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## RAW WATER PIPELINES

### 3.1 INTRODUCTION

Raw water pipelines convey water from wells to the desalter facilities for treatment. They are not part of the potable water distribution system. There are two new sets of raw water pipelines required as part of the Phase 3 expansion project:

- CCWF Raw Water Pipeline System (Chino I)
- Chino II Wellfield Expansion Raw Water Pipeline System (Chino II)

This section presents a discussion of each of these raw water pipelines systems, together with an analysis of alternative routes, and concludes with raw water pipeline design criteria.

### 3.2 CHINO CREEK WELL FIELD PIPELINES

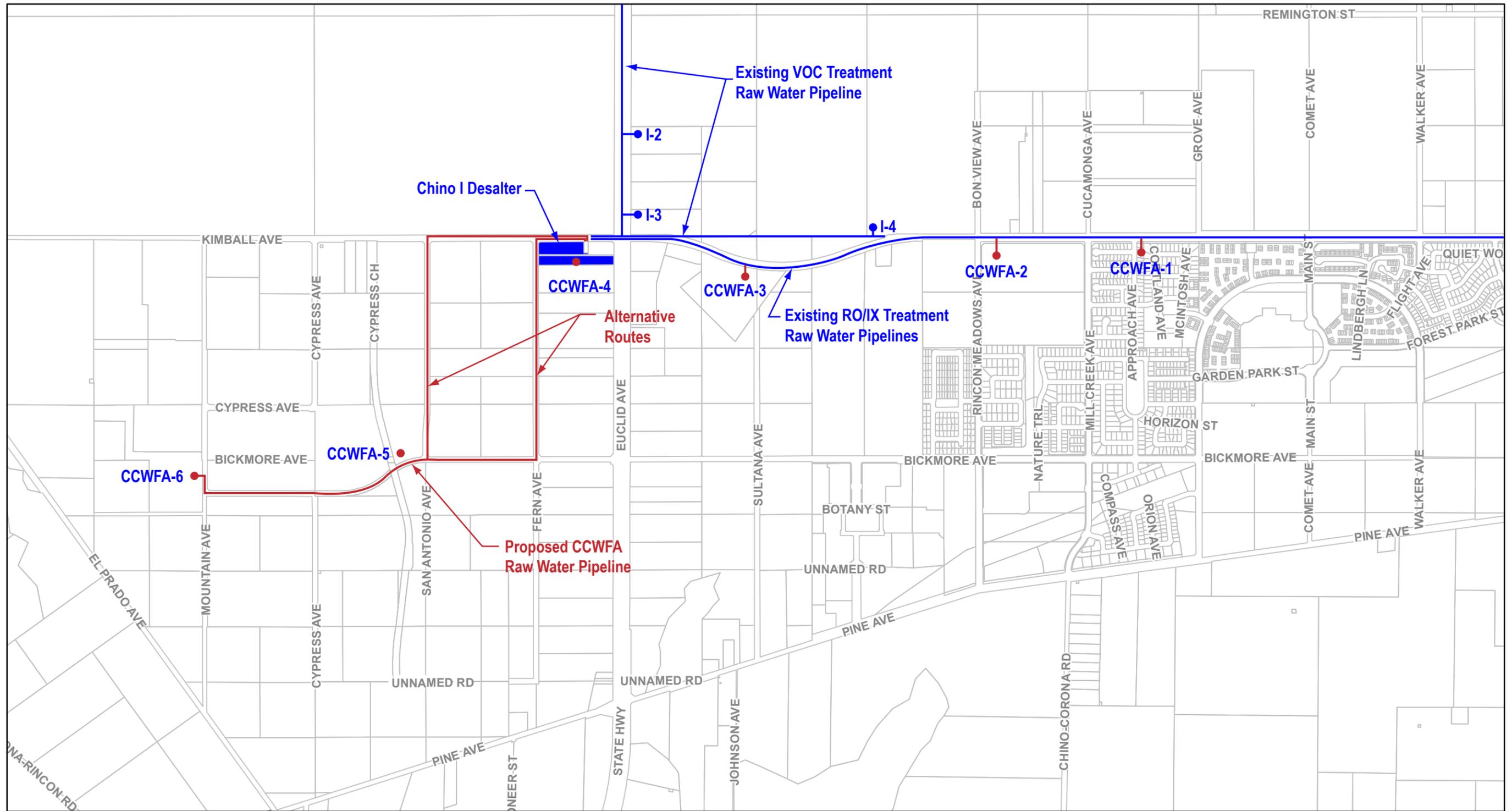
The Chino I Desalter currently has two independent raw water pipeline systems:

- The VOC well pipeline connects wells CDA I-1, 2, 3, and 4 to the air stripping system for removal of VOCs.
- The RO/IX pipeline conveys raw water from wells CDA I-5, 6, 7, 8, 9, 10, 11, 13, 14, and 15 to Chino I for treatment in either the RO or IX process.

Watermaster intends that the proposed CCWF wells will promote hydraulic control of flow from the Chino Groundwater Basin to the Santa Ana River. This will require well production from the upper alluvial aquifer (Layer 1), which is characterized by water quality requiring treatment for removal of nitrates and dissolved salts. Therefore, the proposed CCWF wells will require treatment by RO or IX facilities and can share the same pipeline with wells CDA I-5 through 15.

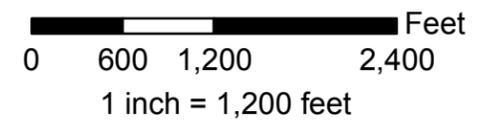
Groundwater models indicate that CCWF wells may produce VOCs in the future. As discussed in Section 4, segregation of VOC producing CCWF wells through construction of separate raw water pipelines is not recommended.

