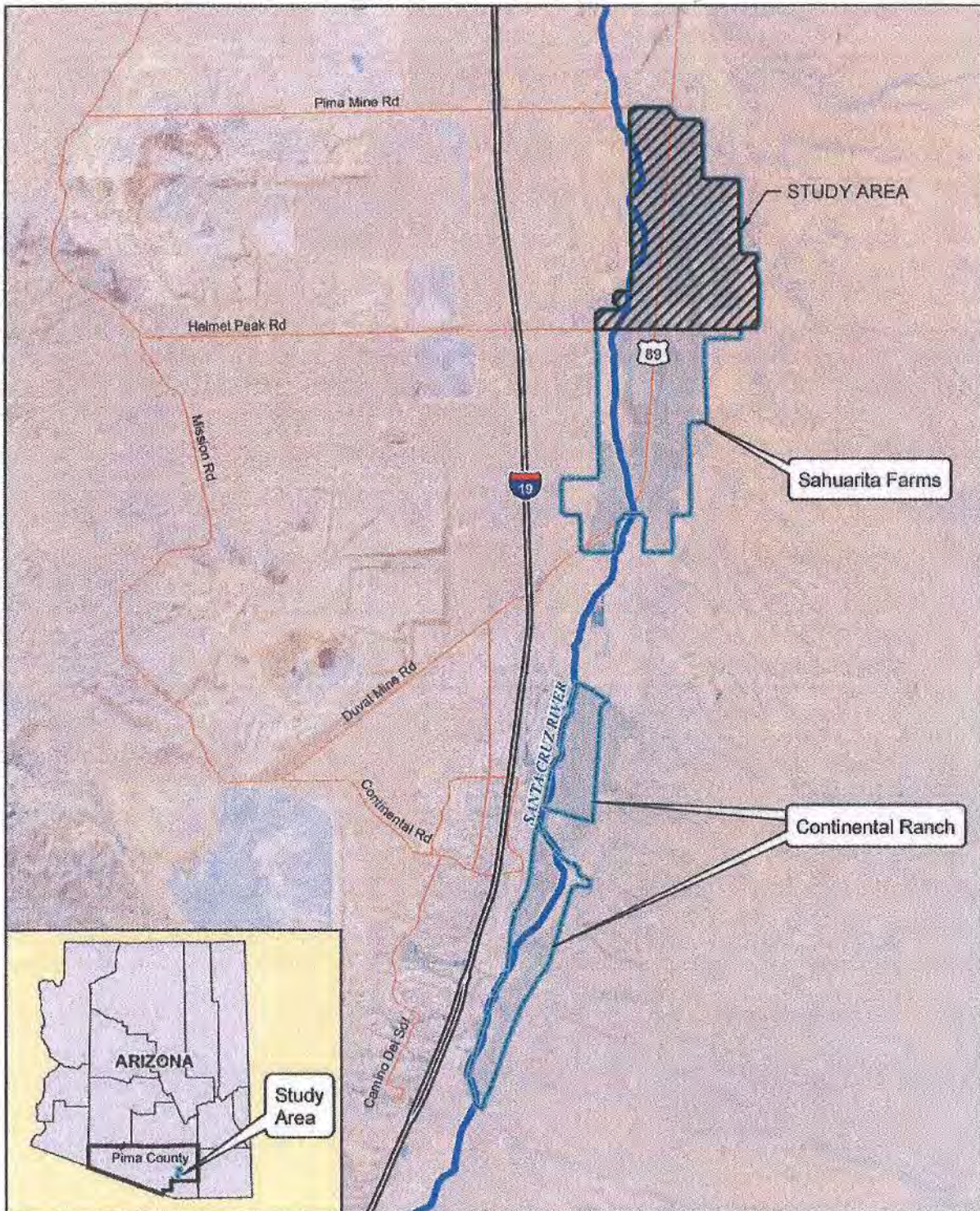
The farm currently holds a Ground Water Saving Facility (GSF) Permit. A GSF program is regarded "in-lieu" of a recharge project. The pumped groundwater saved by the use of CAP water for irrigation would accrue as long-term storage credits. These credits could then be used to offset groundwater pumping in efforts to meet groundwater pumping restrictions.

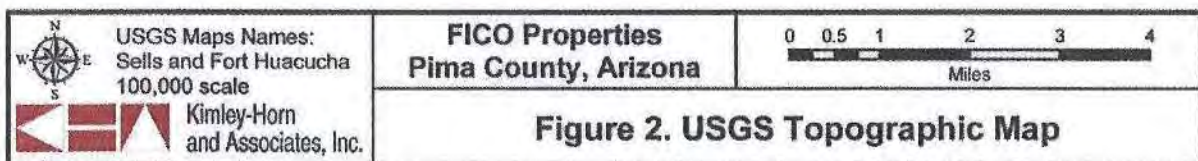
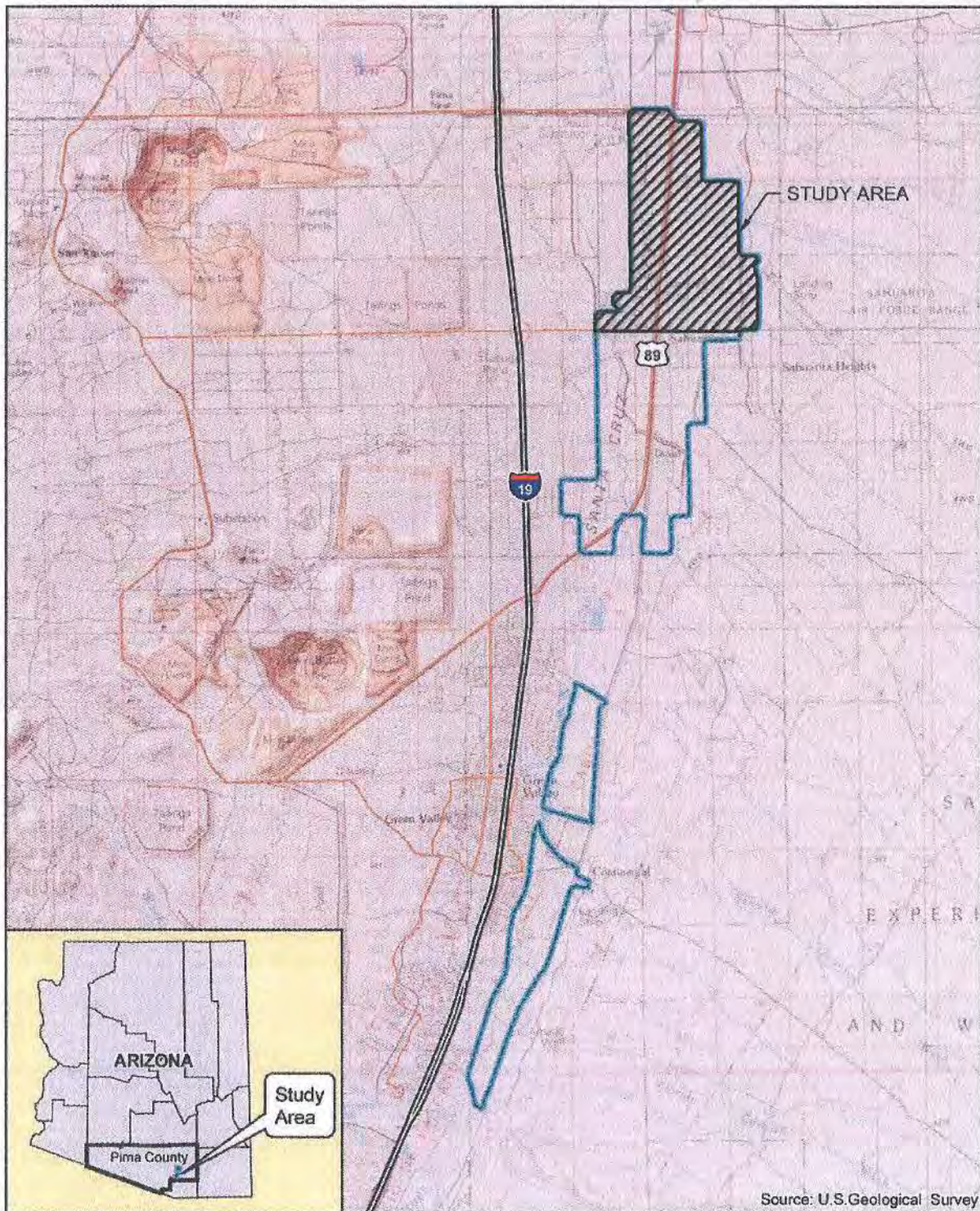
The existing 36" CAP line discussed above is restricted to a 24" line where it crosses Pima Mine Road Bridge, constricting the amount of water that could otherwise be available to the project. Additional water could be available if the 24" line crossing the bridge were "up-sized" to 36". This Report does not evaluate the conditions if the 24" line were to be up-sized. It is our understanding the existing bridge cannot accommodate lines larger than the existing 24" line without compromising the structural integrity of the bridge supporting members. However, according to the Town of Sahuarita, the existing bridge is scheduled for replacement sometime in the near future. The new bridge should be designed to accommodate a 36" line, removing the current constriction. These improvements are not part of any proposed improvements associated with this project, thus, only the 24" line was evaluated.

