Pico Power Project

Appendix 5-A
Route Evaluation Study for the Natural Gas Pipeline

October 2002

16 August 2002

Final Technical Memorandum

To: Mike Fox

From: Gregg Cummings, Jimmy Tan

Reviewed by: Craig Lichty, Stan Shogren

Subject: City of Santa Clara, Silicon Valley Power
120-MW Pico Power Plant Natural Gas Pipeline
K/J 020519.02

INTRODUCTION

Silicon Valley Power (SVP) is planning to construct the 120-MW Pico Power Project (Project) in the City of Santa Clara (City). As part of this project, a natural gas supply pipeline will be constructed. The pipeline will carry natural gas from Pacific Gas & Electric's (PG&E's) existing natural gas pipeline #132 near Silicon Valley Power's (SVP) North Receiving Station/Gianera Generation Plant to the planned gas compression station across Lafayette Street from Kifer Receiving Station. A second natural gas pipeline will carry compressed natural gas from the compression station to the Project site. The Project site is located at 850 Duane Avenue, just south of Highway 101. SVP anticipates needing the gas service at the proposed 120-MW power plant by April 2004.

This memo summarizes the preliminary engineering conducted by Kennedy/Jenks Consultants and our subconsultant, Gas System Engineering (GSE) to identify the location of the gas metering station, preferred pipeline alignment, Highway 101 crossing location, and estimated construction cost.

DESIGN CRITERIA

Based on discussions with SVP and our team, the preliminary design criteria in Table 1 have been established. The total length of the proposed pipeline is approximately 12,000 feet. The pipe material will be welded steel pipeline with epoxy coating on the exterior. Cathodic protection will be provided. A manually operated ball valve will be installed on each end of the pipeline. Regulatory requirements do not require installing intermediate valves on pipelines shorter than 2.5 miles in length. However, to allow the pipeline to be isolated into two sections in case of emergency, one ball valve will be installed at the approximate midpoint of the pipeline.

Table 1 – Design Criteria

Parameter	English Units	Comments
Working Pressure	200-375 psig	Min. pressure of line #132 is 200 psig
Design Pressure	400 psig	Class 300 pipe
Pipe Size	12 inches	Based on minimum pressure.
Minimum Cover	36 inches	-
Min. Vertical Clearance between Existing Utilities	12 inches	-
Min. Horizontal Clearance	12 inches	-

The pipeline will also be designed to the standards established by City of Santa Clara Engineering Department.

Gas Metering Facility

Four alternatives were evaluated for the location of the gas metering facility:

- GM-1 – Existing metering facility at Gianera Street and Lakeshore Drive.
- GM-2 – Empty lot (Parcel 104-06-70) on Gianera Street between Cherry Street and Wilcox Avenue owned by the City of Santa Clara Redevelopment Agency.
- GM-3 – South end of parking lot extension of Stars and Stripes Drive, adjacent to the SVP North Receiving Station.
- GM-4 – Empty lot adjacent to bike path at corner of Gianera Street and Wilcox Avenue.

These locations are shown on Figure 1. The advantages and disadvantages for each alternative are listed in Table 2. Note that all of these sites are City owned, so that is a common advantage to each.

Table 2 – Evaluation of Gas Meter Alternatives

Alternative	Approximate Pipeline Length (FT)	Advantages	Disadvantages	Estimated Raw Cost (no OH&P, etc.)
GM-1	1,500	- Already has gas meter on site.	- Longest pipeline distances. - Overhead electrical lines. - Requires either installing pipeline in Gianera Street or crossing SFPUC right-of-way [(1)] twice running through substation. - Unpaved site.	$690,000
GM-2	500	- Shorter pipeline distances than GM-1. - Preferred location for PG&E. - Largest available lot.	- Longer pipeline distances than GM-4. - Requires either installing pipeline in Gianera Street or crossing SFPUC right-of-way [(1)] twice and running through substation.	$560,000
GM-3	1,800	- Already paved. - Adjacent to substation. - Easy access from parking lot.	- Overhead electrical lines. - Least acceptable to PG&E. - Several underground pipelines located in the vicinity. - Longest pipeline distance. - Requires crossing SFPUC right-of-way [(1)] twice.	$720,000
GM-4	150	- Shortest length of pipe. - Does not require crossing SFPUC right-of-way [(1)]. - Good access.	- Adjacent to house. - Requires relocation of bike path. - Near public access – security issues. - Unpaved.	$520,000

(1) SFPUC – San Francisco Public Utilities Commission (Hetch Hetchy) – owns one 91-inch diameter and one 72-inch diameter water transmission pipeline north of and parallel to Gianera Street. New pipeline would be required to cross under SFPUC pipelines.

GM-4 (Gianera Street and Wilcox Avenue) is the preferred alternative since it requires the shortest pipeline length and provides the best site access. GM-2 is the second choice and GM-1 is the third choice.

Pacific Gas and Electric (PG&E) estimates the gas metering facility will need approximately 30 ft. x 60 ft. of space. It will be located at GM-4 between the existing bike path to the east and the existing residential fence to the west. The bike path will need to be partially relocated to the east to accommodate the metering facility Security of the facility should be evaluated further prior to final design, since the recommended area is adjacent to public access. There are several potential options for mitigating access and security concerns regarding the metering site, including:

1. Constructing 6' high walls (20 foot by 40 foot) around the metering facility which blend in with surrounding development.
2. Installing a new security fence around the facility, with a gate allowing vehicle access from Gianera Street. Landscaping could be installed to help the facility blend in with the surrounding area.

The service for the gas metering facility will be from PG&E line #132 located at Gianera Street and Wilcox Avenue. The proposed layout of the metering facility is shown on Figure 2. The supply pipeline will run from line #132 north to the facility. The discharge pipeline will run east from the metering facility to Lafayette Street, crossing under a sound wall and the Union Pacific Railroad (UPRR) tracks. The gas metering facility will be designed to avoid existing utilities in the vicinity, such as the 24-inch recycled water pipeline, or an underground electric and overhead electrical line.

Natural Gas Pipeline Alignment

VT Power and their subconsultant, CH2M Hill, previously evaluated four preliminary alternative alignments for the natural gas pipeline:

- Along Bassett Street.
- Through PG&E's electrical transmission corridor (overhead lines).
- Adjacent to San Tomas Aquino Creek.
- Within the UPRR easement.

The results were summarized in VT Power's letter to Silicon Valley Power dated 28 November 2001 (See Appendix A). Their conclusion was that the Bassett Street alignment was the preferred alignment.

For purposes of this analysis, the following preliminary alignments (see Figure 3) were studied in greater detail and are included in this Technical Memorandum:

- PA-1 – Bassett Street
- PA-2 – Lafayette Street

The other previously studied alignments were not evaluated further for the following reasons:

- PG&E's electrical transmission corridor: It appears there may be significant public opposition to this option, due to private structures and site features along the easement at several locations. Also, during subsequent discussions with PG&E, they stated that installing gas pipelines underneath overhead electrical lines was not recommended due to safety concerns over dielectric coupling between the power lines and steel pipelines.
- Adjacent to San Tomas Aquino Creek: There would be major environmental issues associated with installing a pipeline adjacent to a creek with potentially sensitive habitats. The permitted construction period would probably be limited to the summer months. Construction issues such as slope stability would also preclude installing a pipeline along this alignment.
- Within the UPRR easement: This alignment appears too expensive due to easement acquisition costs from UPRR. UPRR mentioned the cost for the easements would be derived from the market value during the time of purchase/agreement, on the order of $21 per square foot. Based on the approximate length of 8,000 feet from Gianera Street to Aldo Street and 15 feet easement width, approximately 120,000 square feet would be needed.

The remaining two pipeline alignment alternatives were reviewed based on our review of site conditions, utility information, and a preliminary evaluation of construction feasibility. Field reconnaissance of the pipeline alignments was conducted with SVP and the project team to review site conditions and alignment options. As part of the field investigation, potential utility conflicts and constructibility issues such as crossing existing Union Pacific Railroad (UPRR) tracks, Highway 101, and traffic commuting patterns were noted.

Utility information was collected and analyzed to locate the preliminary pipeline corridor within the selected streets. The following documents were collected and reviewed:

- City block maps for water, reclaimed water, sanitary sewer, storm drain, underground electrical and overhead electrical.
- Private utility maps for telephone and other communication systems.
- Previous pipeline construction drawings along Bassett Street.

- As-built construction drawings for pipelines, residential developments, roadway and bridge projects along Lafayette Street.
- Aerial mapping provided by SVP.

Based on this evaluation, PA-2 (Lafayette Street) was selected as the preferred alignment (shown on Figure 3). The preferred pipeline will start at the gas metering site, proceed easterly across the UPRR tracks and southerly down Lafayette Street. The centerline of the pipeline will be approximately 12 feet east of the western curb line (i.e., the pipeline will be located in the "slow" (west) southbound lane of Lafayette Street. The alignment will proceed southerly on Lafayette Street south to the intersection of Lafayette Street and Aldo Street. The pipeline will then proceed westerly across the UPRR tracks (by bore and jacked casing) and southerly into Bassett Street. At Bassett Street and Laurelwood Road, the pipeline will cross under Highway 101 through a bored and jacked casing (see Highway 101 Alternatives). The casing will extend from Laurelwood Street to the vicinity near Duane Avenue. The pipeline will then proceed southerly to the Pico Power Plant site and cross Lafayette Street to the gas compression station. At the vicinity of the Pico Power Plant, a lateral pipeline will branch off to feed the duct burners. A compressed gas pipeline will proceed from the compression station to the Pico Power Plant. It is anticipated that the two pipelines crossing Lafayette Street will be constructed in the same trench.

Highway 101 Crossing Alternatives

Six alternatives were evaluated for crossing Highway 101:

- HC-1 – Install pipeline in an existing box culvert currently occupied by 24" recycled water pipeline and fiber optic cables at Bassett Street and Laurelwood Road.
- HC-2 – Bore and jack under highway at Bassett Street and Laurelwood Road.
- HC-3 – Bore and jack under highway at Duane Avenue and Raymond Street.
- HC-4 – Reroute the pipeline to the east side of Lafayette Street and bore and jack under the highway at the San Jose Airport Tank Farm.
- HC-5 – Install pipeline under UPRR bridge on Lafayette Street and cross Highway 101 with the pipeline attached to bridge.
- HC-6 – Install pipeline through several parking lots and bore and jack under highway at Duane and Raymond Street.

These locations are shown on Figure 4. The advantages and disadvantages for each alternative are listed in Table 3.