Figure 3.1 shows the location of existing Chino I raw water pipelines and wells together with the proposed CCWF wells (alignment A) and raw water pipeline routes. The CCWFA well locations shown on this figure are approximate locations provided by others (GEOSCIENCE, May 2009) and do not reflect the constraints of property availability or utility locations (e.g., sanitary sewers and overhead power lines). A separate technical memorandum has been prepared to show available, feasible parcel locations for well sites. The proposed sites can be accommodated by the routes shown on Figure 3.1.



**Legend**

Parcels



**Figure 3.1**  
**Vicinity Map**  
**CHINO DESALTER PHASE 3 PDR**  
**JCSD/ONTARIO/WMWD**



As indicated in Figure 3.1, wells CCWFA-1, 2, and 3 will be connected to the existing Chino I RO/IX treatment raw water pipeline in Kimball Avenue. Well CCWFA-4 will be located at the Chino I Desalter site and does not require off-site piping. Well CCWFA-6 will be located within the property boundaries of Inland Empire Utility Agencies' (IEUA's) RP-5 Solids Handling Facility at the intersection of Mountain Avenue and Bickmore Avenue. The termination point of the new CCWF raw water pipeline from the Chino I Desalter has been established by the selection of this site.

Two alternative routes are shown between Chino I and the CCWFA-6 site. The eastern route (along Fern Avenue) is preferable because it requires less pipeline construction along Kimball Avenue, a more heavily traveled street. The western route (along San Antonio Avenue) will be selected if property availability leads to the purchase of a site for CCWFA-5 along this route. Both routes have equivalent pipeline length.

### **3.3 CHINO II WELL FIELD EXPANSION PIPELINE**

As discussed in Section 2 of this report, the recommended expansion of the Chino II Desalter includes the following modifications to the Chino II well field:

- Connect existing wells CDA I-13, 14, and 15 to the Chino II raw water system
- Accommodate the connection of potential, future wells to the Chino II raw water pipeline system.

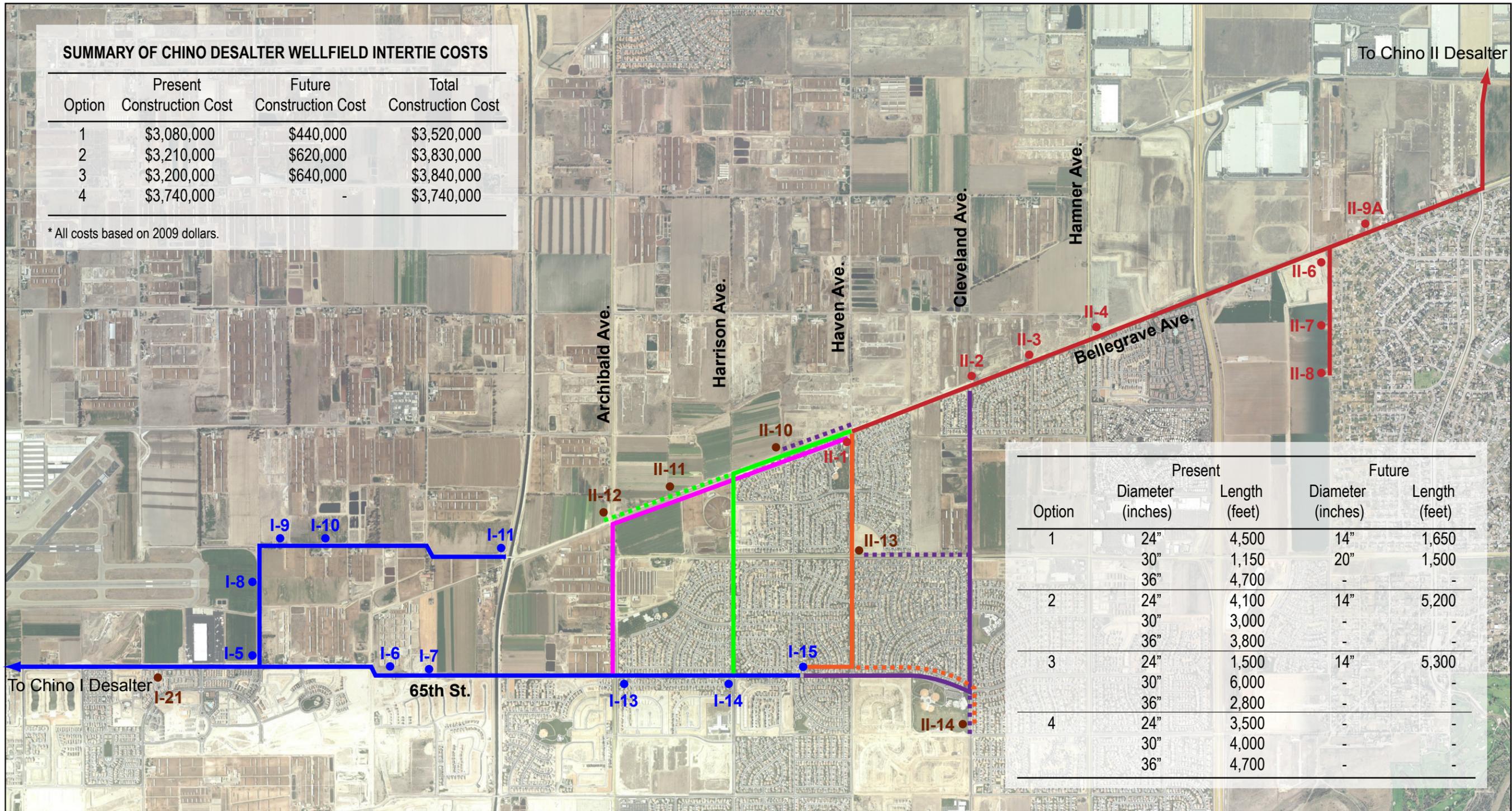
Figure 3.2 shows the locations of five proposed sites for future CDA II wells selected by others (GEOSCIENCE, May 2009), designated as CDA II-10 through 14. Of the five alternative well sites proposed only three will be needed. Four alternative pipeline routes that can connect CDA I-13, 14, and 15 to the Chino II raw water system while accommodating connections to future wells are shown as Options 1 through 4. Each of the alternatives has an initial capital cost to connect CDA I-13, 14, and 15 to the Chino II raw water pipeline and a future capital cost to add piping necessary to connect to three of the proposed Chino II expansion well sites. Initial, future, and total capital costs for the four pipeline routes options are also tabulated in Figure 3.2.