1.4 Complementary Studies

The following existing studies were reviewed and referenced as necessary in the preparation of this Report:

- *Terminus and Pima Mine Road Water Model* by Central Arizona Project dated February 5, 2009
- *Proposed Relocation of Pump Station and Storage Facilities for Sahuarita Acres* by Farmers Water Company; April 10, 2009







2.0 WATER SYSTEM

This Report evaluates the extension of an existing 36" CAP/City of Tucson water line located along the south side of Pima Mine Road. Currently, the 36" CAP/City of Tucson water line located along the south side of Pima Mine Road. The 36" line ends just east of the turnout for the Pima Mine Road Recharge Facility. The existing line ends with the eastern branch of the tee capped. It is anticipated that the proposed 36" line will connect to the eastern branch of the existing tee and exit the Pima Mine Road right-of-way (R.O.W.), crossing under the railroad's R.O.W. and discharging into an open channel sections located within an easement on FICO property. Pumps will be installed in the open channel section and discharge into a line that continues to the east. The line will then be located within a proposed waterline easement, continuing east along FICO property, south of the southern R.O.W. line of Pima Mine Road and the railroad R.O.W., then south on FICO Property, parallel to the western R.O.W. line of Old Nogales Highway alignment terminating at the south side of East Sahuarita Road. (See Figure 4). The 18" lines shown in East Sahuarita Road are for use of irrigation of the Green Valley Pecan Company only are not a part of this project. They are shown for modeling purposes only and will not be constructed with the proposed 36" line.

2.1 Upstream Hydraulics

Development and analysis of the water system for the Study Area was based on the Terminus and Pima Mine Road Water Model by Central Arizona Project (CAP Study). This study can be found in **Appendix C**. The CAP study outlines the available water for transmission through the 36" line to the Study Area based on the four different scenarios listed below:

1. Contract deliveries + max flow to the PMP south;
2. Contract deliveries + max flow w/ 36" pipe on bridge;
3. Existing deliveries + max flow to the PMP south;
4. Existing deliveries + max flow w/ 36" pipe on bridge.

In each scenario, the flow available to the Study Area was determined by maximizing flow to the Pima Mine Road Pipe (PMP South) while maintaining 10 pounds per square inch (psi) residual pressure at the Pima Mine Road Turnout located just upstream of the PMR South node. This residual pressure, according to the CAP study, would ensure adequate flow to the Pima Mine Road Recharge Project.

Of the four scenarios described above, the contract deliveries plus maximum flow to the PMP South node resulted in the lowest available flow: 14.1 cubic feet per second (cfs); 6,328 gallons per minute (gpm); or 27.97 acre feet per day (ac-ft/day). Based on the June 24, 2009 letter from CAP to Mr. Richard Walden (See Appendix A) 8,000 acre feet per 11 months is currently available. This equates to 12.2 cfs, 5,485 gpm, or 24.24 ac-ft/day. If the 24" segment of the line is upgraded to 36" an additional 20,000 acre feet per 11 months will be available. This will bring the total flow available from this project to 28,000 acre feet per 11 months. Is equates to 42.78 cfs, 19,199 gpm, or 84.85 ac-ft/day. The 12.2 cfs currently available will be utilized for this report.

2.2 Design Criteria

The water line for the Study Area was evaluated and designed consistent with the criteria outlined in the Cap Study and Arizona Department of Environmental Quality (ADEQ) Bulletin 10. Additional Design Criteria:

- Maximum demand = 42.8 cfs (19,199 gpm; 84.85 ac-ft/day)
- Current demand = 12.2 cfs (5,485 gpm; 24.24 ac-ft/day)

- Darcy-Weisbach friction factors
 - Concrete pipe = 0.005 ft
 - Steel = 0.001 ft
 - PVC = 0.0004 ft
 - For the purposes of this evaluation, the pipe material was calculated using concrete values
- Minimum pressure at PMR turnout = 10 psi
- Diameter of line on Pima Road bridge = 24"

2.3 Pipe Material

In order to achieve delivery of 12.2 cfs to the intersection of Old Nogales Highway and East Sahuarita Road, the booster pump will need to increase pressure within the pipeline to approximately 67 psi; therefore, many materials for the pipeline could be chosen to adequately handle the anticipated pressure and other safety-related factors.

A variety of materials can be used in this application including:

- Ductile Iron (DIP)
- Welded Steel (AWWA C200)
- Concrete Cylinder Pipe (AWWA 301 or 303)
- PVC C-905
- HDPE (DR-11)

2.4 Right-of-Way

It appears that the connection point of the existing 36" line is located within Town of Sahuarita R.O.W. for Pima Mine Road. The railroad tracks appear to exist on property owned by ASARCO. During the design process, authorization to enter and work within the R.O.W. will be obtained. Easements for construction on ASARCO property will also be obtained prior to construction. R.O.W. coordination must occur between Pima County, the Town of Sahuarita, the Union Pacific Railroad, and ASARCO Inc. Once the line has entered FICO property, the alignment will remain within a dedicated easement on the FICO property for the entire length, until it crosses the Town of Sahuarita R.O.W., on East Sahuarita Road.

3.0 WATER LINE ANALYSIS

In order to properly evaluate the proposed water line in concert with the existing CAP system, we reproduced the model created within the CAP Study and evaluated the 36" line as an extension to the CAP system. The network analysis of the water system, using WaterCAD version 7.0, was created to demonstrate that the design standards outlined in Section 2.2 will be met.

The 12.2 cfs demand was the maximum demand assumed available. The 12.2 cfs is not sufficient to remove the Study Area from reliance on well water for irrigation purposes, but can certainly act as a supplement. According to irrigation documents provided by FICO, there are two orchard areas north of East Sahuarita Road, west and east of Old Nogales within the Study Area. The 12.2 cfs can provide all of the irrigation needs west of the Highway and 62% (12.2 vs. 19.76 cfs) of the irrigation needs for east of the Highway.

3.1 Hydraulic Break Considerations

The CAP line will discharge into a channel to create a hydraulic break between the two systems. This channel will be sized to provide five minutes of storage for the full 42.8 cfs that may be available with upgrades to the CAP line. The channel to provide this storage will be a trapezoidal channel with a top width of 15 feet and a bottom width of 10 feet. This proposed channel will be 105 feet in length and 10 feet in depth. It is anticipated that a free discharge valve will be utilized at the discharge point. This valve will be operated so that opens and closes with a five minute operational period.

3.2 Booster System

In order to provide the greatest flexibility to water delivery for the study area, a booster system was evaluated. The pump system will be sized to provide the full 12.2 cfs to all nodes along the proposed waterline. The results of the pressure and flow evaluation can be found in **Table 1** and **Figure 4**. Only select nodes were evaluated since demand and flow will not change between nodes. The nodes evaluated were the most extreme cases of the system, as well as nodes where additional turnout pipes may be located.

Table 1 – Booster System Results

Point	Elevation (ft)	Max Flow (cfs)	Max Flow (gpm)	Max Flow (ac-ft/day)	Approx. Avail. Head (ft)
5	2674	12.2	5,485	24.24	40.58
6	2690	12.2	5,485	24.24	23.13
8	2706	12.2	5,485	24.24	5.36
9	2704	12.2	5,485	24.24	7.35

The preliminary evaluation of the booster pump system revealed the following characteristics:

- 5,485 gpm discharge capacity
- 67 feet of total dynamic head

The same evaluation indicated that the pump system could include either vertical turbine or centrifugal pumps.

4.0 CONCLUSION

The evaluation an open channel section and booster system for the proposed 36" water line within the proposed alignment indicates that water from the existing CAP line within Pima Mine Road can be brought to and utilized within the Study Area.

A number of pipe materials can be used to accommodate this project; however, DIP or PVC will be utilized to provide the greatest flexibility to future uses and connections and minimize costs.



5.0 REFERENCES

Terminus and Pima Mine Road Water Model by Central Arizona Project dated February 5, 2009

Proposed Relocation of Pump Station and Storage Facilities for Sahuarita Acres by Farmers Water Company; April 10, 2009

Engineering Bulletin 10 – Guidelines for the Construction of Water Systems. Arizona Department of Environmental Quality, May 1978

2006. WaterCAD v7.0 Haestad Methods, Inc.

Appendix A: CAP Capacity Letter



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623-869-2333 • www.cap-az.com

June 24, 2009

Mr. Virgil Davis
Community Water Company of Green Valley
1501 S La Cañada Drive
Green Valley, AZ 85622-1600

Mr. Richard Walden
Farmers Investment Company
1625 E. Sahuarita Rd.
Sahuarita, Arizona 85629

Gentlemen:

At our meeting of May 19, 2009, we discussed the potential for both of your organizations to use some of the available capacity in the existing 36" Pima Mine Road Pipeline. I agreed that CAP staff would review the system capacity as it now exists with the 24" pipeline section across the Santa Cruz River and what additional capacity would be available if that section was replaced with a 36" pipe.