Table 3 – Evaluation of Highway 101 Crossing Alternatives

Alternative	Pipeline Length (FT)	Advantages	Disadvantages	Estimated Raw Cost (no OH&P, etc.)
HC-1	2,000	- Does not require bore and jack. - Easy access to pipeline. - Minimizes pipeline length. - Alignment in City streets.	- Safety concerns expressed by City. - Relatively congested site.	$320,000
HC-2	2,000	- Shorter pipeline distances than HC-3 or HC-4. - Can jack from the vicinity near Duane Avenue. - Alignment in City streets.	- Requires bore and jack crossing of Highway 101. - Requires use of private parking lot for receiving pit. - Requires purchasing easements. - Significant number of existing utilities at receiving site.	$490,000
HC-3	4,000	- Has convenient jacking site. - Alignment in City streets.	- Longer pipeline lengths than HC-1 or HC-2.	$710,000
HC-4	4,500	- Eliminates one crossing of Lafayette Street. - Alignment runs through streets with light traffic loads.	- Alignment runs through three private parking lots (including one trucking firm). - Requires purchasing easements (cost unknown). - Alignment may run though potential burrowing owl habitat (has been mitigated for past projects).	$760,000
HC-5	-	- Alignment in City Streets. - Does not require bore and jack crossing of Highway 101.	- UPRR requires a minimum of 50ft from any bridges. - Caltrans will not allow the pipeline to be attached on overpass bridge.	Not considered

HC-6	3,800	- Minimizes utility conflicts - Can bore and jack from the vicinity near Duane Avenue	- Requires bore and jack crossing of Highway 101 - Requires purchasing easements through parking lots (cost unknown).	$690,000

HC-1 requires the shortest pipeline length and would be the easiest to construct. However, the City has expressed the opinion that they will not allow a natural gas pipeline to be installed inside their existing box culvert. Their primary concern is that the existing fiber optic cables could generate stray electric currents that could ignite the natural gas. Therefore, this alternative was not selected as the preferred alternative.

HC-2 is the preferred crossing alignment since the pipeline can be jacked from near Duane Avenue, thus minimizing pipeline lengths. Also, this alignment does not require construction through a potential burrowing owl habitat. HC-3 is the second choice and HC-4 is the third choice.

The preferred Highway 101 crossing alignment shown on Figure 4 (HC-2) will start at the northeast corner of Bassett Street and Laurelwood Road and will run south to under Duane Avenue to the Pico Power Plant site. The pipeline will be installed in a bored and jacked casing under Highway 101. The private parking lot at the northeast corner of Bassett Street and Laurelwood Road will be used as the jacking pit area. The receiving pit will be located adjacent to Duane Avenue. It appears that this site is currently vacant, and so obtaining an easement for the jacking pit should be feasible. If it is not possible to obtain an easement, then the jacking pit will need to be relocated.

Existing Utilities

As part of the pipeline alignment evaluation, Kennedy/Jenks reviewed available block book maps and available record drawings for the water, reclaimed water, sanitary sewer, storm drain, underground electrical and overhead electrical lines. It appears that, for most of the pipeline alignment, it is feasible to install the pipeline with minimal relocation of existing utilities. However, the following areas will require possible relocation of existing utilities to accommodate construction of the natural gas pipeline:

- Along Bassett Street, where the pipeline crosses underneath the UPRR tracks.
- At the Highway 101 receiving pit (Bassett Street and Laurelwood Road).

This information should be confirmed during final design by performing a detailed survey of the pipeline alignment.

PERMITS

The natural gas pipeline will need to cross over/under existing easements throughout the alignment. These easements include jurisdictional rights-of-way associated with railroads, highways, major utilities and expressways, and are shown on Figure 3. The permitting agencies were contacted to request information on crossing requirements. Permit requirements for the various agencies are summarized in Table 4. Sample permit applications are contained in Appendix B. We anticipate that the bore-and-jack construction method will be used to install casing pipes at these crossings (see Figure 7). The final design of these crossings will be based on specific requirements of the permitting agencies described below.

Table 4 –Permitting Agency Requirements for Preferred Alignment

No.	Location	Agency	Crossing Type	Approximate Length of Crossing (ft)	Steel Casing Diameter (in)
1	Gas Metering Facility (GM-4)	PG&E	N/A	N/A	N/A
2	From Gas Metering Facility to Lafayette	Union Pacific Railroad	Railway	150	18
4	Lafayette Street	San Francisco Public Utilities Commission	Hetch Hetchy Water Pipelines	100	18
5	Intersection of Lafayette Street and Montague Expressway (Encroachment Permit)	County of Santa Clara Roads and Airport Department	Roadway/Highway	-	-
6	Intersection of Lafayette Street and Aldo Avenue to Bassett Street	Union Pacific Railroad	Railway	150	18
7	Highway 101	CalTrans	Roadway/Highway	300	18
8	All City Streets (Street Opening Permit)	City of Santa Clara	N/A	N/A	N/A

1. Casing depth varies depending on Agency requirements and depth of existing utilities, but typically ranges from 8 to 20 feet.

San Francisco Public Utilities Commission

The San Francisco Public Utilities Commission (SFPUC) owns several large water transmission pipelines in the project area north of, and parallel to, Gianera Street. These pipelines transport raw water from the Hetch Hetchy reservoir to the City of San Francisco and other customers in San Mateo, Santa Clara, and Alameda Counties. It is not anticipated that the pipeline will need to cross the SFPUC easement for the preferred alternatives. However, if gas metering facility alternative GM-3 is selected, it will require crossing the SFPUC easement.

The SFPUC requirements for crossing Hetchy Hetchy transmission pipelines include:

1. Submitting a permit application for a revocable permit. An application fee will be required. The application shall be submitted at the 60% design level and takes approximately 4 weeks for processing.

2. Potholing the existing pipelines to determine the depth relative to existing grade. SFPUC will require a written request prior to proceeding with the potholing work. This must be done prior to submitting the permit application.

3. Providing a minimum of 12-inch clearance above existing pipelines during installation by open trench. If directional drilling or bore and jacked casing is considered as an alternative, the clearance below the existing pipeline shall be a minimum of 4 feet.

4. Obtaining insurance necessary prior to proceeding with the construction of the crossing. The insurance consists of General Public Liability providing $1 million for each occurrence.

Permit information is included in Appendix B.1

County of Santa Clara

The preferred and alternative pipeline alignments will require crossing under Santa Clara County's Montague Expressway. The County of Santa Clara requires an encroachment permit for crossing expressways in the City of Santa Clara, even when the crossing will be underneath a bridge. The encroachment permit titled County of Santa Clara Land Development Permit Application needs to be filed with the County Roads and Airport Department prior to commencing any work on County's right-of-way. Additional requirements include:

1. Submitting the plan and profile drawing (60% Design Level) of the expressway crossing to the County for review. The County review takes approximately 4-6 weeks.

2. Providing the encroachment permit fees to the County.

3. If potholing of existing utilities is anticipated on County's right-of-way, additional fees must be submitted to the County prior to beginning work. Potholing requirements will be determined during final design, based on a survey of the pipeline alignment.

A sample permit from another project is included for information in Appendix B.2.

City of Santa Clara

A City of Santa Clara Street Opening Permit will be required for work in City streets, rights-of-way, sites, easements and parks. Since most of the pipeline alignment will be within City streets, this permit will apply to most of the project. The permit is available at the City's Engineering Department for a $27 application fee. The construction contractor will obtain the permit at the beginning of construction. The permit requires the contractor to have a valid City of Santa Clara business license. SVP will be required to pay any inspection fees imposed by the City.

A sample permit application form is included for information in Appendix B.3.

Union Pacific Railroad (UPRR)

The crossing of Union Pacific Railroad tracks is anticipated at two locations. The requirements for working on UPRR right-of-way and crossing of railroad tracks include:

1. Submitting a permit titled Permit To Be On Railroad Property for Nonintrusive Civil Engineering Survey Work prior to conducting any survey work on UPRR property.

2. Entering into a written agreement between UPRR and the City before any construction begins on a new crossing.

3. Submitting a completed application titled Application and a nonrefundable payment of $500.00 (made payable to Union Pacific Railroad Company, Federal Taxpayer Identification No. 94-6001323) for preliminary engineering review of new crossings to the appropriate UPRR manager for the Santa Clara area.

4. Submitting plan and profile drawings (60% Design Level) of the crossings that include the requirements as indicated on the Encased Flammable Pipeline Crossing drawing. UPRR review will take approximately 4-8 weeks.

5. Obtaining insurance necessary prior to proceeding with the construction of the crossing. The amount shall include the cost of the coverage and a Union Pacific administrative fee. Typical insurance requirements are: General Public Liability providing $2 million for each occurrence and general aggregate limit of $4 million; Automobile Public Liability providing $2 million for each occurrence; Worker's Compensation covering the statutory liability determined by state law; Railroad Protective Liability providing $2 million for each occurrence and aggregate limit of $6 million.

A sample permit application form is included for information in Appendix B.4.

Cal-OSHA Mining and Tunneling Unit

CAL-OSHA issues underground classifications for bore-and-jacked casings that are 30 inches diameter or more. The bore-and-jacked crossings for this project are expected to be under 30 inches in diameter, so the classification and associated permits will not be required.

California Department of Transportation (CalTrans)

The California Department of Transportation requires an encroachment permit for the crossing of Highway 101. The requirements for crossing Highway 101 include:

1. Submitting an encroachment permit application along with plan and profile drawings of the crossing. Caltrans stated policy is to either approve or deny the permit application package within 60 calendars days after it has been received. However, past experience has shown that this process can take up to 3 times longer, depending upon the backlog of applications.
2. Submitting an application fee, which will be determined and billed to the City at a later date.
3. Designing the crossing to maintain normal (90 degrees) to the highway alignment where practical. Caltrans normally allows only skews of up to 30 degrees from normal.
4. Installing the new pipeline under the existing roadbed and median by boring and jacking, directional drilling, or other methods approved by Caltrans.
5. Maintaining the boring and jacking pits behind the Highway 101 curb line.
6. Monitoring of roadbed settlement throughout the jacking and boring operation.

A sample of permitting from another project is included for information in Appendix B.5.

GEOTECHNICAL, CORROSION, AND SURVEY INFORMATION

In 1995, Parikh Consultants, Inc. conducted a geotechnical investigation for the recycled water pipeline project along Bassett Street. A total of eleven (11) borings were drilled to a depth of approximately 45 feet and groundwater observation wells were also constructed at four locations. The approximate locations of these borings are shown on Figure 5. Laboratory tests were performed to determine the physical properties of the soils and their corrosion potential. The investigation discovered the pipeline alignment to be in an area of "highly corrosive" to "extremely corrosive" soils.

Since the proposed gas pipeline is to be installed in Lafayette Street, it is reasonable to assume that the soil conditions are similar to Bassett Street. However, a new geotechnical investigation should be conducted along the preferred pipeline route to determine the soil properties in

Lafayette Street as well as at the boring and jacking pits and the gas metering facility. A corrosion evaluation should be conducted for the proposed pipeline, since the pipeline material is welded carbon steel. It is anticipated an epoxy coating (or similar) and active cathodic protection system will be required, at a minimum.