Options 2 and 3 have the highest total capital cost and do not have the lowest initial capital cost. In addition, they require use of well sites CDA II-13 and 14, for which there are limited undeveloped parcels available for a well site. For these reasons, we recommend consideration of either Option 1 or 4, which would allow use of future well sites CDA II-10, 11, and 12 along the extension of Bellegrave Avenue, between Haven Avenue and Archibald Avenue. Property parcels suitable for potential well sites are listed in a separate technical memorandum. For the purpose of this report, the Option 4 pipeline alignment is assumed because it provides the greatest flexibility in the procurement of well sites and is conservative in that it has a higher capital cost than Option 1.

**SUMMARY OF CHINO DESALTER WELLFIELD INTERTIE COSTS**

| Option | Present Construction Cost | Future Construction Cost | Total Construction Cost |
|--------|---------------------------|--------------------------|-------------------------|
| 1      | \$3,080,000               | \$440,000                | \$3,520,000             |
| 2      | \$3,210,000               | \$620,000                | \$3,830,000             |
| 3      | \$3,200,000               | \$640,000                | \$3,840,000             |
| 4      | \$3,740,000               | -                        | \$3,740,000             |

\* All costs based on 2009 dollars.



| Option | Present           |               | Future            |               |
|--------|-------------------|---------------|-------------------|---------------|
|        | Diameter (inches) | Length (feet) | Diameter (inches) | Length (feet) |
| 1      | 24"               | 4,500         | 14"               | 1,650         |
|        | 30"               | 1,150         | 20"               | 1,500         |
|        | 36"               | 4,700         | -                 | -             |
| 2      | 24"               | 4,100         | 14"               | 5,200         |
|        | 30"               | 3,000         | -                 | -             |
|        | 36"               | 3,800         | -                 | -             |
| 3      | 24"               | 1,500         | 14"               | 5,300         |
|        | 30"               | 6,000         | -                 | -             |
|        | 36"               | 2,800         | -                 | -             |
| 4      | 24"               | 3,500         | -                 | -             |
|        | 30"               | 4,000         | -                 | -             |
|        | 36"               | 4,700         | -                 | -             |

**Legend**

- Chino I Wells
- Chino I Pipelines
- Option 1
- Option 3
- Chino II Wells
- Chino II Pipelines
- Option 2
- Option 4
- Well Sites Proposed by Geoscience



**Figure 3.2**  
**Chino Desalter Raw Water Intertie Options**  
**CHINO DESALTER PHASE 3 PDR**  
 JCSD/ONTARIO/MMWD

### **3.4 CHINO I/II RAW WATER INTERTIE**

As discussed in Section 2, we recommend using the capacity of wells CDA I-13, 14, and 15 made available by construction of the CCWF wells as part of the raw water supply for the Chino II expansion instead of drilling and equipping new Chino II wells (e.g., CDA II-10, 11, and 12) at the present time. One of the benefits of this approach is that the raw water pipeline that transfers water from wells CDA I-13, 14, and 15 to the Chino II raw water system is also available as an intertie to transfer water from the entire Chino II well field into the Chino I well field for redundancy and reliability.

The Chino II raw water pipeline system is pressurized to a hydraulic gradeline that allows flow to the Chino II Desalter, with a required gradeline of 885 feet above mean sea level (AMSL) at the desalter site. The Chino I raw water pipeline system is pressurized to allow a gradeline of 770 feet AMSL at the Chino I Desalter site. Therefore, the Chino II raw water system can transfer water through a flow control or pressure control station to the Chino I raw water supply system without additional pumping. We recommend construction of an intertie flow control station to allow transfer of raw water from the Chino II raw water system to the Chino I raw water system as part of the Phase 3 expansion project.

In order to transfer wells CDA I-13, 14, and 15 to the Chino II raw water pipeline it has been proposed previously that the wells would be re-equipped with higher lift pumps capable of producing the added head needed to pump to the Chino II raw water pipeline gradeline. Because of the larger motors (400 hp) required to lift water to the Chino II gradeline, replacement of submersible pumps at wells CDA I-13, 14, and 15 with vertical line-shaft stainless steel pumps is required, including construction of a well pump building with acoustical louvers to provide noise mitigation for the new motor and replacement of electrical equipment including VFDs to match the new motor size. The cost of re-equipping the wells is estimated at \$740,000 per site or \$2,220,000 for the three wells.

An alternative to replacing the pumps and motors at wells CDA I-13, 14, and 15 is to install an intertie pump station instead. This option allows the three wells to continue to pump to the Chino I gradeline using the existing submersible pumps. An inline booster pump station constructed as part of the Chino I/II raw water pipeline intertie will transfer water from the Chino I raw water pipeline to the Chino II raw water pipeline gradeline.