The system, as it exists, can safely flow 58 cfs which will deliver about 38,000 acre feet (af) over an 11-month period, allowing one month for planned canal system maintenance. CAP plans for an optimum schedule of 30,000 af/year with an average flow of 45 cfs at the Pima Mine Road Recharge site. Historically operations are more variable, achieving about 25,000 af with flows peaking a little above 50 cfs. In summary, there is about 8,000 af/year available capacity with an available flow rate that could vary from 5 to 50 cfs but would normally be 10 to 12 cfs that would deliver 700-800 af/month.

The Pima Mine Road Recharge Project and the delivery pipeline is shared 50/50 between CAWCD and Tucson Water with certain rights to use unused capacity of either party. There is also a commitment of 10cfs delivery into the Santa Cruz River on behalf of the Tohono O'odham Nation if requested. If the pipeline section across the river is upsized and the commitment to deliver to the Santa Cruz River is not needed, an additional 30 cfs of delivery capacity is available. That would deliver an additional 20,000 af over the assumed 11-month operating period.

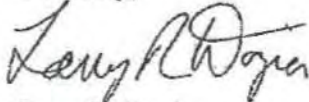
Mr. Virgil Davis
Mr. Richard Walden
June 24, 2009
Page 2

If delivery needs and schedules were carefully coordinated, the existing configuration could reasonably be expected to provide 8,000 to 10,000 af per year at flow rates of 5 to 15 cfs. If both GVWC and FICO desired to connect at the end of the existing pipeline that capacity could be shared in some collaborative and proportional manner.

If GVWC were to pay the cost of upsizing the 24" section to 36", an additional 20,000 af per year could be delivered to GVWC.

It must be understood that any agreement to use the existing pipeline requires the consent of CAWCD and Tucson Water. Specific scheduling and operating parameters would be established and deliveries to the Pima Mine Road Recharge Project would, if needed, take precedent over deliveries to GVWC or FICA.

Sincerely,



Larry R. Dozier
Deputy General Manager

Copy: Mr. Dennis Rule
Tucson Water
PO Box 27210
Tucson AZ 85726-7210

Mr. Virgil Davis
Mr. Richard Walden
June 24, 2009
Page 3

Blind copy: Patrick Dent
Tom Harbour
Brian Henning
Tim Kacerek
Randy Randolph
Suzanne Ticknor

Appendix B: Booster System Output

Scenario: FICO with Hydraulic Break
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Base Flow (cfs)	Demand (Calculated) (cfs)	Calculated Hydraulic Grade (ft)	Pressure (feet H2O)	Pressure Head (ft)
J-N2	2,660.00	Zone	0.00	0.00	2,716.94	56.83	56.94
J-N3	2,664.00	Zone	0.00	0.00	2,716.24	52.13	52.24
J-N4	2,672.00	Zone	0.00	0.00	2,715.13	43.04	43.13
J-N5	2,674.00	Zone	0.00	0.00	2,714.67	40.58	40.67
J-N6	2,690.00	Zone	0.00	0.00	2,713.17	23.13	23.17
J-N7	2,706.00	Zone	12.20	12.20	2,711.37	5.36	5.37
J-N8	2,706.00	Zone	0.00	0.00	2,711.37	5.36	5.37
J-N9	2,704.00	Zone	0.00	0.00	2,711.37	7.35	7.37

Scenario: FICO with Hydraulic Break
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Start Node	Material	Stop Node	Discharge (cfs)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-N2	2,009.00	36.0	J-N2	Concrete	J-N3	12.20	2,716.94	2,716.24	0.71	0.35	1.73
P-N3	3,133.00	36.0	J-N3	Concrete	J-N4	12.20	2,716.24	2,715.13	1.11	0.35	1.73
P-N4	1,317.00	36.0	J-N4	Concrete	J-N5	12.20	2,715.13	2,714.67	0.46	0.35	1.73
P-N5	4,231.00	36.0	J-N5	Concrete	J-N6	12.20	2,714.67	2,713.17	1.49	0.35	1.73
P-N6	5,116.00	36.0	J-N6	Concrete	J-N7	12.20	2,713.17	2,711.37	1.80	0.35	1.73
P-N7	1,878.00	18.0	J-N7	Concrete	J-N8	0.00	2,711.37	2,711.37	0.00	0.00	0.00
P-N8	2,453.00	18.0	J-N7	Concrete	J-N9	0.00	2,711.37	2,711.37	0.00	0.00	0.00
Pump1	964.00	36.0	R-1	Concrete	PUMP-1	12.20	2,651.50	2,651.16	0.34	0.35	1.73
Pump2	2,500.00	36.0	PUMP-1	Concrete	J-N2	12.20	2,717.83	2,716.94	0.88	0.35	1.73

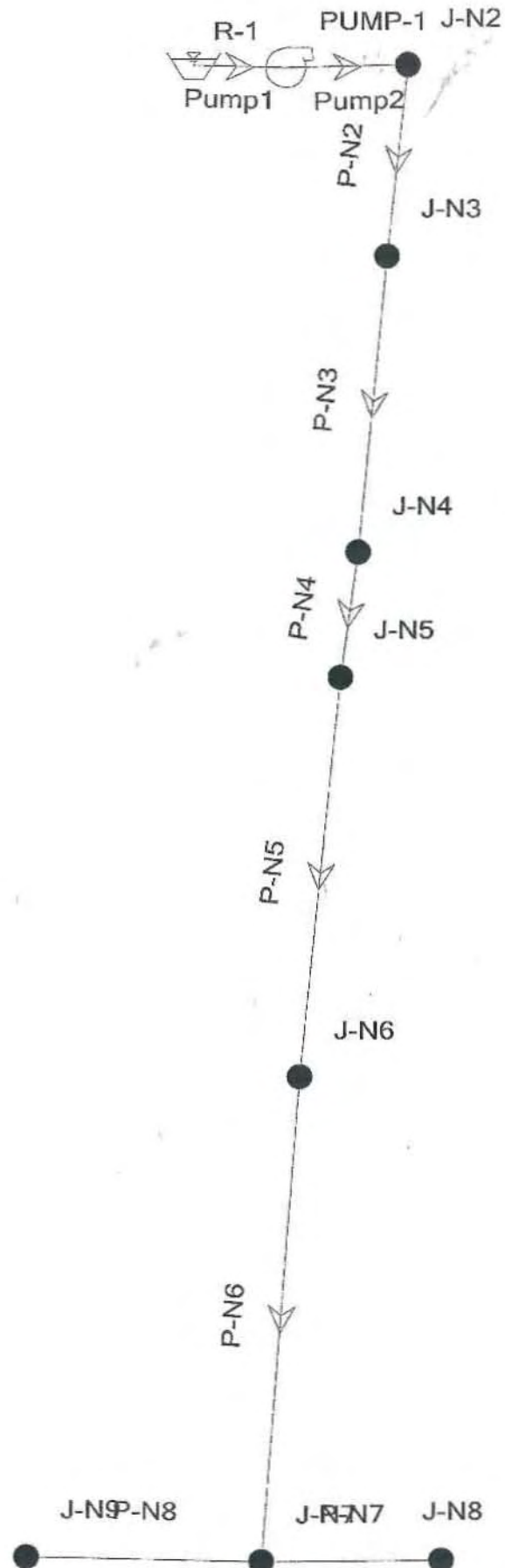
Scenario: FICO with Hydraulic Break
Steady State Analysis
Pump Report

Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (cfs)	Pump Head (ft)	Calculated Water Power (Hp)
PUMP-1	2,651.50	On	2,651.16	2,717.83	12.20	66.67	92.16

Scenario: FICO with Hydraulic Break
Steady State Analysis
Reservoir Report

Label	Elevation (ft)	Zone	Inflow (cfs)	Calculated Hydraulic Grade (ft)
R-1	2,651.50	Zone	-12.20	2,651.50

Scenario: FICO with Hydraulic Break



Appendix C: Terminus and Pima Mine Road Water Model Report

CENTRAL ARIZONA PROJECT



**TERMINUS AND PIMA MINE ROAD
WATER MODEL
STEADY STATE ANALYSIS
February 5, 2009**

**CENTRAL ARIZONA PROJECT – TERMINUS AND PIMA MINE ROAD
WATER MODEL
STEADY STATE ANALYSIS
February 5, 2009**

Central Arizona Project Engineering Resources Division has conducted a hydraulic analysis of the Reach 6 Pipeline and the Pima Mine Road Pipeline (PMRP) to determine if additional capacity exists for water deliveries in the PMRP. The analysis was performed using *Bentley WaterCAD V8 XM* software.

Features included in this study include the Black Mountain Operating Reservoir (BMOR), Terminus Turnout, and the Pima Mine Road Recharge Project. The turnouts included in this analysis are San Xavier, ASARCO, Santa Cruz River, Pima Mine Road Pilot, and Pima Mine Road Expansion turnouts. An additional turnout was added at the end of the PMRP to evaluate the available capacity for additional water deliveries. This turnout is located at the east end of the PMRP (labeled "PMP South" in the model). All of the components of the model listed above can be seen more clearly on Attachment 1 – "PMR Pipe Layout."