A new topographic survey should be conducted along the alignment prior to beginning the final design of the pipeline. The survey should include all the surface features as well as the vertical design data for the sanitary sewer, storm drains and other miscellaneous items such as water valves. Additional supplemental surveying would be required if other items are located during field reconnaissance. Utilities depicted on the survey will be generated from the City's block book maps and as-built construction drawings. Potholing may be required at congested sites to confirm the exact locations of existing utilities.

INSTALLATION METHODS

The preferred installation method for the pipeline is by conventional open trench. A typical trench detail is shown on Figure 6. The estimated trench width, assuming that the trench is shored, is 2 to 3 feet. If the trench is unshored, then the width could be up to 12 feet wide at the top. Approximately 10 feet adjacent to the edge of trench will be required for equipment access. It will be necessary to close one or two lanes of roadway while the pipeline is being installed.

At locations where the alignment proceeds across the jurisdictional agency rights-of-way such as UPRR or Caltrans, a trenchless installation method will be required. Several trenchless alternatives exist; however, bore-and-jacked casing and directional drilling are considered the two most viable alternatives due to the relatively short distances. A brief description of each trenchless alternative is summarized below.

Bore-and-Jacked Casing

Boring and jacking is an underground method of installing a casing pipe by using a horizontal boring machine or auger to advance the tunnel bore. The bore length is generally determined by the soil conditions but is usually 1,000 feet or less. The casing pipe is normally one to two standard pipe sizes larger than the pipeline being installed. In our case, the casing pipe will likely be 18-inches in diameter. The casing is installed by pushing a line of casing pipes through the bore hole with hydraulic rams from a jacking pit. Excavation for this procedure is carried out at the forward end of the leading pipe or from a shield in front of the leading pipe as the pipeline is pushed from the jacking pit. The jacking pit is expected to be about 40 feet long and 15 feet wide, and the receiving pit about 15 feet by 15 feet.

After advancing the pipe segment into the augered hole, a new pipe segment is placed in the pit and the process is repeated. When a shield is used, hydraulic jacks provided between the shield and the lead pipe can be used to adjust the alignment of the shield. In general, the cutting face of the shield or boring machine typically cuts an excavation that is larger in diameter

than the outside diameter of the remainder of the shield or the pipe. The overcut reduces friction between the pipe and soil during advance and improves steerability of the shield. To further reduce friction on long drives, and to help prevent movement of the soil into the resulting annular space, the annular space is commonly filled with bentonite slurry under pressure. After the casing is installed, the pipe is installed inside the casing. A typical bore-and-jacked casing detail is shown on Figure 7.

Directional Drilling

Directional drilling employs techniques similar to those used in vertical well drilling using a two-stage construction process that is set-up and controlled by above-grade equipment. Directional drills of up to 3,000 feet are generally feasible, depending on soil conditions and other factors. The initial stage consists of drilling a small diameter pilot hole long the desired alignment. Successively larger boring heads are used until the desired hole size is achieved. The second stage involves a "pull-back" where the pipe is pulled back through the enlarged bore in one continuous piece. The enlarged hole is somewhat larger than the outside diameter of the pipe and is surrounded by drilling fluid, which reduces the friction between the pipe and the in-situ materials.

The entry angle is the angle which the pilot hole enters the ground above the horizontal and is typically 8 – 12 degrees from horizontal. The exit angle typically ranges from 10 – 15 degrees. These angles can vary over a wide range depending on the length of the crossing, the size and type of pipe, and subsurface conditions. This method provides a flexible, structural, watertight finished pipeline with accuracy of line and level typically on the order of +/- 1-inch in stable ground. Directional drilling is generally more expensive than boring and jacking but can be performed for longer distances.

COST ESTIMATE

The preliminary cost estimate for the proposed pipeline project for each alternative has been developed based upon previous construction cost models derived from the recycled water project in Santa Clara. The accuracy of the costs should be recognized as being within +30% to –15% of the expected actual construction bid price for the facilities. This level of accuracy is commensurate with levels developed by the American Association of Cost Engineers (AACE) for preliminary design. Some of the criteria and assumptions that were used to develop this estimate of probable cost for pipeline, jacking and receiving pits are as follows:

<u>Pipeline</u>:

- Sheeting and Shoring: Length x 2 sides x Average Depth (SF)
- Excavation: Length x Trench Width x Average Depth (CY)
- Disposal of Excavated Materials: Equals Excavation (CY)

- Bedding: Length x Trench Width x 0.5 ft x 1/27 (CY)
- Backfill: Length x [Trench Width x (Pipe OD + 1 ft) – $\Pi(OD)^2/4$] x 1/27 (CY)
- Pavement Restoration: Length x [Trench Width + 1 ft] x 1/9 (SY)

Jacking Pit:

- Pit Size: 40 ft long x 15 ft wide x 15 ft deep (CF)
- Excavation: Pit Size x 1/27 (CY)
- Disposal of Excavated Materials: Equals Excavation (CY)
- Sheeting and Shoring: 2 x (Length + Width) x Depth (SF)
- Backfill: Equals Excavation (CY)

Receiving Pit:

- Pit Size: 15 ft long x 15 ft wide x 15 feet deep (CF)
- Excavation: Pit Size x 1/27 (CY)
- Disposal of Excavated Materials: Equals Excavation (CY)
- Sheeting and Shoring: 2 x (Length + Width) x Depth (SF)
- Backfill: Equals Excavation (CY)

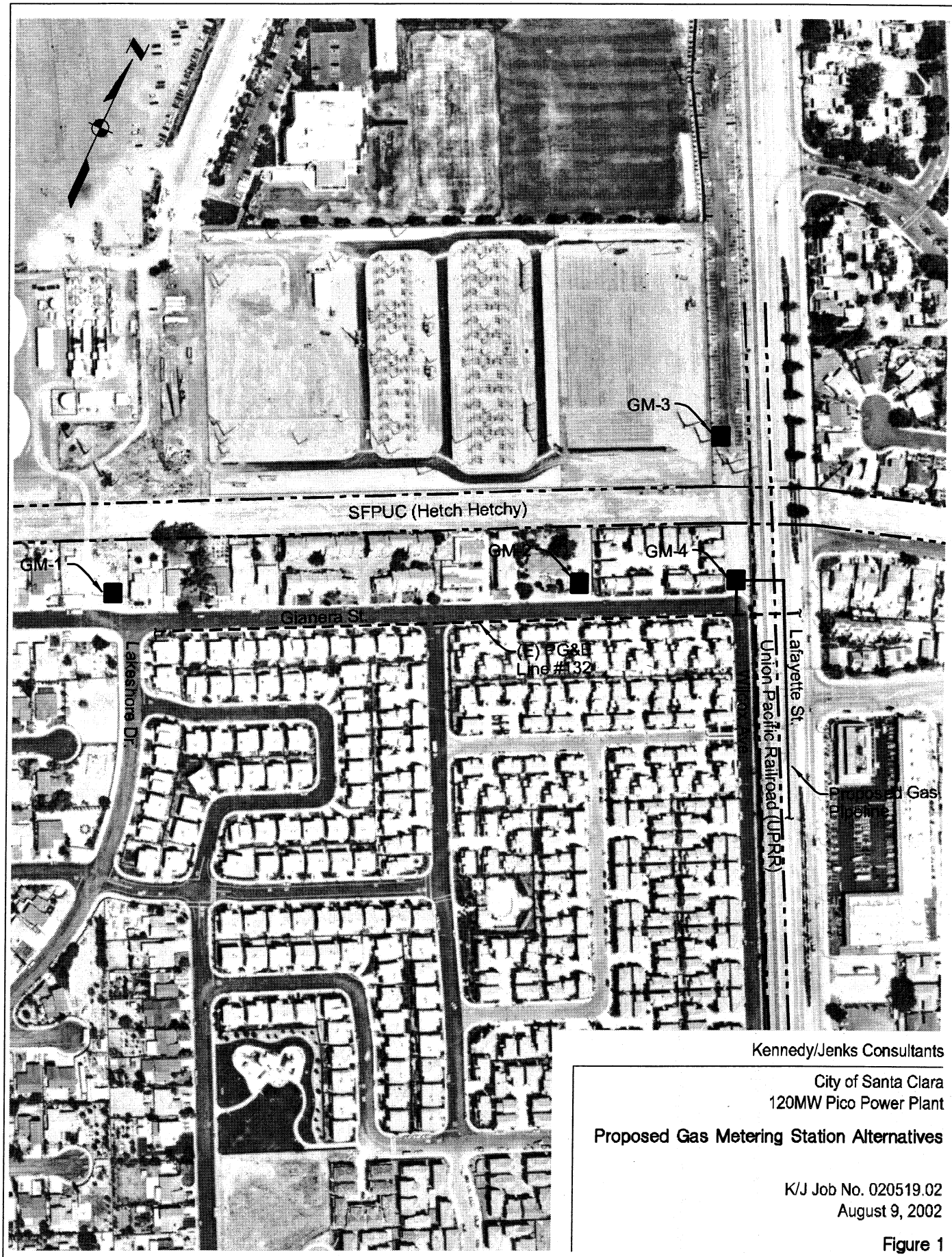
The probable cost of construction for the preferred alignment is shown in Table 5. The supporting cost estimates are contained in Appendix C.

Table 5 – Probable Cost of Construction for Preferred Alignment (+30% to –15%)

Preferred Alignment	Cost
Mobilization/Demobilization	$50,000
General Conditions (insurance, administration, etc.)	$100,000
Gas Metering Station Site (GM-4)	$514,000
UPRR Crossing	$117,000
Pipeline Alignment (PA-2)	$1,126,000
UPRR Crossing	$117,000
Highway Crossing (HC-2)	$334,000
Caltrans Crossing	$154,000
Gas Pipeline to Pico Power Plant	$232,000
Sales Tax on Materials (8.5%)	$84,000
Subcontractor's Markup (10%)	$67,000
Subtotal	$2,895,000
Contractor's Overhead and Profit (15%)	$435,000
Subtotal	$3,330,000
Permitting, Engineering and Construction Services (20%)	$666,000
Contingency (25%)	$833,000
Subtotal	$4,829,000
Escalation Factor	1.045
Total Cost Estimate	$5,047,000

SCHEDULE

The preliminary schedule for final design and construction is shown in Figure 8. Upon notice to proceed, the final design can be completed in approximately 115 days. Bidding phase will last 60 days, which include bidder pre-qualification and City Council approvals. Currently, we anticipate the construction phase to last approximately 6 months after review of shop drawings and delivery of pipe.