The intertie pump station will work together with the intertie flow control station to allow flexibility in raw water transfer from Chino II to Chino I and vice versa. If possible, the intertie pump station and flow control can be incorporated with one of the future well sites. A schematic representation is shown in Figure 3.3 and a site plan layout is shown in Figure 3.4. The estimated construction cost of the pump station is \$2,870,000 or approximately 30 percent more than the estimated construction cost of the modification of the three wells to pump to Chino II.

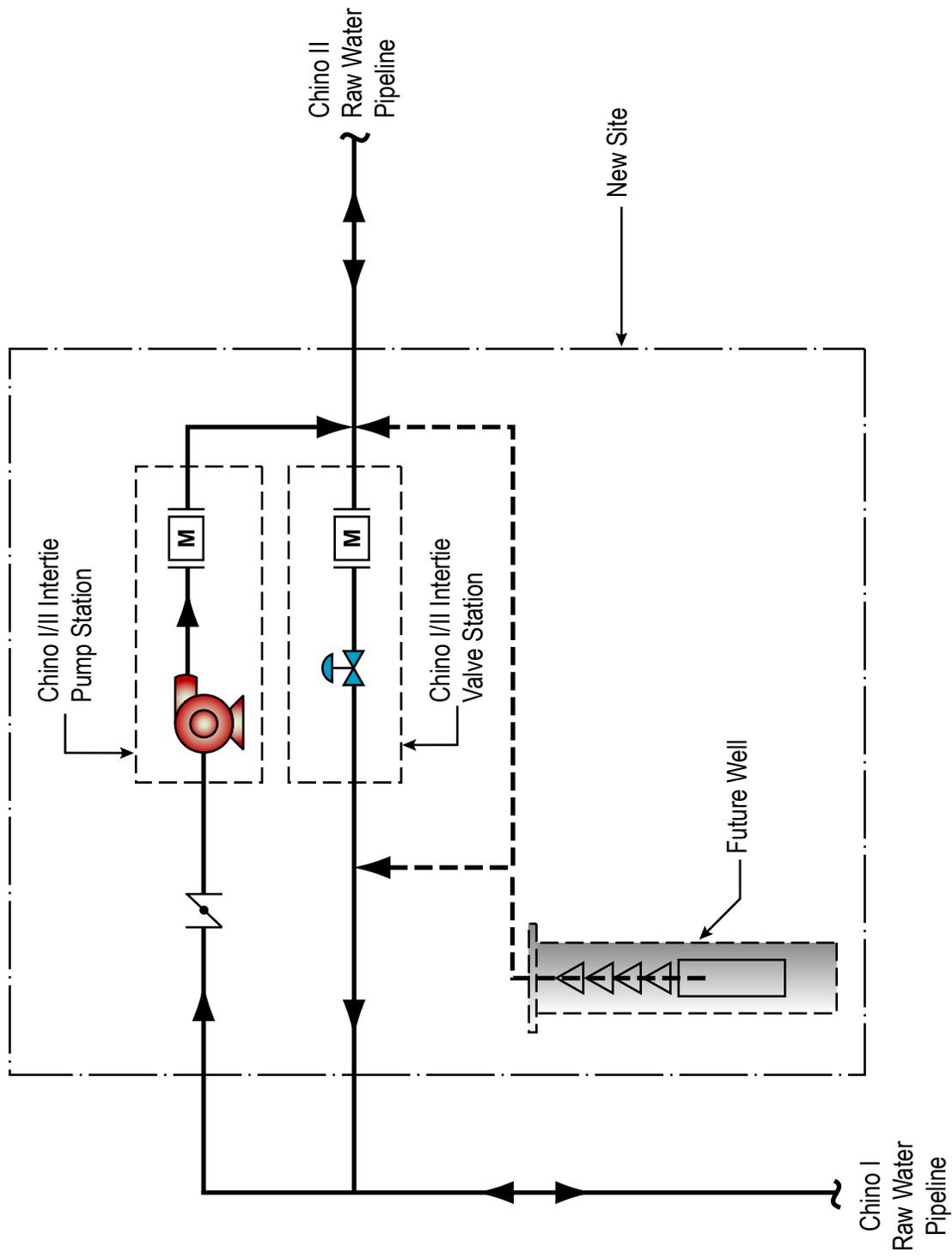


Figure 3.3  
 Chino Desalter Raw Water Intertie Schematic  
 CHINO DESALTER PHASE 3 PDR  
 JCSD/ONTARIO/WMWD