The PMRP is a 36" mortar-lined mortar coated steel pipe. There is 465' section that is 24" in diameter where the pipeline crosses the Santa Cruz River. This section is attached to the bridge and can be seen above grade from the road (labeled "P-Bridge" in the model). This section is a critical component of the pipeline with respect to capacity. Consequently, the modeling scenarios in this report evaluate the impact of upsizing this section of the pipeline to a 36" diameter pipe.

Assumptions:

The following assumptions were made.

- All pipe elevations listed are invert elevations and in datum NAVGP 1929 Vertical.
- The outlet invert elevation of the BMOR is 2,849.0 ft. The model assumes 6 ft of water in the BMOR to give a hydraulic grade of 2,855.0 ft.
- All concrete pipes assume a roughness height of 0.005 ft.
- All steel pipes assume a roughness height of 0.001 ft.
- A hydraulic grade of 2674.65 was maintained at the PMR turnout for deliveries to the PMR recharge project. This hydraulic grade line corresponds to a minimum pressure of 10 psi needed for deliveries at the recharge project.

Scenarios:

The modeled scenarios consist of two cases. The first represent the estimated maximum daily deliveries that are currently being made from the BMOR. The second includes deliveries in the PMRP as described in the Inter-Governmental Agreement (IGA) between CAWCD and the City of Tucson. The IGA quantifies the amount of capacity in the pipeline at 68 cubic feet per second (cfs), 58 cfs for the recharge project and 10 cfs for recharge deliveries into the Santa Cruz River. The difference in the two cases is the 10 cfs allocated for deliveries to the river. The remaining system deliveries are identical. The cases are described in the report as the "Contract Deliveries Scenario" (those defined by the IGA) and the "Existing Deliveries Scenario" (those that do not include deliveries to the Santa Cruz River).

Each of the cases is modeled under two conditions, the first being the existing PMRP, and the second with the 24" section upsized to 36 inches.

The resulting four scenarios are described below.

- Contract Deliveries
 - 1A. Contract Deliveries + Max PMP South Scenario
 - 1B. Contract Deliveries + Max PMP South w/ 36" Pipe on Bridge Scenario
- Existing Deliveries
 - 2A. Existing Deliveries + Max PMP South Scenario
 - 2B. Existing Deliveries + Max PMP South w/ 36" Pipe on Bridge Scenario

Each of the scenarios determines the amount of water that can be delivered at the PMP south scenario by maintaining 10 psi at the PMR recharge project turnout (labeled "PMR Turnout" in the model).

1A. Contract Deliveries + Max PMP South Scenario

Scenario 1A, the *Contract Deliveries + Max PMP South Scenario*, was run to find the maximum amount of water that could be delivered at the PMP South junction. The PMP South junction is located east of the recharge project. For this scenario, the demand flow at the junction was maximized while maintaining 10 psi for delivery of water to the Pima Mine Road Recharge Project at the junction labeled *PMR Turnout*. See the tables below for the results of Scenario 1A.

Junction Report 1A

Label	Elevation (ft)	Demand (cfs)	Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)
ASARCO TURNOUT	2,785.00	17.0	2,810.88	11.2	25.88
PMP SOUTH	2,651.50	14.1	2,674.55	10.0	23.05
PMR EXPANSION 1	2,627.00	6.0	2,667.23	17.4	40.23
PMR EXPANSION 2	2,622.00	6.0	2,666.77	19.4	44.77
PMR EXPANSION 3	2,621.50	6.0	2,666.66	19.5	45.16
PMR PILOT 1	2,639.70	10.0	2,655.33	6.8	15.63
PMR PILOT 2	2,639.60	10.0	2,654.13	6.3	14.53
PMR PILOT 3	2,637.70	10.0	2,651.09	5.8	13.39
PMR PILOT 4	2,637.60	10.0	2,650.95	5.8	13.35
PMR TURNOUT	2,651.50	0.0	2,674.58	10.0	23.08
SAN XAVIER TURNOUT	2,777.00	28.0	2,821.85	19.4	44.85
SANTA CRUZ TURNOUT	2,657.40	10.0	2,720.04	27.1	62.64
TERMINUS TURNOUT	2,785.03	0.0	2,817.86	14.2	32.83

Reservoir Report 1A

Label	Elevation (Outlet Invert) (ft)	Hydraulic Grade (ft)	Outflow (cfs)
Black Mountain Reservoir	2,849.00	2,855.00	127.1

It was determined that the PMP South junction would deliver an additional 14 cfs through the PMRP. The water velocity in the 24" section at the bridge is 23 feet per second (fps) for this scenario. Pipe velocities in this range are outside the normal design guidelines for a water distribution system of this pressure class. Delivering raw water at 23 fps is a scour concern for the mortar-coated pipe. In addition, transients are a significant concern with velocities of this magnitude.

1B. Contract Deliveries + Max PMP South Scenario w 36" Pipe on Bridge

Scenario 1B, the *Contract Deliveries + Max PMP South w/ 36" Bridge Scenario*, was run to see how much water could be delivered at the PMP South junction if the 24" pipe on the Lower Santa Cruz Bridge was upgraded to a 36" pipe. After up-sizing the 24" pipe to a 36" pipe in the model, the demand flow at the PMP South junction was maximized again while still maintaining 10 psi for delivery at PMR Turnout. All of the other turnouts in the model assumed the same demand as Scenario 1A. *Junction Report 1B* and *Reservoir Report 1B* summarize the results of this scenario.

Junction Report 1B

Label	Elevation (ft)	Demand (cfs)	Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)
ASARCO TURNOUT	2,785.00	17.0	2,806.06	9.1	21.06
PMP SOUTH	2,651.50	21.9	2,674.65	10.0	23.15
PMR EXPANSION 1	2,627.00	6.0	2,667.36	17.5	40.36
PMR EXPANSION 2	2,622.00	6.0	2,666.90	19.4	44.90
PMR EXPANSION 3	2,621.50	6.0	2,666.79	19.6	45.29
PMR PILOT 1	2,639.70	10.0	2,655.46	6.8	15.76
PMR PILOT 2	2,639.60	10.0	2,654.25	6.3	14.65
PMR PILOT 3	2,637.70	10.0	2,651.22	5.8	13.52
PMR PILOT 4	2,637.60	10.0	2,651.08	5.8	13.48
PMR TURNOUT	2,651.50	0.0	2,674.71	10.0	23.21
SAN XAVIER TURNOUT	2,777.00	28.0	2,817.69	17.6	40.69
SANTA CRUZ TURNOUT	2,657.40	10.0	2,695.93	16.7	38.53
TERMINUS TURNOUT	2,785.03	0.0	2,813.04	12.1	28.01

Reservoir Report 1B

Label	Elevation (Outlet Invert) (ft)	Hydraulic Grade (ft)	Outflow (cfs)
Black Mountain Reservoir	2,849.00	2,855.00	134.9

It was determined that the PMP South Junction would deliver an additional 22 cfs through the PMRP. The water velocity PMRP pipeline is 11.3 fps which is more consistent with the design range for this type of raw water delivery system.

2A. Existing Deliveries + Max PMP South Scenario

Scenario 2A, the *Existing Deliveries + Max PMP South Scenario*, was run to find the maximum amount of water that could be delivered at the PMP South junction under the conditions of the existing demands. A minimum of 10 psi was maintained for the Pima Mine Road Recharge Project while maximizing the available water at PMP South. All of the other turnouts in the model assumed the same demand as Scenario 2. See the tables below for the results of Scenario 2A.

Junction Report 2A

Label	Elevation (ft)	Demand (cfs)	Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)
ASARCO TURNOUT	2,785.00	17.0	2,812.71	12.0	27.71
PMP SOUTH	2,651.50	21.0	2,674.47	9.9	22.97
PMR EXPANSION 1	2,627.00	6.0	2,667.17	17.4	40.17
PMR EXPANSION 2	2,622.00	6.0	2,666.71	19.3	44.71
PMR EXPANSION 3	2,621.50	6.0	2,666.60	19.5	45.10
PMR PILOT 1	2,639.70	10.0	2,655.27	6.7	15.57
PMR PILOT 2	2,639.60	10.0	2,654.07	6.3	14.47
PMR PILOT 3	2,637.70	10.0	2,651.03	5.8	13.33
PMR PILOT 4	2,637.60	10.0	2,650.89	5.7	13.29
PMR TURNOUT	2,651.50	0.0	2,674.52	10.0	23.02
SAN XAVIER TURNOUT	2,777.00	28.0	2,823.43	20.1	46.43
SANTA CRUZ TURNOUT	2,657.40	0.0	2,729.15	31.0	71.75
TERMINUS TURNOUT	2,785.03	0.0	2,819.69	15.0	34.66

Reservoir Report 2A

Label	Elevation (Outlet Invert) (ft)	Hydraulic Grade (ft)	Outflow (cfs)
Black Mountain Reservoir	2,849.00	2,855.00	124

It was determined that the PMP South Junction would deliver an additional 21 cfs through the PMRP. The water velocity in the 24" section at the bridge is 25.2 feet per second (fps) for this scenario. Pipe velocities in this range are outside the normal design guidelines for a water distribution system of this pressure class. Delivering raw water at 23 fps is a scour concern for the mortar-coated pipe. In addition, transients are a significant concern with velocities of this magnitude.