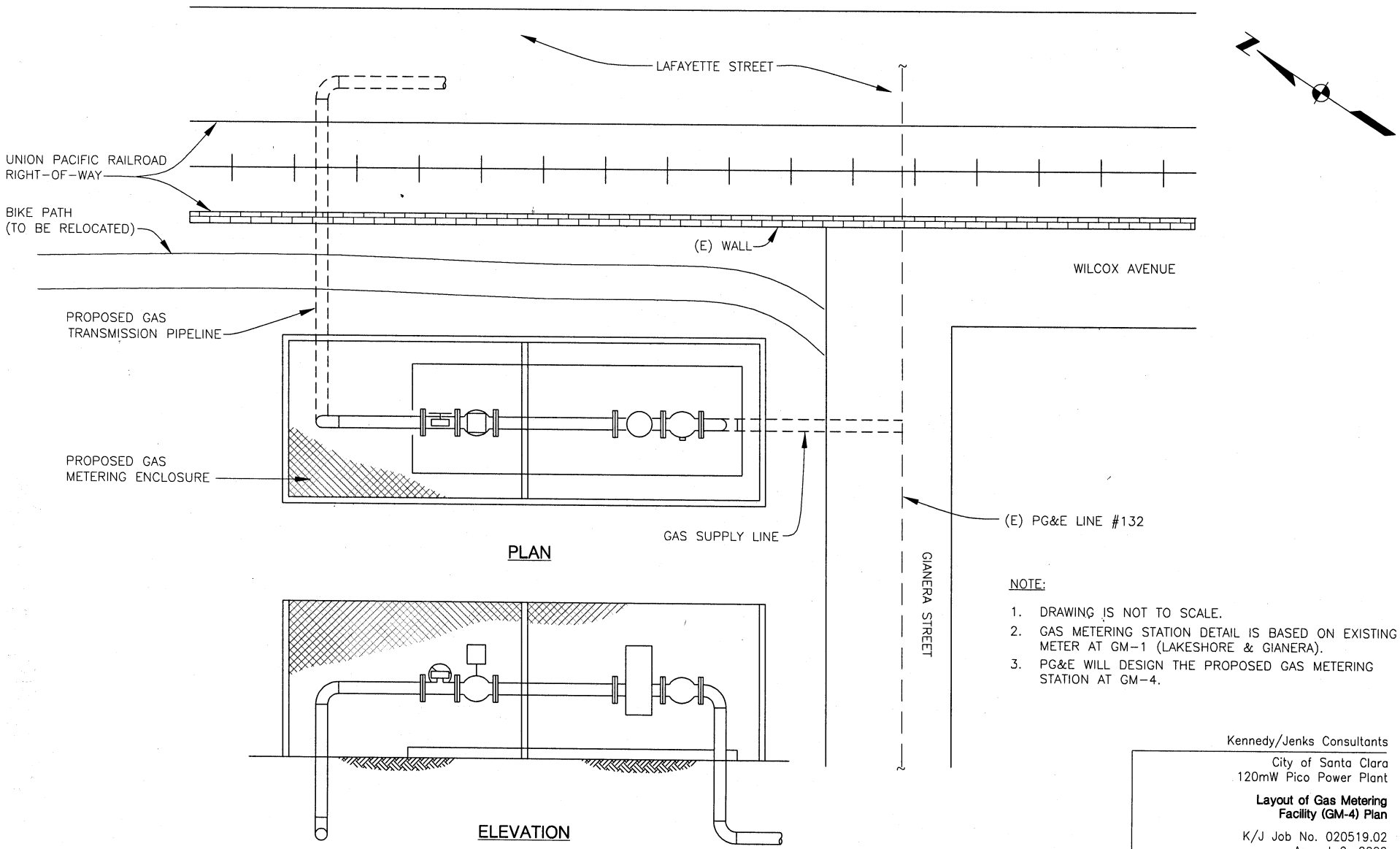
Kennedy/Jenks Consultants

City of Santa Clara
120MW Pico Power Plant

Proposed Gas Metering Station Alternatives

K/J Job No. 020519.02
August 9, 2002

Figure 1



NOTE:

1. DRAWING IS NOT TO SCALE.
2. GAS METERING STATION DETAIL IS BASED ON EXISTING METER AT GM-1 (LAKESHORE & GIANERA).
3. PG&E WILL DESIGN THE PROPOSED GAS METERING STATION AT GM-4.

Kennedy/Jenks Consultants

City of Santa Clara
120mW Pico Power Plant

Layout of Gas Metering Facility (GM-4) Plan

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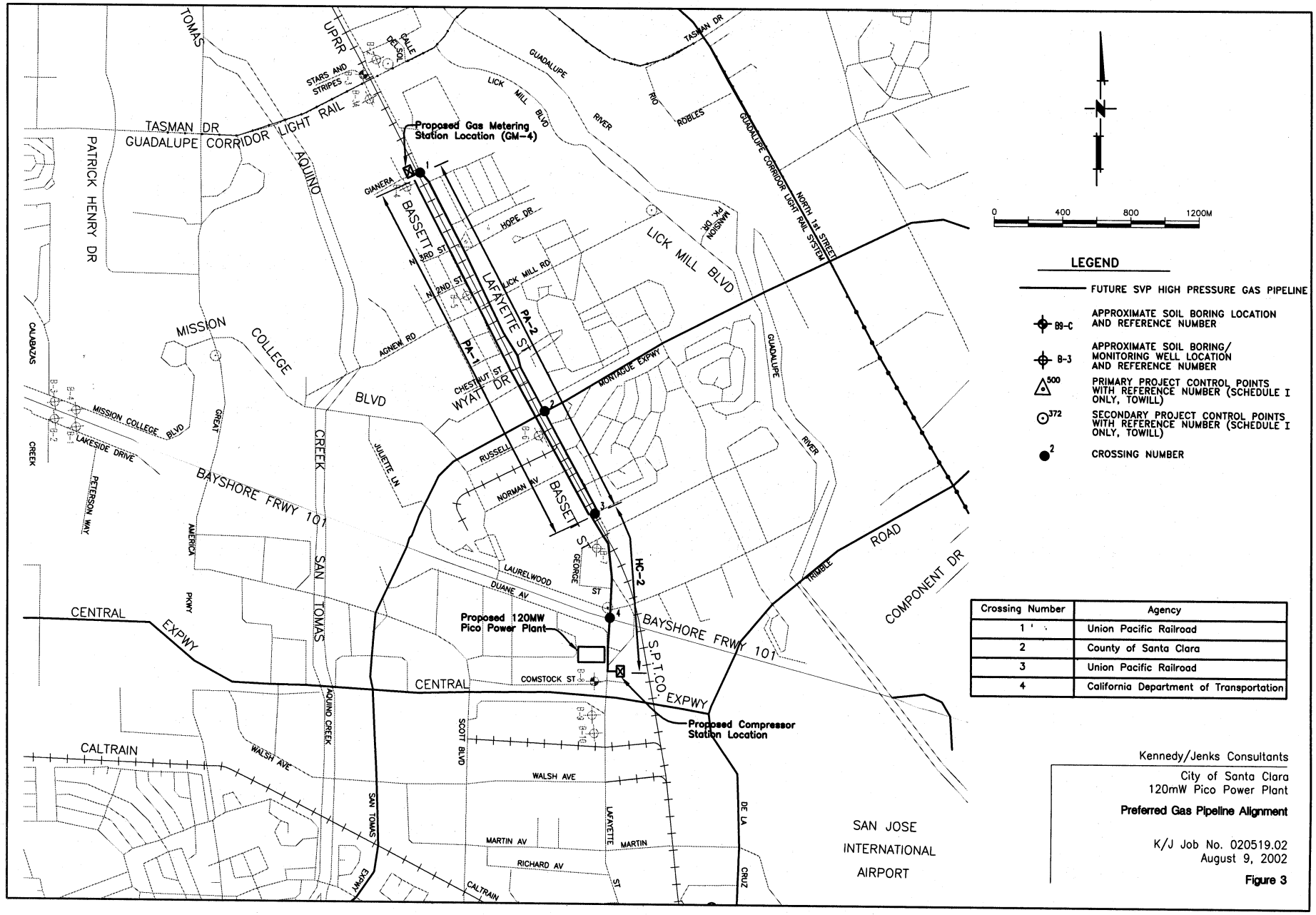
Figure 2



Crossing Number	Agency
1	Union Pacific Railroad
2	County of Santa Clara
3	Union Pacific Railroad
4	California Department of Transportation