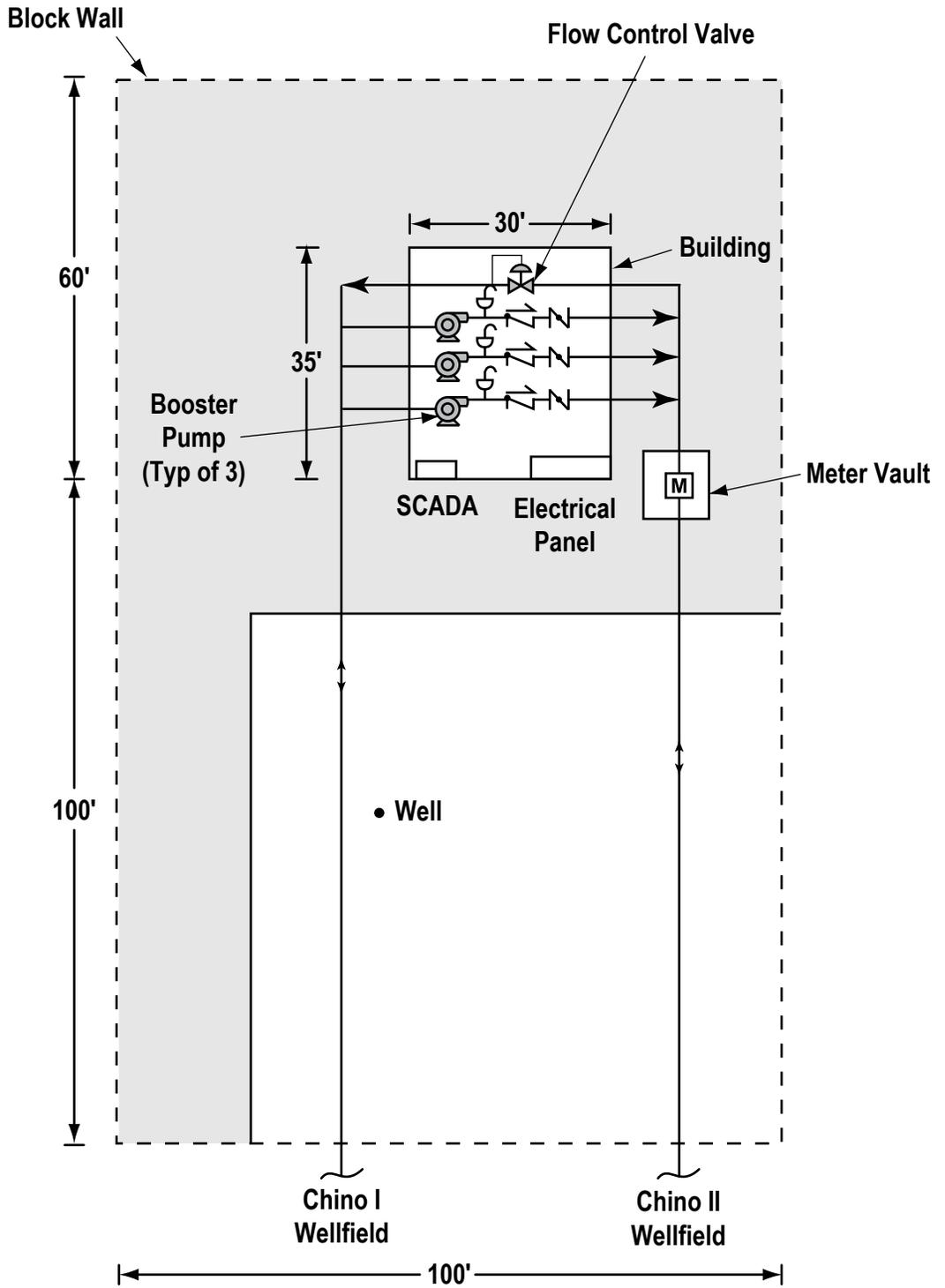


Figure 3.4  
 Raw Water Intertie Site Plan  
 CHINO DESALTER PHASE 3 PDR  
 JCSD/ONTARIO/WMWD

Benefits of the raw water intertie pump station include the following:

- It allows mutual reciprocity between the Chino I and Chino II raw water systems; that is, water can flow in either direction as required for reliability and redundancy.
- The pump station replaces the costs of modifying wells CDA I-13, 14, and 15, which can be left equipped with submersible pumps operating at the gradeline of the Chino I Desalter.
- Wells CDA I-13, 14, and 15 are more energy efficient using the existing submersible pumps if pumping to Chino I is required.
- Greater flexibility is provided because all Chino I wells are available for pumping to Chino II instead of only CDA I-13, 14, and 15.
- When properties were purchased for Wells CDA I-13, 14, and 15 it was represented that motors would be submersible without noise or a building. Continued use of submersible motors maintains those representations.

We recommend construction of a raw water intertie pump station to allow transfer of raw water from the Chino I raw water system to the Chino II raw water system as part of the Phase 3 expansion project.

The proposed Chino II raw water pipeline system is shown in plan and profile views in Figures 3.5 and 3.6, respectively. Calculations for the hydraulic gradeline profile are included in Appendix B.4. The hydraulic gradeline profile is shown in Figure 3.6, both with the proposed raw water intertie pump station and with new 400 hp pumps installed at wells CDA I-13, 14, and 15. One of the effects of constructing the intertie pump station is to reduce the amount of existing piping that is exposed to the higher pressure required to pump to the Chino II hydraulic gradeline. The existing PVC pipe is DR 25, which has a pressure rating of 165 psi, corresponding to a maximum safe operating pressure with a safety factor of 2.0 and a surge pressure of zero (AWWA C-905, Table 3). The maximum safe operating pressure at worst case locations is indicated in Figure 3.6.

The existing Chino II raw water pipeline along the Day Creek Channel, between Harrel Street and Bellegrave Avenue, was increased in size from 30-inch to 36-inch diameter by JCSD to provide extra capacity in anticipation of the expansion of Chino II. The western sections of the existing Chino II raw water pipeline system were sized only for existing Chino II well field capacity without allowance for expansion. For example, the most western pipe section is 16-inch diameter DR 25 PVC (inside diameter = 16.70 inches); it has an acceptable pipeline velocity of 2.9 fps under existing conditions when conveying only well CDA II-1 production of 2,000 gpm. The same 16-inch pipeline would have an unacceptable velocity (11.5 fps) with high headloss when carrying wells CDA II-1 plus CDA I-13, 14, and 15.