2B. Existing Deliveries Scenario + Max PMP South w 36" Pipe on Bridge

Scenario 2B, the *Existing Deliveries + Max PMP South w/ 36" Bridge Scenario*, was run to see how much water could be delivered at the PMP South junction if the 24" pipe on the Lower Santa Cruz Bridge was upgraded to a 36" pipe. After up-sizing the 24" pipe to a 36" pipe in the model, the demand flow at the PMP South junction was maximized while still maintaining 10 psi for delivery at PMR Turnout. All of the other turnouts in the model assumed the same demand as Scenario 2. *Junction Report 2B* and *Reservoir Report 2B* summarize the results of this scenario.

Junction Report 2B

Label	Elevation (ft)	Demand (cfs)	Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)
ASARCO TURNOUT	2,785.00	17.0	2,806.98	9.5	21.98
PMP SOUTH	2,651.50	30.5	2,674.48	9.9	22.98
PMR EXPANSION 1	2,627.00	6.0	2,667.24	17.4	40.24
PMR EXPANSION 2	2,622.00	6.0	2,666.77	19.4	44.77
PMR EXPANSION 3	2,621.50	6.0	2,666.66	19.5	45.16
PMR PILOT 1	2,639.70	10.0	2,655.34	6.8	15.64
PMR PILOT 2	2,639.60	10.0	2,654.13	6.3	14.53
PMR PILOT 3	2,637.70	10.0	2,651.09	5.8	13.39
PMR PILOT 4	2,637.60	10.0	2,650.95	5.8	13.35
PMR TURNOUT	2,651.50	0.0	2,674.58	10.0	23.08
SAN XAVIER TURNOUT	2,777.00	28.0	2,818.48	17.9	41.48
SANTA CRUZ TURNOUT	2,657.40	0.0	2,700.65	18.7	43.25
TERMINUS TURNOUT	2,785.03	0.0	2,813.96	12.5	28.93

Reservoir Report 2B

Label	Elevation (Outlet Invert) (ft)	Hydraulic Grade (ft)	Outflow (cfs)
Black Mountain Reservoir	2,849.00	2,855.00	133.5

It was determined that the PMP South Junction would deliver an additional 30 cfs through the PMRP. The water velocity PMRP pipeline is 12.5 fps which is more consistent with the design range for this type of raw water delivery system.

Conclusions:

Given the high velocities that result from additional flows in the PRMP, it is not recommended that additional capacity be allocated for this pipeline in its current configuration. The high flow velocities increase the risk of system damage due to material scour of the mortar coating and potential transients.

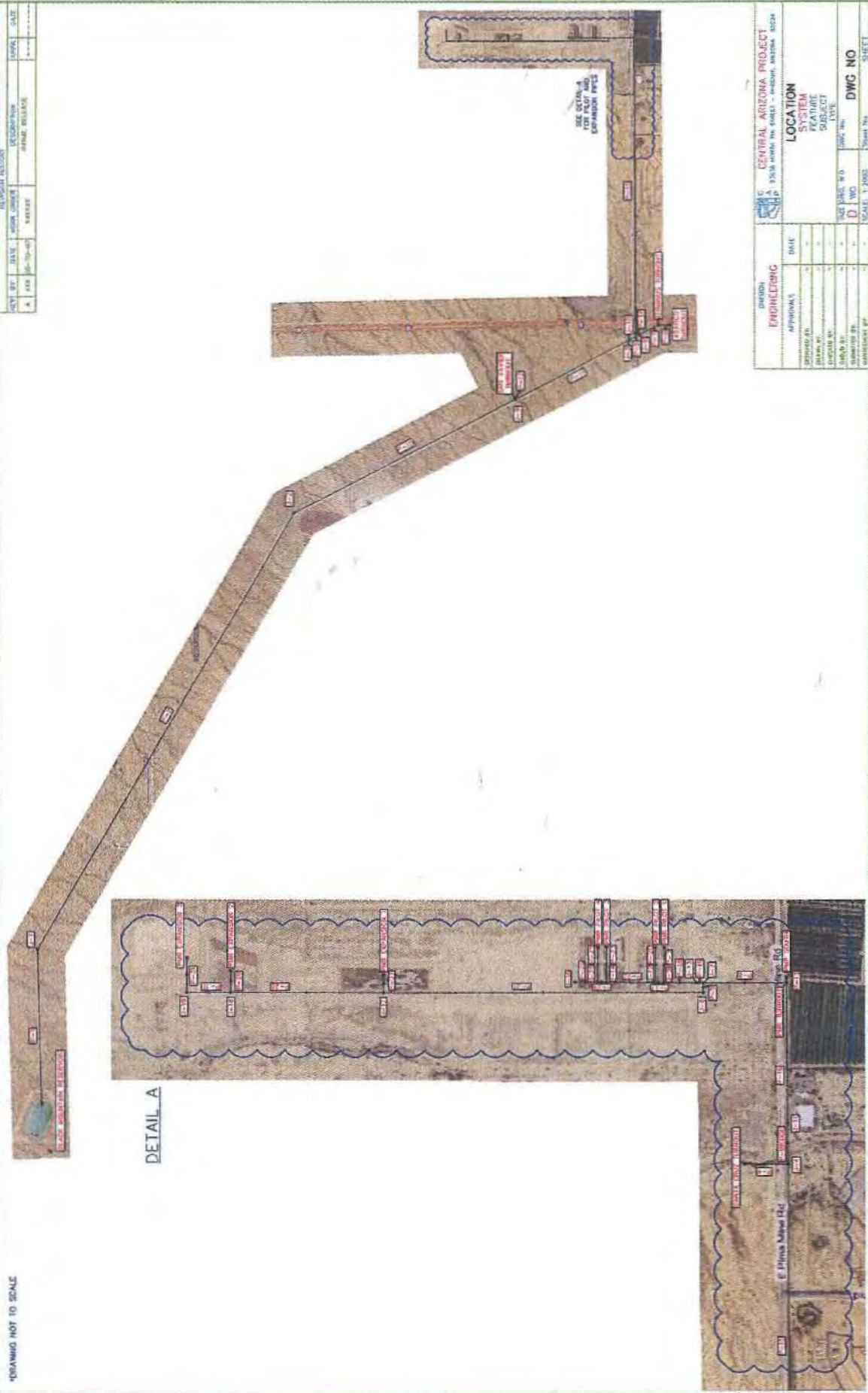
To accommodate additional flows in this system, it is recommended that the 24" section of pipe be replaced with 36" diameter pipe. This change will allow approximately 22 cfs of additional capacity to be allocated from the system.

Any new connections that are made to the system should include a transient evaluation to evaluate impacts of the connection. Once identified, impacts will need to be addressed in the design effort for new connections to this system.

ATTACHMENTS

ATTACHMENT 1
PMR PIPE LAYOUT

REV	BY	DATE	WORK ORDER	DESCRIPTION	QTY	UNIT
1	100	06-10-03	100000	100000	100000	100000



DRAWING	<div style="border: 1px solid black; padding: 5px; text-align: center;"> ENGINEERING </div>	<div style="border: 1px solid black; padding: 5px; text-align: center;">  </div>	CENTRAL ARIZONA PROJECT 350 S. WILSON PKY. SUITE 101 - MCDONALD, ARIZONA 85024	
			<div style="border: 1px solid black; padding: 5px; text-align: center;"> LOCATION SYSTEM FEATURE SUBJECT TYPE </div>	
DATE	APPROVALS	DATE	APPROVALS	DATE
DESIGNED BY	DESIGNED BY	DATE	DATE	DATE
CHECKED BY	CHECKED BY	DATE	DATE	DATE
APPROVED BY	APPROVED BY	DATE	DATE	DATE
REVISIONS	REVISIONS	DATE	DATE	DATE
SCALE: 1" = 1000'	SCALE: 1" = 1000'	SCALE: 1" = 1000'	SCALE: 1" = 1000'	SCALE: 1" = 1000'
DWG NO.	DWG NO.	DWG NO.	DWG NO.	DWG NO.
SHEET	SHEET	SHEET	SHEET	SHEET