Kennedy/Jenks Consultants

City of Santa Clara
120mW Pico Power Plant

Preferred Gas Pipeline Alignment

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Figure 3

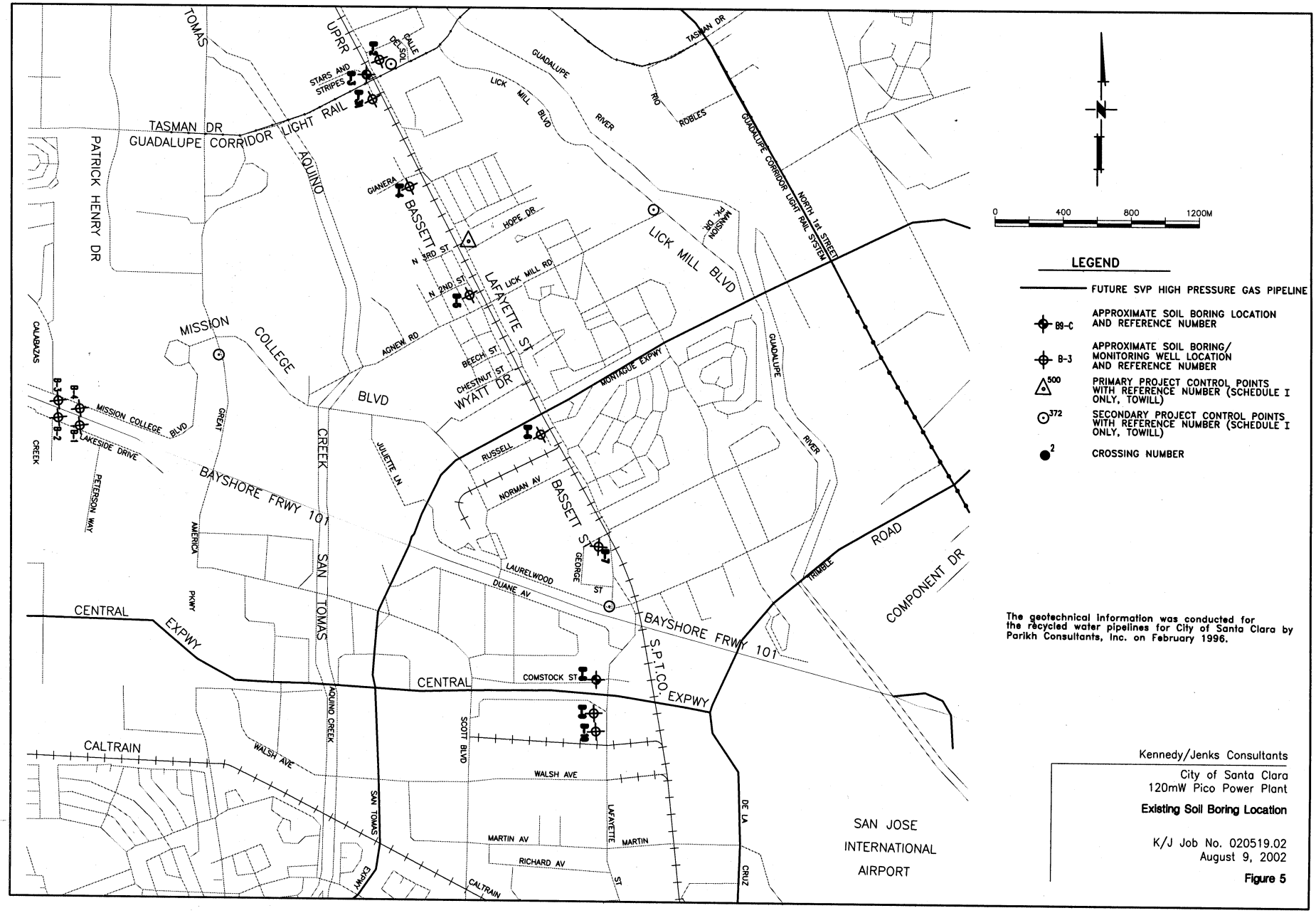
Kennedy/Jenks Consultants

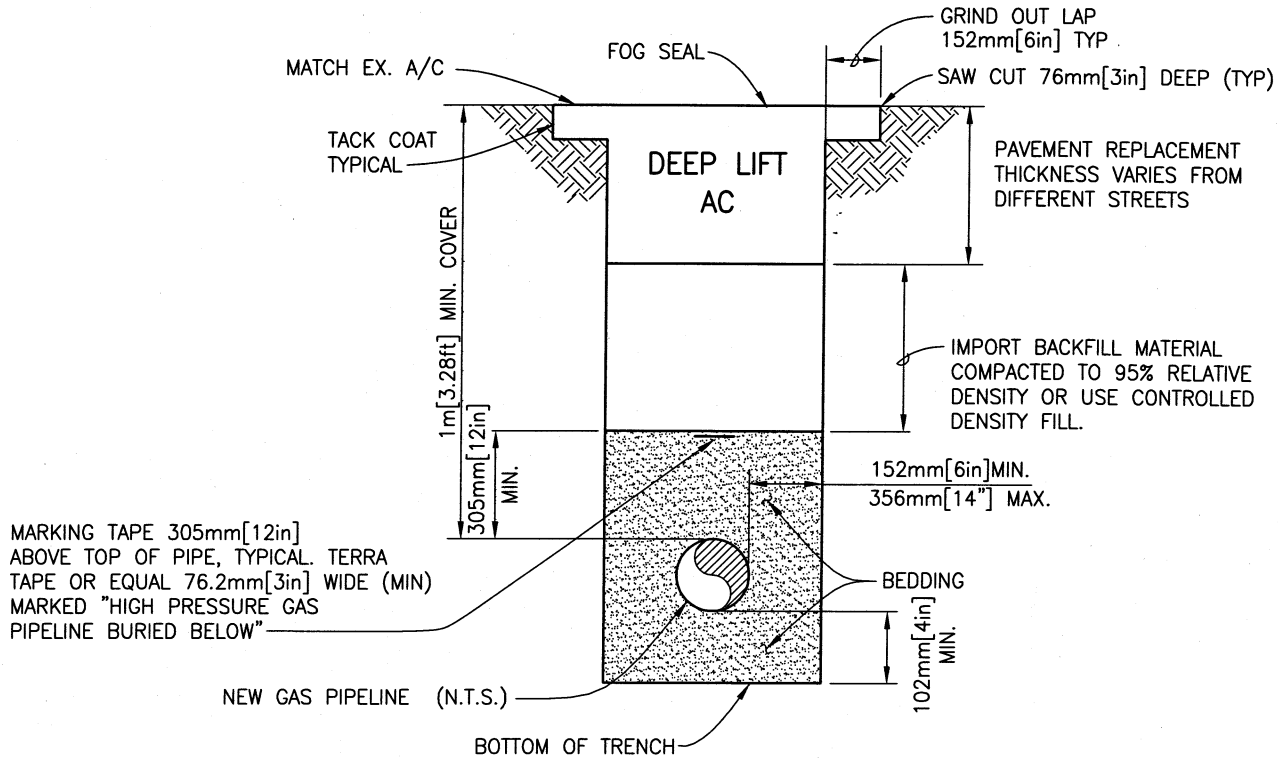
City of Santa Clara
120MW Pico Power Plant

Proposed Highway 101 Crossing Locations

K/J Job No. 020519.02
August 9, 2002

Figure 4


TASMAN DR
GUADALUPE CORRIDOR LIGHT RAIL
PATRICK HENRY DR
TOMAS
AQUINO
UPRR
CALLE DEL SOL
STARS AND STRIPES
GIANERA
BASSETT ST
N 3RD ST
N 2ND ST
HOPE DR
LICK MILL BLVD
LICK MILL RD
LAFAYETTE ST
AGNEW RD
BEECH ST
CHESTNUT ST
WYATT DR
MISSION COLLEGE BLVD
MISSION COLLEGE BLVD
LAKESIDE DRIVE
PETERSON WAY
CALABAZAS CREEK
GREAT AMERICA PKWY
SAN TOMAS CREEK
JULIETTE LN
BAYSHORE FRWY 101
CENTRAL EXPWY
CALTRAIN
WALSH AVE
AQUINO CREEK
SAN TOMAS EXPWY
SCOTT BLVD
RUSSELL
NORMAN AV
LAURELWOOD
DUANE AV
GEORGE ST
COMSTOCK ST
MARTIN AV
RICHARD AV
LAFAYETTE ST
MARTIN
S.P.T.CO.
GUADALUPE RIVER
RIO ROBLES
MANSION PK. DR.
MONTAGUE EXPWY
GUADALUPE CORRIDOR LIGHT RAIL SYSTEM
NORTH 1st STREET
TASMAN DR
GUADALUPE RIVER
TRIMBLE ROAD
COMPONENT DR
DE LA CRUZ
SAN JOSE INTERNATIONAL AIRPORT
0 400 800 1200M
LEGEND
FUTURE SVP HIGH PRESSURE GAS PIPELINE
B9-C APPROXIMATE SOIL BORING LOCATION AND REFERENCE NUMBER
B-3 APPROXIMATE SOIL BORING/ MONITORING WELL LOCATION AND REFERENCE NUMBER
500 PRIMARY PROJECT CONTROL POINTS WITH REFERENCE NUMBER (SCHEDULE I ONLY, TOWILL)
372 SECONDARY PROJECT CONTROL POINTS WITH REFERENCE NUMBER (SCHEDULE I ONLY, TOWILL)
2 CROSSING NUMBER
The geotechnical information was conducted for the recycled water pipelines for City of Santa Clara by Parikh Consultants, Inc. on February 1996.
Kennedy/Jenks Consultants
City of Santa Clara
120mW Pico Power Plant
Existing Soil Boring Location
K/J Job No. 020519.02
August 9, 2002
Figure 5



NOTE:

1. TRENCH SECTION APPLIES TO NON PAVED AREAS, EXCEPT BACKFILL SHALL BE 90% RELATIVE DENSITY AND PAVEMENT WORK DOES NOT APPLY.

TYPICAL TRENCH SECTION

NOT TO SCALE

1

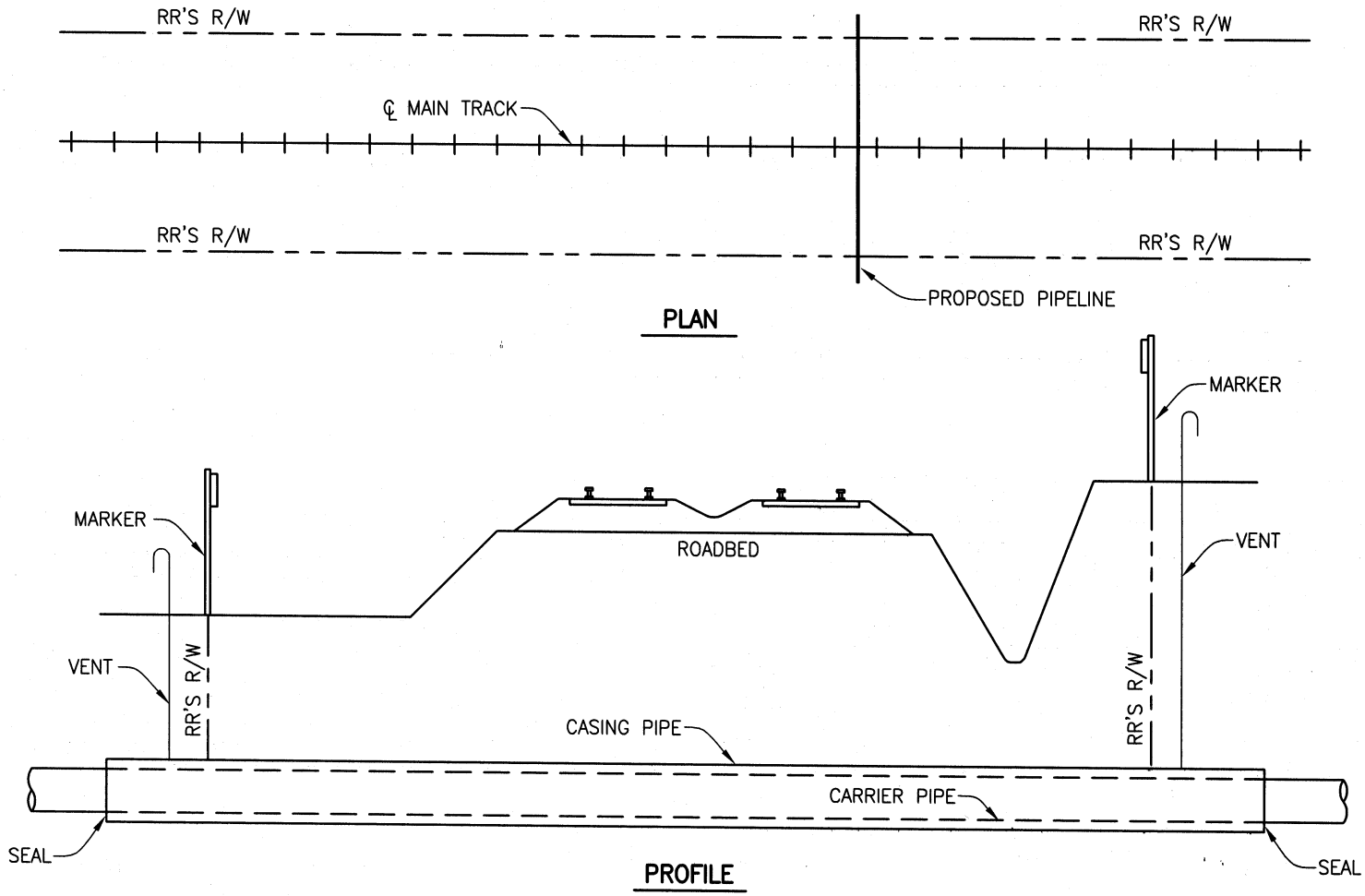
Kennedy/Jenks Consultants

City of Santa Clara
120mW Pico Power Plant

Typical Trench Section

K/J Job No. 020519.02
August 9, 2002

Figure 6



TYPICAL BORE-AND-JACKED CASING (1)