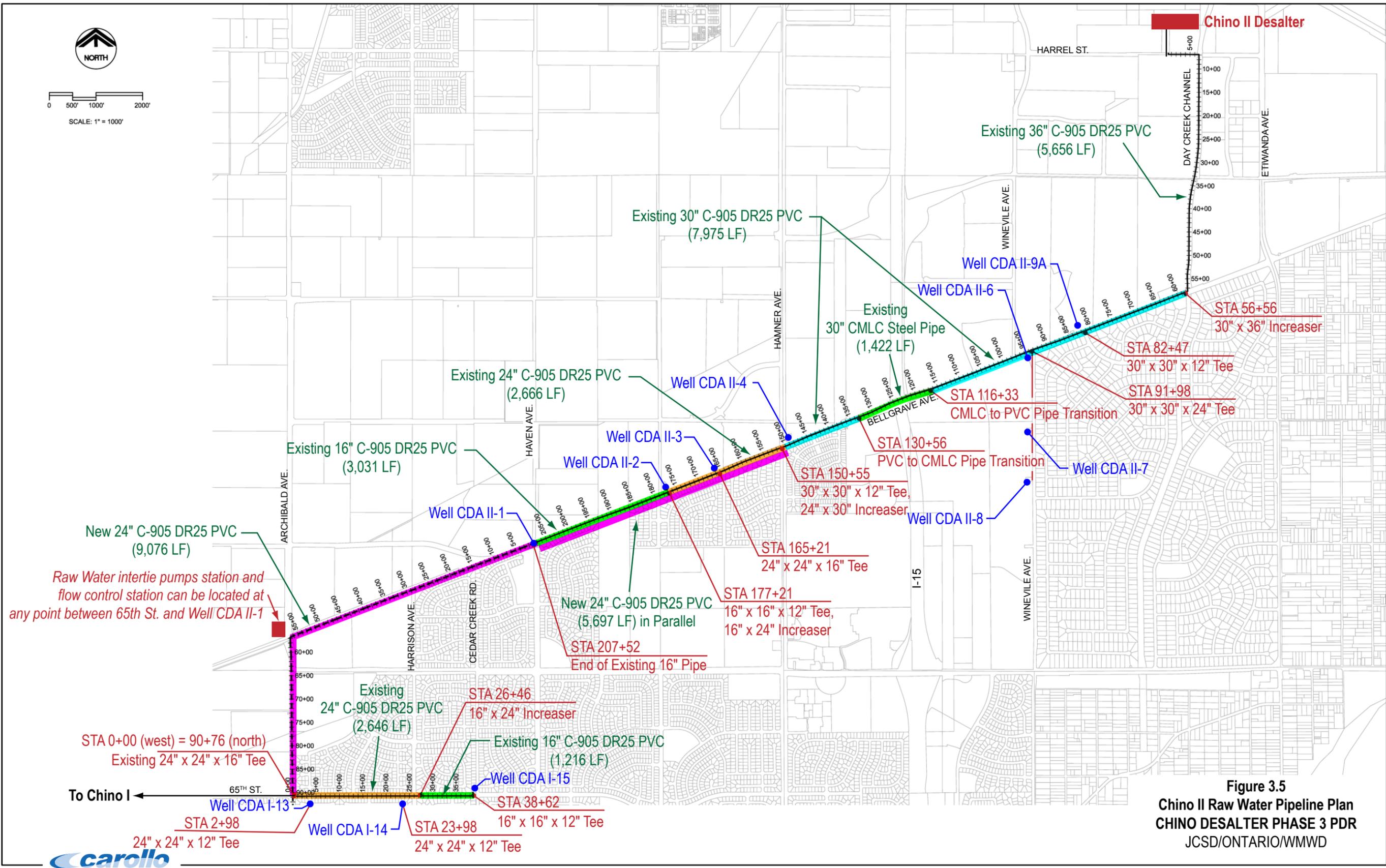
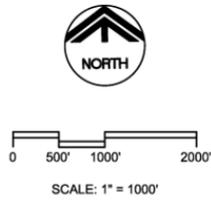
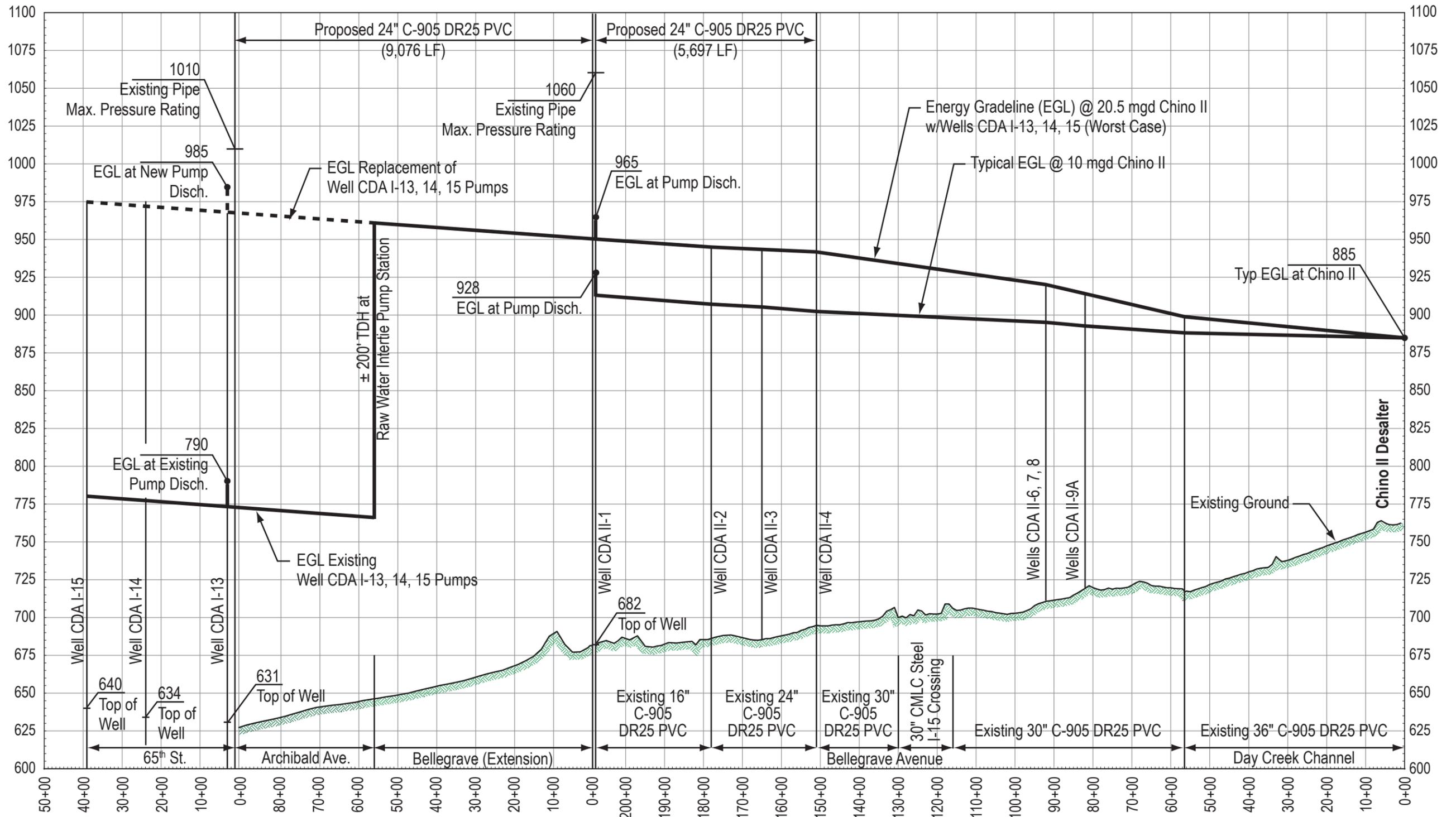