ATTACHMENT 2
WATERCAD DATA

CONTRACT DELIVERIES + MAX PMP SOUTH SCENARIO (1A)					
JUNCTION REPORT					
Label	Elevation (ft)	Demand (cfs)	Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)
ASARCO TURNOUT	2,785.00	17.0	2,810.88	11.2	25.88
J-1	2,791.00	0.0	2,849.38	25.3	58.38
J-2	2,750.70	0.0	2,830.98	34.7	80.28
J-3	2,780.80	0.0	2,819.09	16.6	38.29
J-4	2,657.40	0.0	2,720.13	27.1	62.73
J-5	2,647.70	0.0	2,659.84	5.3	12.14
J-6	2,779.91	0.0	2,817.92	16.4	38.01
J-7	2,647.70	0.0	2,669.39	9.4	21.69
J-8	2,646.50	0.0	2,669.33	9.9	22.83
J-9	2,777.00	0.0	2,821.93	19.4	44.93
J-10	2,778.65	0.0	2,816.08	16.2	37.43
J-11	2,656.50	0.0	2,688.05	13.7	31.55
J-12	2,647.60	0.0	2,658.63	4.8	11.03
J-13	2,648.00	0.0	2,667.65	8.5	19.65
J-14	2,645.70	0.0	2,655.59	4.3	9.89
J-15	2,645.60	0.0	2,655.45	4.3	9.85
J-16	2,644.50	0.0	2,655.45	4.7	10.95
J-17	2,634.33	0.0	2,667.34	14.3	33.01
J-18	2,630.19	0.0	2,666.90	15.9	36.71
J-19	2,629.50	0.0	2,666.87	16.2	37.37
PMP SOUTH	2,651.50	14.1	2,674.55	10.0	23.05
PMR EXPANSION 1	2,627.00	6.0	2,667.23	17.4	40.23
PMR EXPANSION 2	2,622.00	6.0	2,666.77	19.4	44.77
PMR EXPANSION 3	2,621.50	6.0	2,666.66	19.5	45.16
PMR PILOT 1	2,639.70	10.0	2,655.33	6.8	15.63
PMR PILOT 2	2,639.60	10.0	2,654.13	6.3	14.53
PMR PILOT 3	2,637.70	10.0	2,651.09	5.8	13.39
PMR PILOT 4	2,637.60	10.0	2,650.95	5.8	13.35
PMR TURNOUT	2,651.50	0.0	2,674.58	10.0	23.08
SAN XAVIER TURNOUT	2,777.00	28.0	2,821.85	19.4	44.85
SANTA CRUZ TURNOUT	2,657.40	10.0	2,720.04	27.1	62.64
TERMINUS TURNOUT	2,785.03	0.0	2,817.86	14.2	32.83

RESERVOIR REPORT			
Label	Elevation (Outlet Invert) (ft)	Hydraulic Grade (ft)	Outflow (cfs)
Black Mountain Reservoir	2,849.00	2,855.00	127.1

CONTRACTUAL DELIVERIES + MAX PMP SOUTH SCENARIO (1A)

PIPE REPORT

Label	Is Active?	Length (ft)	Start Node	Stop Node	Diameter (in)	Material	Darcy-Weisbach e (ft)	Flow (cfs)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Headloss (ft)
P-1	TRUE	5,855.88	Black Mountain Reservoir	J-1	72	Concrete	0.005	127	4.50	0.00099	5.62
P-2	TRUE	18,536.00	J-1	J-2	72	Concrete	0.005	127	4.50	0.00099	18.41
P-3	TRUE	400.00	J-5	PMR PILOT 1	16	Steel	0.001	10	7.16	0.01126	4.50
P-4	TRUE	500.00	J-4	SANTA CRUZ TURNOUT	36	Steel	0.001	10	1.41	0.00017	0.09
P-5	TRUE	430.00	J-3	J-6	54	Concrete	0.005	99	6.23	0.00272	1.17
P-6	TRUE	400.00	TERMINUS TURNOUT	ASARCO TURNOUT	18	Steel	0.001	17	9.82	0.01746	6.98
P-7	TRUE	770.14	J-6	TERMINUS TURNOUT	54	Concrete	0.005	17	1.07	0.00008	0.06
P-8	TRUE	950.00	PMR TURNOUT	J-7	36	Steel	0.001	58	8.21	0.00546	5.18
P-9	TRUE	111.18	J-7	J-8	36	Steel	0.001	18	2.55	0.00055	0.06
P-10	TRUE	9,109.02	J-2	J-9	72	Concrete	0.005	127	4.50	0.00099	9.95
P-11	TRUE	4,689.98	J-9	J-3	72	Concrete	0.005	99	3.50	0.00061	2.84
P-12	TRUE	45.00	J-9	SAN XAVIER TURNOUT	36	Concrete	0.005	28	3.96	0.00184	0.08
P-13	TRUE	67.95	PMR TURNOUT	PMP SOUTH	36	Steel	0.001	14	1.99	0.00034	0.02
P-14	TRUE	169.45	J-6	J-10	36	Steel	0.001	82	11.61	0.01086	1.84
P-15	TRUE	8,832.00	J-10	J-4	36	Steel	0.001	82	11.61	0.01086	95.95
P-16	TRUE	1,605.00	J-11	PMR TURNOUT	36	Steel	0.001	72	10.20	0.00840	13.48
P-17	TRUE	100.00	J-5	J-12	24	Steel	0.001	30	9.55	0.01208	1.21
P-18	TRUE	365.34	J-13	J-5	24	Steel	0.001	40	12.73	0.02138	7.81
P-19	TRUE	81.68	J-7	J-13	24	Steel	0.001	40	12.73	0.02138	1.75
P-20	TRUE	400.00	J-12	PMR PILOT 2	16	Steel	0.001	10	7.16	0.01126	4.50
P-21	TRUE	3,650.00	J-8	J-17	36	Steel	0.001	18	2.55	0.00055	2.00
P-22	TRUE	560.62	J-12	J-14	24	Steel	0.001	20	8.37	0.00542	3.04
P-23	TRUE	400.00	J-14	PMR PILOT 3	16	Steel	0.001	10	7.16	0.01126	4.50
P-24	TRUE	100.00	J-14	J-15	24	Steel	0.001	10	3.18	0.00139	0.14
P-25	TRUE	400.00	J-15	PMR PILOT 4	16	Steel	0.001	10	7.16	0.01126	4.50
P-26	TRUE	256.90	J-15	J-16	24	Steel	0.001	0	0.00	0.00000	0.00
P-27	TRUE	200.00	J-17	PMR EXPANSION 1	24	Steel	0.001	6	1.91	0.00051	0.10
P-28	TRUE	1,750.00	J-17	J-18	36	Steel	0.001	12	1.70	0.00025	0.44
P-29	TRUE	250.00	J-18	PMR EXPANSION 2	24	Steel	0.001	6	1.91	0.00051	0.13
P-30	TRUE	500.00	J-18	J-19	36	Steel	0.001	6	0.85	0.00007	0.03
P-31	TRUE	400.00	J-19	PMR EXPANSION 3	24	Steel	0.001	6	1.91	0.00051	0.21
P-BRIDGE	TRUE	465.00	J-4	J-11	24	Steel	0.001	72	22.95	0.06898	32.08

CONTRACT DELIVERIES + MAX PMP SOUTH W/ 36" PIPE ON BRIDGE SCENARIO (1B)
JUNCTION REPORT

Label	Elevation (ft)	Demand (cfs)	Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)
ASARCO TURNOUT	2,785.00	17.0	2,806.06	9.1	21.06
J-1	2,791.00	0.0	2,848.68	25.0	57.68
J-2	2,750.70	0.0	2,827.95	33.4	77.25
J-3	2,780.80	0.0	2,814.47	14.6	33.67
J-4	2,657.40	0.0	2,696.01	16.7	38.61
J-5	2,647.70	0.0	2,659.97	5.3	12.27
J-6	2,779.91	0.0	2,813.11	14.4	33.20
J-7	2,647.70	0.0	2,669.52	9.4	21.82
J-8	2,646.50	0.0	2,669.46	9.9	22.96
J-9	2,777.00	0.0	2,817.77	17.6	40.77
J-10	2,778.65	0.0	2,810.90	14.0	32.25
J-11	2,656.50	0.0	2,691.23	15.0	34.73
J-12	2,647.60	0.0	2,658.76	4.8	11.16
J-13	2,648.00	0.0	2,667.78	8.6	19.78
J-14	2,645.70	0.0	2,655.72	4.3	10.02
J-15	2,645.60	0.0	2,655.58	4.3	9.98
J-16	2,644.50	0.0	2,655.58	4.8	11.08
J-17	2,634.33	0.0	2,667.46	14.3	33.13
J-18	2,630.19	0.0	2,667.03	15.9	36.84
J-19	2,629.50	0.0	2,667.00	16.2	37.50
PMP SOUTH	2,651.50	21.9	2,674.65	10.0	23.15
PMR EXPANSION 1	2,627.00	6.0	2,667.36	17.5	40.36
PMR EXPANSION 2	2,622.00	6.0	2,666.90	19.4	44.90
PMR EXPANSION 3	2,621.50	6.0	2,666.79	19.6	45.29
PMR PILOT 1	2,639.70	10.0	2,655.46	6.8	15.76
PMR PILOT 2	2,639.60	10.0	2,654.25	6.3	14.65
PMR PILOT 3	2,637.70	10.0	2,651.22	5.8	13.52
PMR PILOT 4	2,637.60	10.0	2,651.08	5.8	13.48
PMR TURNOUT	2,651.50	0.0	2,674.71	10.0	23.21
SAN XAVIER TURNOUT	2,777.00	28.0	2,817.69	17.6	40.69
SANTA CRUZ TURNOUT	2,657.40	10.0	2,695.93	16.7	38.53
TERMINUS TURNOUT	2,785.03	0.0	2,813.04	12.1	28.01