NOT TO SCALE

Kennedy/Jenks Consultants

City of Santa Clara
120mW Pico Power Plant

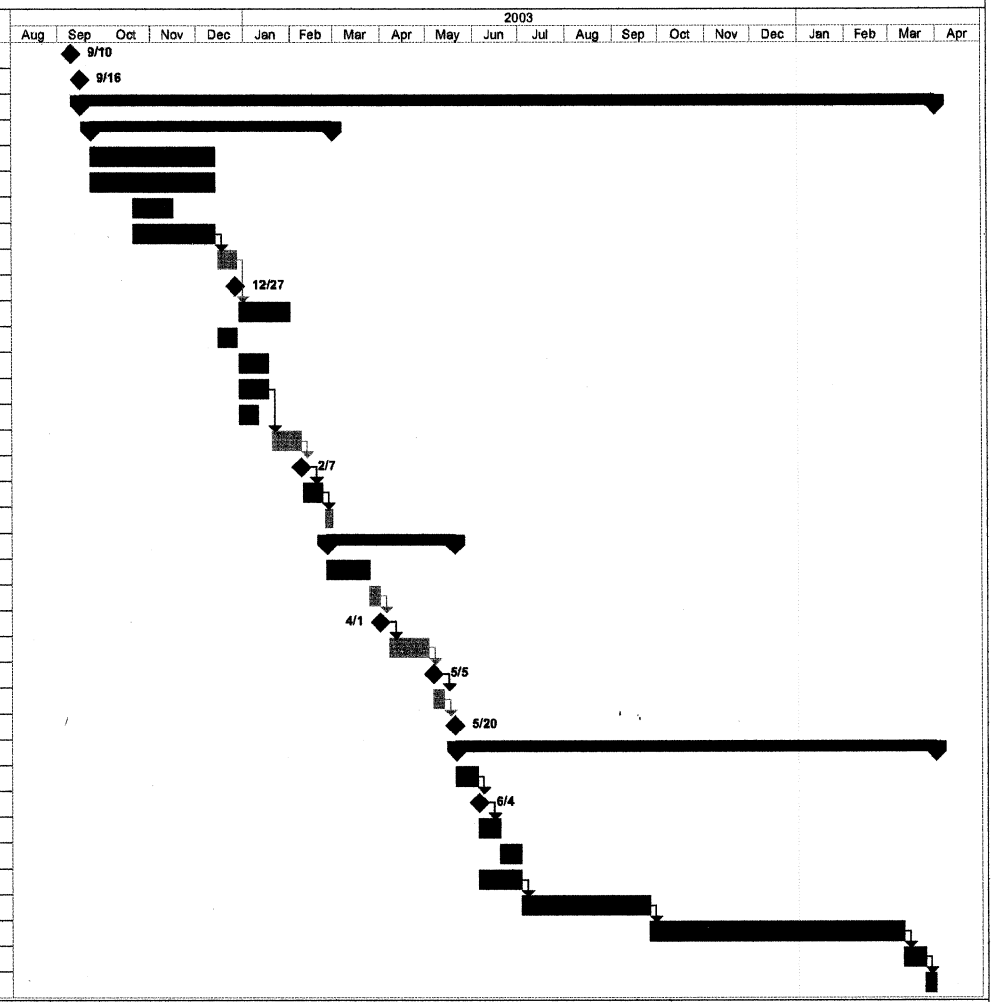
Typical Bore-and-Jacked Casing Plan and Profile

K/J Job No. 020519.02
August 9, 2002

Figure 7

Silicon Valley Power
Natural Gas Pipeline for 120-mW Power Plant in Santa Clara
Project Schedule

ID	Task Name	Duration	Start	Finish
1	Council Meeting	0 days	Tue 9/10/02	Tue 9/10/02
2	Notice to Proceed	0 days	Mon 9/16/02	Mon 9/16/02
3	**Project Management**	**403 days**	**Mon 9/16/02**	**Wed 3/31/04**
8	**Final Design (50%, 90% and 100% Design Submittals)**	**115 days**	**Mon 9/23/02**	**Fri 2/28/03**
9	Surveying and Mapping (Includes Supplemental Surveying)	12 wks	Mon 9/23/02	Fri 12/13/02
10	Geotechnical Investigation (Includes Draft and Final Submittal Reviews)	12 wks	Mon 9/23/02	Fri 12/13/02
11	Coordinate Design with SVP	4 wks	Mon 10/21/02	Fri 11/15/02
12	Prepare 50% Design Submittal	8 wks	Mon 10/21/02	Fri 12/13/02
13	SVP Review	2 wks	Mon 12/16/02	Fri 12/27/02
14	Review Meeting w/ City Staff	0 days	Fri 12/27/02	Fri 12/27/02
15	Prepare 90% Design Submittal	5 wks	Mon 12/30/02	Fri 1/31/03
16	Obtain Permits (All fees by City)	2 wks	Mon 12/16/02	Fri 12/27/02
17	Prepare Final Technical Specifications and Contract Doc's	3 wks	Mon 12/30/02	Fri 1/17/03
18	Prepare Final Bid Documents (Bidding Doc's by City)	3 wks	Mon 12/30/02	Fri 1/17/03
19	Prepare Engineering Cost Estimate	2 wks	Mon 12/30/02	Fri 1/10/03
20	SVP & City Review	3 wks	Mon 1/20/03	Fri 2/7/03
21	Review Meeting	0 days	Fri 2/7/03	Fri 2/7/03
22	Prepare 100% Design Submittal	2 wks	Mon 2/10/03	Fri 2/21/03
23	SVP & City Review	1 wk	Mon 2/24/03	Fri 2/28/03
24	**Bidding Phase**	**60 days**	**Tue 2/25/03**	**Tue 5/20/03**
25	Bidder Prequalification	1 mon	Tue 2/25/03	Mon 3/24/03
26	Prepare Project Advertisement for Council Agenda	1 wk	Tue 3/25/03	Mon 3/31/03
27	City Council Approval	0 days	Tue 4/1/03	Tue 4/1/03
28	Advertise for Bid	4 wks	Mon 4/7/03	Fri 5/2/03
29	Bid Opening	0 days	Mon 5/5/03	Mon 5/5/03
30	Review Bids and Prepare Project Award Recommendation for Council Agenda	1 wk	Tue 5/6/03	Mon 5/12/03
31	Award by City Council	0 days	Tue 5/20/03	Tue 5/20/03
32	**Construction Phase**	**226 days**	**Wed 5/21/03**	**Wed 3/31/04**
33	Submit Bond & Insurance (by Contractor)	2 wks	Wed 5/21/03	Tue 6/3/03
34	Notice to Proceed	0 days	Wed 6/4/03	Wed 6/4/03
35	Obtain Permits (by Contractor)	2 wks	Thu 6/5/03	Wed 6/18/03
36	Mobilization	2 wks	Thu 6/19/03	Wed 7/2/03
37	Submit/Approve Shop Drawings & Submittals	4 wks	Thu 6/5/03	Wed 7/2/03
38	Pipeline Fabrication & Delivery	3 mons	Thu 7/3/03	Wed 9/24/03
39	Construct Pipeline	6 mons	Thu 9/25/03	Wed 3/10/04
40	Complete Work/Punchlist Items	2 wks	Thu 3/11/04	Wed 3/24/04
41	Demobilization	1 wk	Thu 3/25/04	Wed 3/31/04



Project: Overall Schedule
Date: Mon 8/26/02

Task | Milestone | Summary | Rolled Up Milestone | SVP & City Review

Figure 8

012068.10

DRAFT
City of Santa Clara
Silicon Valley Power
120MW Pico Power Plant
Bore-and-Jacked Casing Cost

Item No.	Description	Quantity	SI Unit	Quantity	E Unit	Material		Labor		Subcontract		Total Cost	
						Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension
4.400	**Crossing - Hetch Hetchy**												
a	Mobilize/Demobilize	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
b	Excavation	382	CM	500	CY	$0	$0	$0	$0	$4	$2,000	$4	$2,000
c	Disposal of Excavated Material	382	CM	500	CY	$0	$0	$18.9	$9,425	$0	$0	$18.9	$9,425
d	Sheeting/Shoring	1,881	SM	2,250	SF	$0	$0	$0	$0	$20	$45,000	$20	$45,000
e	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
f	610mm[24in] Casing-Installed	30	LM	100	LF	$0	$0	$0	$0	$250	$25,000	$250	$25,000
g	Backfill	382	CM	500	CY	$18	$9,000	$11	$5,500	$0.0	$0	$18.8	$14,501
h	Surface Restoration	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
							$9,000				$87,000		

Hetch Hetchy Subtotal $110,926

Item No.	Description	Quantity	SI Unit	Quantity	E Unit	Material		Labor		Subcontract		Total Cost	
						Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension
4.401	**Crossing - UPRR**												
a	Mobilize/Demobilize	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
b	Excavation	287	CM	375	CY	$0	$0	$0	$0	$4	$1,500	$4	$1,500
c	Disposal of Excavated Material	287	CM	375	CY	$0	$0	$18.9	$7,069	$0	$0	$18.9	$7,069
d	Sheeting/Shoring	1,881	SM	2,250	SF	$0	$0	$0	$0	$20	$45,000	$20	$45,000
e	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
f	610mm[24in] Casing-Installed	46	LM	150	LF	$0	$0	$0	$0	$250	$37,500	$250	$37,500
g	Backfill	287	CM	375	CY	$18	$6,750	$11	$4,125	$0.0	$0	$29.0	$10,875
h	Surface Restoration	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
							$6,750				$99,000		

UPRR Subtotal $116,944

Item No.	Description	Quantity	SI Unit	Quantity	E Unit	Material		Labor		Subcontract		Total Cost	
						Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension
4.402	**Crossing - CalTrans**												
a	Mobilize/Demobilize	1	LS	1	LS	$0	$0	$0	$0	$4,000	$4,000	$4,000	$4,000
b	Excavation	287	CM	375	CY	$0	$0	$0	$0	$4	$1,500	$4	$1,500
c	Disposal of Excavated Material	287	CM	375	CY	$0	$0	$18.9	$7,069	$0	$0	$18.9	$7,069
d	Sheeting/Shoring	1,881	SM	2,250	SF	$0	$0	$0	$0	$20	$45,000	$20	$45,000
e	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
f	610mm[24in] Casing-Installed	91	LM	300	LF	$0	$0	$0	$0	$250	$75,000	$250	$75,000
g	Backfill	287	CM	375	CY	$18	$6,750	$11	$4,125	$0.0	$0	$29.0	$10,875
h	Surface Restoration	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
							$6,750				$135,500		