Figure 3.5  
 Chino II Raw Water Pipeline Plan  
 CHINO DESALTER PHASE 3 PDR  
 JCSD/ONTARIO/WMWD



**Figure 3.6**  
**Chino II Raw Water Pipeline Profile**  
**CHINO DESALTER PHASE 3 PDR**  
 JCSD/ONTARIO/WMWD

In order to reduce headloss and pipeline velocities in existing raw water pipelines to acceptable levels after expansion of the Chino II well field it is necessary to install parallel pipelines. Our recommendation is to install new 24-inch diameter pipe in parallel with the existing 16-inch diameter pipeline from wells CDA II-1 to CDA II-2, also to install new 24-inch diameter pipe in parallel with the existing 24-inch diameter pipeline from wells CDA II-2 to CDA II-4. As shown in Figures 3.5 and 3.6, the total length of new 24-inch pipe recommended in parallel with existing pipelines is approximately 5,700 lineal feet. Calculations of pipeline velocity and headloss are included in Appendix B.4.

Even with the installation of the proposed parallel pipe there will be an increase in the pressure at the pump discharge for the existing Chino II wells. Under worst case conditions, with the westernmost wells operating at full capacity and the easternmost wells turned off, the calculated discharge pressure at the Well CDA II-1 pump will increase by approximately 40 feet (16 psi) from typical, existing conditions. A review of the pump curve for Well CDA II-1 shows that the design condition of the existing pump is 2,000 gpm at a total dynamic head (TDH) of 425 feet. The 40 feet of additional head from the Chino II well field expansion will increase the pump TDH to approximately 440 feet under current pumping level conditions. This will result in a flow of 1,900 gpm at 100 percent motor speed.

### 3.4.1 Water Quality

DPH Policy Memo 97-005 provides guidelines and requirements for use of “extremely impaired” water supplies. A supply is defined as extremely impaired when it contains contaminant levels that exceed 10 times an maximum contaminant level (MCL)/action level for chronic health effects or exceeds three times an MCL/action level for acute health effects. Nitrate has an MCL of 45 mg/L as nitrate ( $\text{NO}_3^-$ ) and is regulated based on acute health effects. Therefore, sources with 135 mg/L, or greater, as nitrate are classified as extremely impaired.

Some of the wells currently operating in the Chino I raw water supply system have nitrate levels that approach or exceed 135 mg/L as  $\text{NO}_3^-$  and may therefore be classified as extremely impaired. One potential implication is that California Department of Public Health (CDPH) may require treatment for nitrate levels instead of allowing blending at Chino II when the proposed raw water intertie piping conveys extremely impaired water from the Chino I well field to Chino II for treatment. Currently, some raw water at Chino II is bypassed around the IX and RO treatment processes without nitrate removal.

There are several alternatives for use of extremely impaired well water at Chino II, including the following:

- Option 1: Continue the Chino II raw water bypass. This alternative is a continuation of current practice and requires approval from CDPH. It is the lowest cost alternative because it allows a continuation of the low cost bypass while also using the capacity of existing wells (CDA II-13, 14, and 15) without the cost of drilling new wells. This

option has a low risk to public health because operational procedures can ensure that product water nitrate standards are not exceeded even with the raw water bypass.

- Option 2: Eliminate the Chino II raw water bypass. This alternative assumes that CDPH does not allow a continuation of the raw water bypass at Chino II when treating raw water from extremely impaired Chino I wells. This alternative also avoids the cost of drilling new wells but it has a higher operating cost than Option 1 because of the added expense of treating Chino II raw water that is currently bypassed around the RO and IX processes. This option also has a low risk to public health.
- Option 3: Pretreat Chino I well field water for nitrate removal at the raw water intertie. This option would continue the use of the Chino II raw water bypass by removing nitrates from Chino I well water prior to introduction into the Chino II raw water pipeline using an IX treatment process, which could be located at the proposed intertie pump station as shown in Figure 3.3. This option has the highest cost because it requires construction and operation of a new treatment facility but it also provides a low risk to public health.
- Option 4: Drill new Chino II wells instead of using existing well CDA II-13, 14, and 15. This option assumes that new Chino II wells can be drilled that are not critically impaired with respect to nitrates. This option has a high cost (for construction of the wells) and also a risk of failure because of the challenge of locating new wells that produce water from the Layer 1 aquifer (the purpose of the Chino Desalter wells) without exceeding the extremely impaired nitrate limit. As discussed in Section 2, the area for new wells with greatest sustainability (i.e., lowest long-term drawdown) is in the vicinity of wells CDA I-13, 14, and 15, which are critically impaired. There is a risk that new wells in the same vicinity would also produce raw water that is critically impaired with respect to nitrates, either initially or over time.