RESERVOIR REPORT

Label	Elevation (Outlet Invert) (ft)	Hydraulic Grade (ft)	Outflow (cfs)
Black Mountain Reservoir	2,849.00	2,855.00	134.9

CONTRACT DELIVERIES + MAX PMP SOUTH W/ 36" PIPE ON BRIDGE SCENARIO (1B)

PIPE REPORT

Label	is Active?	Length (ft)	Start Node	Stop Node	Diameter (in)	Material	Darcy-Weisbach e (ft)	Flow (cfs)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Headloss (ft)
P-1	TRUE	5,655.88	Black Mountain Reservoir	J-1	72	Concrete	0.005	135	4.77	0.00112	6.32
P-2	TRUE	18,536.00	J-1	J-2	72	Concrete	0.005	135	4.77	0.00112	20.72
P-3	TRUE	400.00	J-5	PMR PILOT 1	16	Steel	0.001	10	7.16	0.01126	4.50
P-4	TRUE	500.00	J-4	SANTA CRUZ TURNOUT	36	Steel	0.001	10	1.41	0.00018	0.09
P-5	TRUE	430.00	J-3	J-6	54	Concrete	0.005	107	6.72	0.00316	1.36
P-6	TRUE	400.00	TERMINUS TURNOUT	ASARCO TURNOUT	18	Steel	0.001	17	9.62	0.01746	6.98
P-7	TRUE	770.14	J-6	TERMINUS TURNOUT	54	Concrete	0.005	17	1.07	0.00008	0.06
P-8	TRUE	950.00	PMR TURNOUT	J-7	36	Steel	0.001	58	8.21	0.00546	5.18
P-9	TRUE	111.18	J-7	J-8	36	Steel	0.001	18	2.55	0.00055	0.06
P-10	TRUE	9,109.02	J-2	J-9	72	Concrete	0.005	135	4.77	0.00112	10.18
P-11	TRUE	4,689.98	J-9	J-3	72	Concrete	0.005	107	3.78	0.00070	3.30
P-12	TRUE	45.00	J-9	SAN XAVIER TURNOUT	36	Concrete	0.005	28	3.96	0.00183	0.08
P-13	TRUE	67.95	PMR TURNOUT	PMP SOUTH	36	Steel	0.001	22	3.10	0.00080	0.05
P-14	TRUE	169.45	J-6	J-10	36	Steel	0.001	90	12.72	0.01301	2.20
P-15	TRUE	8,832.00	J-10	J-4	36	Steel	0.001	90	12.72	0.01301	114.89
P-16	TRUE	1,605.00	J-11	PMR TURNOUT	36	Steel	0.001	80	11.30	0.01029	16.52
P-17	TRUE	100.00	J-5	J-12	24	Steel	0.001	30	9.55	0.01208	1.21
P-18	TRUE	365.34	J-13	J-5	24	Steel	0.001	40	12.73	0.02138	7.81
P-19	TRUE	81.68	J-7	J-13	24	Steel	0.001	40	12.73	0.02138	1.75
P-20	TRUE	400.00	J-12	PMR PILOT 2	16	Steel	0.001	10	7.16	0.01126	4.50
P-21	TRUE	3,650.00	J-8	J-17	36	Steel	0.001	18	2.55	0.00055	2.00
P-22	TRUE	560.62	J-12	J-14	24	Steel	0.001	20	6.37	0.00542	3.04
P-23	TRUE	400.00	J-14	PMR PILOT 3	16	Steel	0.001	10	7.16	0.01126	4.50
P-24	TRUE	100.00	J-14	J-15	24	Steel	0.001	10	3.18	0.00139	0.14
P-25	TRUE	400.00	J-15	PMR PILOT 4	16	Steel	0.001	10	7.16	0.01126	4.50
P-26	TRUE	256.90	J-15	J-16	24	Steel	0.001	0	0.00	0.00000	0.00
P-27	TRUE	200.00	J-17	PMR EXPANSION 1	24	Steel	0.001	6	1.91	0.00051	0.10
P-28	TRUE	1,750.00	J-17	J-18	36	Steel	0.001	12	1.70	0.00025	0.44
P-29	TRUE	250.00	J-18	PMR EXPANSION 2	24	Steel	0.001	6	1.91	0.00051	0.13
P-30	TRUE	500.00	J-18	J-19	36	Steel	0.001	6	0.85	0.00007	0.03
P-31	TRUE	400.00	J-19	PMR EXPANSION 3	24	Steel	0.001	6	1.91	0.00051	0.21
P-BRIDGE	TRUE	465.00	J-4	J-11	36	Steel	0.001	80	11.30	0.01029	4.79

EXISTING DELIVERIES + MAX PMP SOUTH SCENARIO (2A)
JUNCTION REPORT

Label	Elevation (ft)	Demand (cfs)	Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)
ASARCO TURNOUT	2,785.00	17.0	2,812.71	12.0	27.71
J-1	2,791.00	0.0	2,849.65	25.4	58.65
J-2	2,750.70	0.0	2,832.13	35.2	81.43
J-3	2,780.80	0.0	2,820.85	17.3	40.05
J-4	2,657.40	0.0	2,729.15	31.0	71.75
J-5	2,647.70	0.0	2,659.78	5.2	12.08
J-6	2,779.91	0.0	2,819.75	17.2	39.84
J-7	2,647.70	0.0	2,669.33	9.4	21.63
J-8	2,646.50	0.0	2,669.27	9.9	22.77
J-9	2,777.00	0.0	2,823.52	20.1	46.52
J-10	2,778.65	0.0	2,818.05	17.0	39.40
J-11	2,656.50	0.0	2,690.67	14.8	34.17
J-12	2,647.60	0.0	2,658.57	4.7	10.97
J-13	2,648.00	0.0	2,667.59	8.5	19.59
J-14	2,645.70	0.0	2,655.53	4.3	9.83
J-15	2,645.60	0.0	2,655.39	4.2	9.79
J-16	2,644.50	0.0	2,655.39	4.7	10.89
J-17	2,634.33	0.0	2,667.28	14.3	32.95
J-18	2,630.19	0.0	2,666.84	15.9	36.65
J-19	2,629.50	0.0	2,666.81	16.1	37.31
PMP SOUTH	2,651.50	21.0	2,674.47	9.9	22.97
PMR EXPANSION 1	2,627.00	6.0	2,667.17	17.4	40.17
PMR EXPANSION 2	2,622.00	6.0	2,666.71	19.3	44.71
PMR EXPANSION 3	2,621.50	6.0	2,666.60	19.5	45.10
PMR PILOT 1	2,639.70	10.0	2,655.27	6.7	15.57
PMR PILOT 2	2,639.60	10.0	2,654.07	6.3	14.47
PMR PILOT 3	2,637.70	10.0	2,651.03	5.8	13.33
PMR PILOT 4	2,637.60	10.0	2,650.89	5.7	13.29
PMR TURNOUT	2,651.50	0.0	2,674.52	10.0	23.02
SAN XAVIER TURNOUT	2,777.00	28.0	2,823.43	20.1	46.43
SANTA CRUZ TURNOUT	2,657.40	0.0	2,729.15	31.0	71.75
TERMINUS TURNOUT	2,785.03	0.0	2,819.69	15.0	34.66

RESERVOIR REPORT

Label	Elevation (Outlet Invert)	Hydraulic Grade (ft)	Outflow (cfs)
Black Mountain Reservoir	2,849.00	2,855.00	124

EXISTING DELIVERIES + MAX PMP SOUTH SCENARIO (2A)