CalTrans Subtotal $153,444

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City of Santa Clara
Silicon Valley Power
120MW Pico Power Plant
Gas Metering Station Costs

	Alternative GM-1		SI		E	Material		Labor & Equipment		Subcontract		Total Cost	
Item No.	Description	Quantity	Unit	Quantity	Unit	Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension
4.300	Gas Metering Station[1]	1	LS	1	LS	$450,000	$0	$0	$0	$0	$0	$450,000	$450,000
4.301	305mm[12in] Steel Pipe	457	LM	1,500	LF	$50	$75,000	$20.0	$30,000	$0	$0	$70.0	$105,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.303	Excavation	425	CM	556	CY	$0	$0	$4.5	$2,500	$0	$0	$4.5	$2,500
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.305	Disposal of Excavated Material	425	CM	556	CY	$0	$0	$18.9	$10,500	$0	$0	$18.9	$10,500
4.306	Bedding	53	CM	69	CY	$19.5	$1,354	$9.0	$625	$0	$0	$28.5	$1,979
4.307	Backfill	183	CM	239	CY	$18.0	$4,300	$11.0	$2,628	$0	$0	$29.0	$6,927
4.308	Pavement Restoration	557	SM	667	SY	$32.0	$21,333	$9.0	$6,000	$0	$0	$41.0	$27,333
4.309	Allowance - Fittings (Bends and Tees)	10	EA	10	EA	$3,000	$30,000	$2,000	$20,000	$0	$0	$5,000	$50,000
4.311	Connections	1	EA	1	EA	$6,000	$6,000	$4,000	$4,000	$0	$0	$10,000	$10,000
4.310	Allowance - Gas Meter Site Work	1	LS	1	LS	$0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500
							$137,987				$20,000		

Alternative GM-1 Subtotal $684,240

Note:
1. The Unit Cost for gas metering station is based on information provided by PG&E to John Schwartz on September 7, 2001.
2. This alternative will require the crossing of Union Pacific Railroad tracks for PA-2 (Lafayette Street) alignment.

	Alternative GM-2		SI		E	Material		Labor & Equipment		Subcontract		Total Cost	
Item No.	Description	Quantity	Unit	Quantity	Unit	Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension	Unit Cost	Extension
4.300	Gas Metering Station[1]	1	LS	1	LS	$450,000	$0	$0	$0	$0	$0	$450,000	$450,000
4.301	305mm[12in] Steel Pipe	152	LM	500	LF	$50	$25,000	$20.0	$10,000	$0	$0	$70.0	$35,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.303	Excavation	142	CM	185	CY	$0	$0	$4.5	$833	$0	$0	$4.5	$833
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.305	Disposal of Excavated Material	142	CM	185	CY	$0	$0	$18.9	$3,500	$0	$0	$18.9	$3,500
4.306	Bedding	18	CM	23	CY	$19.5	$451	$9.0	$208	$0	$0	$28.5	$660
4.307	Backfill	61	CM	80	CY	$18.0	$1,433	$11.0	$876	$0	$0	$29.0	$2,309
4.308	Pavement Restoration	186	SM	222	SY	$32.0	$7,111	$9.0	$2,000	$0	$0	$41.0	$9,111
4.309	Allowance - Fittings (Bends and Tees)	5	EA	5	EA	$3,000	$15,000	$2,000	$10,000	$0	$0	$5,000	$25,000
4.310	Connections	1	EA	1	EA	$6,000	$6,000	$4,000	$4,000	$0	$0	$10,000	$10,000
4.311	Allowance - Gas Meter Site Work	1	LS	1	LS	$0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500
							$54,996				$20,000		

Alternative GM-2 Subtotal $556,413

Notes:
1. The Unit Cost for gas metering station is based on information provided by PG&E to John Schwartz on September 7, 2001.
2. This alternative will require the crossing of Union Pacific Railroad tracks for PA-2 (Lafayette Street) alignment.

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City of Santa Clara
Silicon Valley Power
120MW Pico Power Plant
Gas Metering Station Costs

Item No.	**Alternative GM-3** Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.300	Gas Metering Station[1]	1	LS	1	LS	$450,000	$0	$0	$0	$0	$0	$450,000	$450,000
4.301	305mm[12in] Steel Pipe	549	LM	1,800	LF	$50	$90,000	$20.0	$36,000	$0	$0	$70.0	$126,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.303	Excavation	510	CM	667	CY	$0	$0	$4.5	$3,000	$0	$0	$4.5	$3,000
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.305	Disposal of Excavated Material	510	CM	667	CY	$0	$0	$18.9	$12,600	$0	$0	$18.9	$12,600
4.306	Bedding	64	CM	83	CY	$19.5	$1,625	$9.0	$750	$0	$0	$28.5	$2,375
4.307	Backfill	219	CM	287	CY	$18.0	$5,160	$11.0	$3,153	$0	$0	$29.0	$8,313
4.308	Pavement Restoration	669	SM	800	SY	$32.0	$25,600	$9.0	$7,200	$0	$0	$41.0	$32,800
4.309	Allowance - Fittings (Bends and Tees)	10	EA	10	EA	$3,000	$30,000	$2,000	$20,000	$0	$0	$5,000	$50,000
4.310	Connections	1	EA	1	EA	$6,000	$6,000	$4,000	$4,000	$0	$0	$10,000	$10,000
4.311	Allowance - Gas Meter Site Work	1	LS	1	LS	$0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500
							$158,385				$20,000		

Alternative GM-3 Subtotal $715,088

Notes:
1. The Unit Cost for gas metering station is based on information provided by PG&E to John Schwartz on September 7, 2001.
2. This alternative will require the crossing of Hetch Hetchy Pipelines (twice) for PA-1 (Bassett Street) alignment.
3. This alternative will require the crossing of Hetch Hetchy Pipeline (twice) and Union Pacific Railroad tracks for PA-2 (Lafayette Street) alignment.

Item No.	**Alternative GM-4** Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.300	Gas Metering Station[1]	1	LS	1	LS	$450,000	$0	$0	$0	$0	$0	$450,000	$450,000
4.301	305mm[12in] Steel Pipe	46	LM	150	LF	$50	$7,500	$20.0	$3,000	$0	$0	$70.0	$10,500
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$2,000	$2,000	$2,000	$2,000
4.303	Excavation	42	CM	56	CY	$0	$0	$4.5	$250	$0	$0	$4.5	$250
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$1,000	$1,000	$1,000	$1,000
4.305	Disposal of Excavated Material	42	CM	56	CY	$0	$0	$18.9	$1,050	$0	$0	$18.9	$1,050
4.306	Bedding	5	CM	7	CY	$19.5	$135	$9.0	$63	$0	$0	$28.5	$198
4.307	Backfill	18	CM	24	CY	$18.0	$430	$11.0	$263	$0	$0	$29.0	$693
4.308	Pavement Restoration	56	SM	67	SY	$32.0	$2,133	$9.0	$600	$0	$0	$41.0	$2,733
4.309	Allowance - Fittings (Bends and Tees)	5	EA	5	EA	$3,000	$15,000	$2,000	$10,000	$0	$0	$5,000	$25,000
4.310	Connections	1	EA	1	EA	$6,000	$6,000	$4,000	$4,000	$0	$0	$10,000	$10,000
4.311	Allowance - Gas Meter Site Work	1	LS	1	LS	$0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500
							$31,199				$13,000		

Alternative GM-4 Subtotal $513,424

Notes:
1. The Unit Cost for gas metering station is based on information provided by PG&E to John Schwartz on September 7, 2001.
2. This alternative will require the crossing of Union Pacific Railroad tracks for PA-2 (Lafayette Street) alignment.

DRAFT
City of Santa Clara
Silicon Valley Power
120MW Pico Power Plant
Highway Crossing Costs

Item No.	**Alternative HC-1** Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.301	305mm[12in] Steel Pipe	610	LM	2,000	LF	$50	$100,000	$20.0	$40,000	$0	$0	$70.0	$140,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.303	Excavation	566	CM	741	CY	$0	$0	$4.5	$3,333	$0	$0	$4.5	$3,333
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.305	Disposal of Excavated Material	1	LS	1	LS	$0	$0	$0	$0	$6,000	$6,000	$6,000	$6,000
4.306	Bedding	71	CM	93	CY	$19.5	$1,806	$9.0	$833	$0	$0	$28.5	$2,639
4.307	Backfill	244	CM	318	CY	$18.0	$5,733	$11.0	$3,503	$0	$0	$29.0	$9,236
4.308	Sawcutting	1	LS	1	LS	$0	$0	$0	$0	$6,000	$6,000	$6,000	$6,000
4.309	Pavement Restoration	743	SM	889	SY	$32.0	$28,444	$9.0	$8,000	$0	$0	$41.0	$36,444
4.310	Allowance - Fittings (Bends and Tees)	10	EA	10	EA	$3,000	$30,000	$2,000	$20,000	$0	$0	$5,000	$50,000
4.311	Connections	2	EA	2	EA	$6,000	$12,000	$4,000	$8,000	$0	$0	$10,000	$20,000
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
							$177,983				$52,000		

Alternative HC-1 Subtotal $313,653

Note:
1. This alternative does not include bore-and-jacked cost for Highway 101 since it's assumed to be installed in existing utility tunnel.

Item No.	**Alternative HC-2** Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.301	305mm[12in] Steel Pipe	610	LM	2,000	LF	$50	$100,000	$20.0	$40,000	$0	$0	$70.0	$140,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.303	Excavation	566	CM	741	CY	$0	$0	$4.5	$3,333	$0	$0	$4.5	$3,333
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.305	Disposal of Excavated Material	1	LS	1	LS	$0	$0	$0	$0	$6,000	$6,000	$6,000	$6,000
4.306	Bedding	71	CM	93	CY	$19.5	$1,806	$9.0	$833	$0	$0	$28.5	$2,639
4.307	Backfill	244	CM	318	CY	$18.0	$5,733	$11.0	$3,503	$0	$0	$29.0	$9,236
4.308	Sawcutting	1	LS	1	LS	$0	$0	$0	$0	$6,000	$6,000	$6,000	$6,000
4.309	Pavement Restoration	743	SM	889	SY	$32.0	$28,444	$9.0	$8,000	$0	$0	$41.0	$36,444
4.310	Allowance - Fittings (Bends and Tees)	10	EA	10	EA	$3,000	$30,000	$2,000	$20,000	$0	$0	$5,000	$50,000
4.311	Connections	2	EA	2	EA	$6,000	$12,000	$4,000	$8,000	$0	$0	$10,000	$20,000
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
							$177,983				$72,000		

Alternative HC-2 Subtotal $333,653

NoteS:
1. This alternative requires a bore-and-jacked crossing for Highway 101.
2. Does not include bore-and-jacked costs for Highway 101 crossing.