The costs and risks of these alternatives are summarized in Table 3.1. This table and associated concepts were discussed with representatives of the San Bernardino and San Diego offices of CDPH in a meeting on July 13, 2009 attended by representatives of Carollo and the Phase 3 project Sponsors. CDPH will not make a decision until after an application for a revised operating permit is submitted; however, CDPH indicated a willingness to consider continued use of the Chino II raw water bypass (Option 1). Discussion included the following points:

- CDPH has flexibility and discretion, gained through experience, in how to apply Policy Memo 97-005.
- With acceptable operational procedures in place to manage the Chino II blended raw water nitrate levels and ensure that product water nitrate limits are not exceeded, the risk to public health is low.

| <b>Table 3.1 Extremely Impaired Well Treatment Cost Comparison<br/>Chino Desalter Phase 3 PDR<br/>JCSD/Ontario/WMWD</b>  |                                   |                                  |                                  |
|--|-----------------------------------|----------------------------------|----------------------------------|
|  | <b>Additional<br/>Annual Cost</b> | <b>Cost Relative<br/>Ranking</b> | <b>Risk Relative<br/>Ranking</b> |
| <b>Option 1: Continue Raw Water Bypass</b>   |                                   |                                  |                                  |
| O&M  | \$0                               |                                  |                                  |
| Capital Debt Service   | \$0                               |                                  |                                  |
| Total <sup>a</sup>   | \$0                               | Lowest                           | Low                              |
| <b>Option 2: Eliminate Raw Water Bypass</b>  |                                   |                                  |                                  |
| O&M <sup>b</sup>   | \$880,000                         |                                  |                                  |
| Capital Debt Service   | \$0                               |                                  |                                  |
| Total  | \$880,000                         | Higher                           | Low                              |
| <b>Option 3: Pretreat with IX</b>  |                                   |                                  |                                  |
| O&M <sup>c</sup>   | \$930,000                         |                                  |                                  |
| Capital Debt Service <sup>d</sup>  | \$1,030,000                       |                                  |                                  |
| Total  | \$1,960,000                       | Highest                          | Low                              |
| <b>Option 4: Drill Wells II-10, 11, and 12</b>   |                                   |                                  |                                  |
| O&M  | \$0                               |                                  |                                  |
| Capital Debt Service <sup>e</sup>  | \$590,000                         |                                  |                                  |
| Total  | \$590,000                         | High                             | High                             |
| Notes:   |                                   |                                  |                                  |
| a. Continued use of the existing bypass is the baseline condition and does not require additional O&M or capital costs.  |                                   |                                  |                                  |
| b. O&M costs based upon treatment of 4,100 AF/year previously bypassed (assuming 20% bypass of 20.5 mgd capacity with 90% operating factor) at a unit cost of \$215/AF, which is the FY 08/09 budget variable treatment cost (\$497/AF x 57%) less cost of product water pumping to the 1110 Zone (330 feet lift at \$20/AF per 100 feet of lift). |                                   |                                  |                                  |
| c. O&M costs based upon Wells I-13, 14, and 15 operating at a combined average annual flow of 4,827 gpm to produce 7,726 AF/year per Wildermuth model scenario. IX treatment cost is assumed as \$120/AF.  |                                   |                                  |                                  |
| d. Capital cost debt service is based on estimated capital cost of \$15.8M for 7.0 mgd of IX treatment capacity with 30 year amortization period at 4.5% amortization rate.  |                                   |                                  |                                  |
| e. Capital cost debt service is based on estimated capital cost of \$9M (three wells at \$3M per well) for drilling and equipping Wells II-10, 11, and 12 with 30 year amortization period at 5% amortization rate.  |                                   |                                  |                                  |

- CDPH has approved operating permits allowing use of extremely impaired wells (with respect to nitrates) with nitrate treatment bypass in the following cases:
  - Chino II uses well CDA II-9A as a raw water supply while using the existing raw water bypass.
  - Chino I uses CDA I-4 as a VOC well that is treated through the air stripping tower, which provides no nitrate removal (i.e., bypasses the RO/IX nitrate treatment).

Costs presented in this report assume continued use of the Chino II raw water bypass (Option 1). If CDPH does not approve an application for a revised operating permit allowing Option 1, then elimination of the Chino II raw water bypass during those periods when extremely impaired wells are treated at Chino II is the least expensive low risk option.

It would be beneficial to eliminate uncertainty about the effect nitrate-impaired wells in the Chino I well field on the continued use of the Chino II raw water bypass as soon as possible. We recommend that the CDA submit a draft application for an amended permit to CDPH as soon as the PDR is accepted by the CDA.

### **3.5 RAW WATER PIPELINE CRITERIA**

Comprehensive pipeline criteria are presented in Section 6. These criteria will be used for design of the CCWF and Chino II well field expansion pipelines with the following differences. Raw water pipelines will be constructed of PVC, either AWWA C-900 for pipelines 12-inch diameter or smaller or C-905 for pipelines 14-inch to 48-inch diameter.