PIPE REPORT

Label	Is Active?	Length (ft)	Start Node	Stop Node	Diameter (in)	Material	Darcy-Weisbach e (ft)	Flow (cfs)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Headloss (ft)
P-1	TRUE	5,655.88	Black Mountain Reservoir	J-1	72	Concrete	0.005	124	4.39	0.00095	5.35
P-2	TRUE	18,536.00		J-2	72	Concrete	0.005	124	4.39	0.00095	17.52
P-3	TRUE	400.00		J-5	16	Steel	0.001	10	7.16	0.01126	4.50
P-4	TRUE	500.00		J-4	36	Steel	0.001	0	0.00	0.00000	0.00
P-5	TRUE	430.00		J-3	54	Concrete	0.005	96	6.04	0.00255	1.10
P-6	TRUE	400.00	TERMINUS TURNOUT	ASARCO TURNOUT	18	Steel	0.001	17	9.62	0.01746	8.98
P-7	TRUE	770.14		J-6	54	Concrete	0.005	17	1.07	0.00008	0.06
P-8	TRUE	950.00	PMR TURNOUT	J-7	36	Steel	0.001	58	8.21	0.00546	5.18
P-9	TRUE	111.18		J-7	36	Steel	0.001	18	2.55	0.00055	0.06
P-10	TRUE	9,109.02		J-2	72	Concrete	0.005	124	4.39	0.00095	8.61
P-11	TRUE	4,689.98		J-9	72	Concrete	0.005	98	3.40	0.00057	2.66
P-12	TRUE	45.00		J-9	36	Concrete	0.005	28	3.96	0.00183	0.08
P-13	TRUE	67.95	PMR TURNOUT	PMP SOUTH	36	Steel	0.001	21	2.97	0.00074	0.05
P-14	TRUE	169.45		J-6	36	Steel	0.001	79	11.18	0.01007	1.71
P-15	TRUE	8,832.00		J-10	36	Steel	0.001	79	11.18	0.01007	88.90
P-16	TRUE	1,605.00		J-11	36	Steel	0.001	78	11.18	0.01007	16.15
P-17	TRUE	100.00		J-5	24	Steel	0.001	30	9.55	0.01208	1.21
P-18	TRUE	365.34		J-13	24	Steel	0.001	40	12.73	0.02138	7.81
P-19	TRUE	81.88		J-7	24	Steel	0.001	40	12.73	0.02138	1.75
P-20	TRUE	400.00		J-12	16	Steel	0.001	10	7.16	0.01126	4.50
P-21	TRUE	3,650.00		J-8	36	Steel	0.001	18	2.55	0.00055	2.00
P-22	TRUE	560.62		J-12	24	Steel	0.001	20	6.37	0.00542	3.04
P-23	TRUE	400.00		J-14	16	Steel	0.001	10	7.16	0.01126	4.50
P-24	TRUE	100.00		J-14	24	Steel	0.001	10	3.18	0.00139	0.14
P-25	TRUE	400.00		J-15	16	Steel	0.001	10	7.16	0.01126	4.50
P-26	TRUE	256.90		J-15	24	Steel	0.001	0	0.00	0.00000	0.00
P-27	TRUE	200.00		J-17	24	Steel	0.001	6	1.91	0.00051	0.10
P-28	TRUE	1,750.00		J-17	36	Steel	0.001	12	1.70	0.00025	0.44
P-29	TRUE	250.00		J-18	24	Steel	0.001	6	1.91	0.00051	0.13
P-30	TRUE	500.00		J-18	36	Steel	0.001	6	0.85	0.00007	0.03
P-31	TRUE	400.00		J-19	24	Steel	0.001	6	1.91	0.00051	0.21
P-BRIDGE	TRUE	465.00		J-4	24	Steel	0.001	79	25.15	0.08275	38.48

EXISTING DELIVERIES + MAX PMP SOUTH W/ 36" PIPE ON BRIDGE SCENARIO (2B)
PIPE REPORT

Label	Elevation (ft)	Demand (cfs)	Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)
ASARCO TURNOUT	2,785.00	17.0	2,806.98	9.5	21.98
J-1	2,791.00	0.0	2,848.81	25.0	57.81
J-2	2,750.70	0.0	2,828.53	33.7	77.83
J-3	2,780.80	0.0	2,815.35	14.9	34.55
J-4	2,657.40	0.0	2,700.65	18.7	43.25
J-5	2,647.70	0.0	2,659.84	5.3	12.14
J-6	2,779.91	0.0	2,814.02	14.8	34.11
J-7	2,647.70	0.0	2,669.40	9.4	21.70
J-8	2,646.50	0.0	2,669.34	9.9	22.84
J-9	2,777.00	0.0	2,818.56	18.0	41.56
J-10	2,778.65	0.0	2,811.89	14.4	33.24
J-11	2,656.50	0.0	2,694.79	16.6	38.29
J-12	2,647.60	0.0	2,658.63	4.8	11.03
J-13	2,648.00	0.0	2,667.65	8.5	19.65
J-14	2,645.70	0.0	2,655.59	4.3	9.89
J-15	2,645.60	0.0	2,655.45	4.3	9.85
J-16	2,644.50	0.0	2,655.45	4.7	10.95
J-17	2,634.33	0.0	2,667.34	14.3	33.01
J-18	2,630.19	0.0	2,666.90	15.9	36.71
J-19	2,629.50	0.0	2,666.87	16.2	37.37
PMP SOUTH	2,651.50	30.5	2,674.48	9.9	22.98
PMR EXPANSION 1	2,627.00	6.0	2,667.24	17.4	40.24
PMR EXPANSION 2	2,622.00	6.0	2,666.77	19.4	44.77
PMR EXPANSION 3	2,621.50	6.0	2,666.66	19.5	45.16
PMR PILOT 1	2,639.70	10.0	2,655.34	6.8	15.64
PMR PILOT 2	2,639.60	10.0	2,654.13	6.3	14.53
PMR PILOT 3	2,637.70	10.0	2,651.09	5.8	13.39
PMR PILOT 4	2,637.60	10.0	2,650.95	5.8	13.35
PMR TURNOUT	2,651.50	0.0	2,674.58	10.0	23.08
SAN XAVIER TURNOUT	2,777.00	28.0	2,818.48	17.9	41.48
SANTA CRUZ TURNOUT	2,657.40	0.0	2,700.65	18.7	43.25
TERMINUS TURNOUT	2,785.03	0.0	2,813.96	12.5	28.93

RESERVOIR REPORT

Label	Elevation (Outlet Invert)	Hydraulic Grade (ft)	Outflow (cfs)
Black Mountain Reservoir	2,849.00	2,855.00	133.5

EXISTING DELIVERIES + MAX PMP SOUTH W/ 36" PIPE ON BRIDGE SCENARIO (2B)

PIPE REPORT

Label	Is Active?	Length (ft)	Start Node	Stop Node	Diameter (in)	Material	Darcy-Weisbach e (ft)	Flow (cfs)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Headloss (ft)
P-1	TRUE	5,655.88	Black Mountain Reservoir	J-1	72	Concrete	0.005	133	4.72	0.00109	6.19
P-2	TRUE	18,536.00		J-1	72	Concrete	0.005	133	4.72	0.00109	20.28
P-3	TRUE	400.00		J-6	16	Steel	0.001	10	7.16	0.01126	4.50
P-4	TRUE	500.00		J-4	36	Steel	0.001	0	0.00	0.00000	0.00
P-5	TRUE	430.00		J-3	54	Concrete	0.005	105	6.63	0.00308	1.32
P-6	TRUE	400.00	TERMINUS TURNOUT	ASARCO TURNOUT	18	Steel	0.001	17	9.62	0.01746	6.88
P-7	TRUE	770.14		J-6	54	Concrete	0.005	17	1.07	0.00008	0.06
P-8	TRUE	950.00	PMR TURNOUT	J-7	36	Steel	0.001	58	8.21	0.00546	5.18
P-9	TRUE	111.18		J-7	36	Steel	0.001	18	2.55	0.00055	0.06
P-10	TRUE	9,109.02		J-2	72	Concrete	0.005	133	4.72	0.00109	9.97
P-11	TRUE	4,689.98		J-9	72	Concrete	0.005	105	3.73	0.00088	3.21
P-12	TRUE	45.00		J-9	36	Concrete	0.005	28	3.96	0.00184	0.08
P-13	TRUE	67.95	PMR TURNOUT	PMP SOUTH	36	Steel	0.001	30	4.31	0.00153	0.10
P-14	TRUE	189.45		J-6	36	Steel	0.001	88	12.51	0.01260	2.13
P-15	TRUE	8,832.00		J-10	36	Steel	0.001	88	12.51	0.01259	111.24
P-16	TRUE	1,605.00		J-11	36	Steel	0.001	88	12.51	0.01259	20.21
P-17	TRUE	100.00		J-5	24	Steel	0.001	30	9.55	0.01208	1.21
P-18	TRUE	365.34		J-13	24	Steel	0.001	40	12.73	0.02138	7.81
P-19	TRUE	81.88		J-7	24	Steel	0.001	40	12.73	0.02138	1.75
P-20	TRUE	400.00		J-12	16	Steel	0.001	10	7.16	0.01126	4.50
P-21	TRUE	3,559.00		J-8	36	Steel	0.001	18	2.55	0.00055	2.00
P-22	TRUE	560.52		J-12	24	Steel	0.001	20	6.37	0.00542	3.04
P-23	TRUE	400.00		J-14	18	Steel	0.001	10	7.16	0.01126	4.50
P-24	TRUE	100.00		J-14	24	Steel	0.001	10	3.18	0.00139	0.14
P-25	TRUE	400.00		J-15	18	Steel	0.001	10	7.16	0.01126	4.50
P-26	TRUE	256.90		J-15	24	Steel	0.001	0	0.00	0.00000	0.00
P-27	TRUE	200.00		J-17	24	Steel	0.001	6	1.91	0.00051	0.10
P-28	TRUE	1,750.00		J-17	36	Steel	0.001	12	1.70	0.00025	0.44
P-29	TRUE	250.00		J-18	24	Steel	0.001	6	1.91	0.00051	0.13
P-30	TRUE	500.00		J-18	36	Steel	0.001	6	0.85	0.00007	0.03
P-31	TRUE	400.00		J-19	24	Steel	0.001	6	1.91	0.00051	0.21
P-BRIDGE	TRUE	485.00		J-4	36	Steel	0.001	88	12.51	0.01260	5.86