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Item No.	**Alternative HC-3** Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.301	305mm[12in] Steel Pipe	1,219	LM	4,000	LF	$50	$200,000	$20.0	$80,000	$0	$0	$70.0	$280,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.303	Excavation	1,133	CM	1,481	CY	$0	$0	$4.5	$6,667	$0	$0	$4.5	$6,667
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.305	Disposal of Excavated Material	1	LS	1	LS	$0	$0	$0	$0	$6,000	$6,000	$6,000	$6,000
4.306	Bedding	142	CM	185	CY	$19.5	$3,611	$9.0	$1,667	$0	$0	$28.5	$5,278
4.307	Backfill	487	CM	637	CY	$18.0	$11,466	$11.0	$7,007	$0	$0	$29.0	$18,473
4.308	Sawcutting	1	LS	1	LS	$0	$0	$0	$0	$10,000	$10,000	$10,000	$10,000
4.309	Pavement Restoration	1,486	SM	1,778	SY	$32.0	$56,889	$9.0	$16,000	$0	$0	$41.0	$72,889
4.310	Allowance - Fittings (Bends and Tees)	10	EA	10	EA	$3,000	$30,000	$2,000	$20,000	$0	$0	$5,000	$50,000
4.311	Connections	2	EA	2	EA	$6,000	$12,000	$4,000	$8,000	$0	$0	$10,000	$20,000
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$50,000	$50,000	$50,000	$50,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
							$313,966				$101,000		

Alternative HC-3 Subtotal $554,306

Notes:
1. This alternative requires a bore-and-jacked crossing for Highway 101.
2. Does not include bore-and-jacked costs for Highway 101 crossing.

Item No.	**Alternative HC-4** Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.301	305mm[12in] Steel Pipe	1,372	LM	4,500	LF	$50	$225,000	$20.0	$90,000	$0	$0	$70.0	$315,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.303	Excavation	1,274	CM	1,667	CY	$0	$0	$4.0	$6,667	$0	$0	$4.0	$6,667
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.305	Disposal of Excavated Material	1	LS	1	LS	$0	$0	$0	$0	$6,000	$6,000	$6,000	$6,000
4.306	Bedding	159	CM	208	CY	$19.5	$4,063	$9.0	$1,875	$0	$0	$28.5	$5,938
4.307	Backfill	548	CM	717	CY	$18.0	$12,899	$11.0	$7,883	$0	$0	$29.0	$20,782
4.308	Sawcutting	1	LS	1	LS	$0	$0	$0	$0	$10,000	$10,000	$10,000	$10,000
4.309	Pavement Restoration	1,672	SM	2,000	SY	$32.0	$64,000	$9.0	$18,000	$0	$0	$41.0	$82,000
4.310	Allowance - Fittings (Bends and Tees)	10	EA	10	EA	$3,000	$30,000	$2,000	$20,000	$0	$0	$5,000	$50,000
4.311	Connections	2	EA	2	EA	$6,000	$12,000	$4,000	$8,000	$0	$0	$10,000	$20,000
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$56,000	$56,000	$56,000	$56,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
							$347,962				$107,000		

Alternative HC-4 Subtotal $607,386

Notes:
1. This alternative requires a bore-and-jacked crossing for Highway 101 and Union Pacific Railroad tracks.
2. The alignment requires easement acquisitions - costs unknown.
3. Does not include bore-and-jacked costs for Highway 101 crossing.

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Highway Crossing Costs

Item No.	**Alternative HC-6** Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.301	305mm[12in] Steel Pipe	1,158	LM	3,800	LF	$50	$190,000	$20.0	$76,000	$0	$0	$70.0	$266,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.303	Excavation	1,076	CM	1,407	CY	$0	$0	$4.0	$5,630	$0	$0	$4.0	$5,630
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.305	Disposal of Excavated Material	1	LS	1	LS	$0	$0	$0	$0	$6,000	$6,000	$6,000	$6,000
4.306	Bedding	135	CM	176	CY	$19.5	$3,431	$9.0	$1,583	$0	$0	$28.5	$5,014
4.307	Backfill	463	CM	605	CY	$18.0	$10,892	$11.0	$6,657	$0	$0	$29.0	$17,549
4.308	Sawcutting	1	LS	1	LS	$0	$0	$0	$0	$10,000	$10,000	$10,000	$10,000
4.309	Pavement Restoration	1,412	SM	1,689	SY	$32.0	$54,044	$9.0	$15,200	$0	$0	$41.0	$69,244
4.310	Allowance - Fittings (Bends and Tees)	10	EA	10	EA	$3,000	$30,000	$2,000	$20,000	$0	$0	$5,000	$50,000
4.311	Connections	2	EA	2	EA	$6,000	$12,000	$4,000	$8,000	$0	$0	$10,000	$20,000
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$56,000	$56,000	$56,000	$56,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
							$300,367				$107,000		

Alternative HC-6 Subtotal $540,437

Notes:
1. This alternative requires a bore-and-jacked crossing for Highway 101 and Union Pacific Railroad tracks.
2. The alignment requires easement acquisitions - costs unknown.
3. Does not include bore-and-jacked costs for Highway 101 crossing.

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Pipeline Costs

Item No.	Alternative PA-1 Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.301	305mm[12in] Steel Pipe	2,438	LM	8,000	LF	$50	$400,000	$20.0	$160,000	$0	$0	$70.0	$560,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.303	Excavation	2,265	CM	2,963	CY	$0	$0	$4.5	$13,333	$0	$0	$4.5	$13,333
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$20,000	$20,000	$20,000	$20,000
4.305	Disposal of Excavated Material	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.306	Bedding	283	CM	370	CY	$19.5	$7,222	$9.0	$3,333	$0	$0	$28.5	$10,556
4.307	Backfill	974	CM	1,274	CY	$18.0	$22,932	$11.0	$14,014	$0	$0	$29.0	$36,945
4.308	Sawcutting	1	LS	1	LS	$0	$0	$0	$0	$24,000	$24,000	$24,000	$24,000
4.309	Pavement Restoration	2,973	SM	3,556	SY	$32.0	$113,778	$9.0	$32,000	$0	$0	$41.0	$145,778
4.310	Allowance - Fittings (Bends and Tees)	20	EA	20	EA	$3,000	$60,000	$2,000	$40,000	$0	$0	$5,000	$100,000
4.311	Connections	1	EA	1	EA	$6,000	$6,000	$4,000	$4,000	$0	$0	$10,000	$10,000
4.312	Allowance - Valves	3	EA	3	EA	$10,000	$30,000	$5,000	$15,000	$0	$0	$15,000	$45,000
4.313	Allowance - Utilities Relocation[2]	1	LS	1	LS	$0	$0	$0	$0	$200,000	$200,000	$200,000	$200,000
4.314	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$100,000	$100,000	$100,000	$100,000
4.315	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$10,000	$10,000	$10,000	$10,000
							$639,932				$404,000		

Alternative PA-1 Subtotal $1,325,612

Notes:
1. This alternative is from intersection of Gianera and Wilcox to Aldo Avenue
2. Assumed relocation of approximately 2,000 LF of pipeline along Bassett.

Item No.	Alternative PA-2 Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.301	305mm[12in] Steel Pipe	2,438	LM	8,000	LF	$50	$400,000	$20.0	$160,000	$0	$0	$70.0	$560,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.303	Excavation	2,265	CM	2,963	CY	$0	$0	$4.5	$13,333	$0	$0	$4.5	$13,333
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$20,000	$20,000	$20,000	$20,000
4.305	Disposal of Excavated Material	1	LS	1	LS	$0	$0	$0	$0	$25,000	$25,000	$25,000	$25,000
4.306	Bedding	283	CM	370	CY	$19.5	$7,222	$9.0	$3,333	$0	$0	$28.5	$10,556
4.307	Backfill	974	CM	1,274	CY	$18.0	$22,932	$11.0	$14,014	$0	$0	$29.0	$36,945
4.308	Sawcutting	1	LS	1	LS	$0	$0	$0	$0	$24,000	$24,000	$24,000	$24,000
4.309	Pavement Restoration	2,973	SM	3,556	SY	$32.0	$113,778	$9.0	$32,000		$0	$41.0	$145,778
4.310	Allowance - Fittings (Bends and Tees)	20	EA	20	EA	$3,000	$60,000	$2,000	$40,000	$0	$0	$5,000	$100,000
4.311	Connections	1	EA	1	EA	$6,000	$6,000	$4,000	$4,000	$0	$0	$10,000	$10,000
4.312	Allowance - Valves	3	EA	3	EA	$10,000	$30,000	$5,000	$15,000	$0	$0	$15,000	$45,000
4.313	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$100,000	$100,000	$100,000	$100,000
4.314	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$10,000	$10,000	$10,000	$10,000
							$639,932				$204,000		

Alternative PA-2 Subtotal $1,125,612

Note:
1. This alternative is from intersection of Gianera and Wilcox to Aldo Avenue
2. This alignment requires crossing of Union Pacific Railroad from Aldo Avenue to Bassett Street for HC-1, HC-2 and HC-3 alternatives.

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120MW Pico Power Plant
Pipeline Costs

Item No.	Gas Pipeline to Pico Power Plant Description	Quantity	SI Unit	Quantity	E Unit	Material Unit Cost	Material Extension	Labor & Equipment Unit Cost	Labor & Equipment Extension	Subcontract Unit Cost	Subcontract Extension	Total Cost Unit Cost	Total Cost Extension
4.301	305mm[12in] Steel Pipe	488	LM	1,600	LF	$50	$80,000	$20.0	$32,000	$0	$0	$70.0	$112,000
4.302	Sheeting & Shoring	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.303	Excavation	453	CM	593	CY	$0	$0	$4.5	$2,667	$0	$0	$4.5	$2,667
4.304	Dewatering	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.305	Disposal of Excavated Material	1	LS	1	LS	$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
4.306	Bedding	57	CM	74	CY	$19.5	$1,444	$9.0	$667	$0	$0	$28.5	$2,111
4.307	Backfill	195	CM	255	CY	$18.0	$4,586	$11.0	$2,803	$0	$0	$29.0	$7,389
4.308	Sawcutting	1	LS	1	LS	$0	$0	$0	$0	$6,000	$6,000	$6,000	$6,000
4.309	Pavement Restoration	595	SM	711	SY	$32.0	$22,756	$9.0	$6,400	$0	$0	$41.0	$29,156
4.310	Allowance - Fittings (Bends and Tees)	5	EA	5	EA	$3,000	$15,000	$2,000	$10,000	$0	$0	$5,000	$25,000
4.311	Connections	1	EA	1	EA	$6,000	$6,000	$4,000	$4,000	$0	$0	$10,000	$10,000
4.312	Allowance - Cathodic Protection	1	LS	1	LS	$0	$0	$0	$0	$20,000	$20,000	$20,000	$20,000
4.313	Allowance - Landscape Restoration	1	LS	1	LS	$0	$0	$0	$0	$2,500	$2,500	$2,500	$2,500
							$129,786				$43,500		

Gas Pipeline to Pico Power Plant Subtotal $231,822