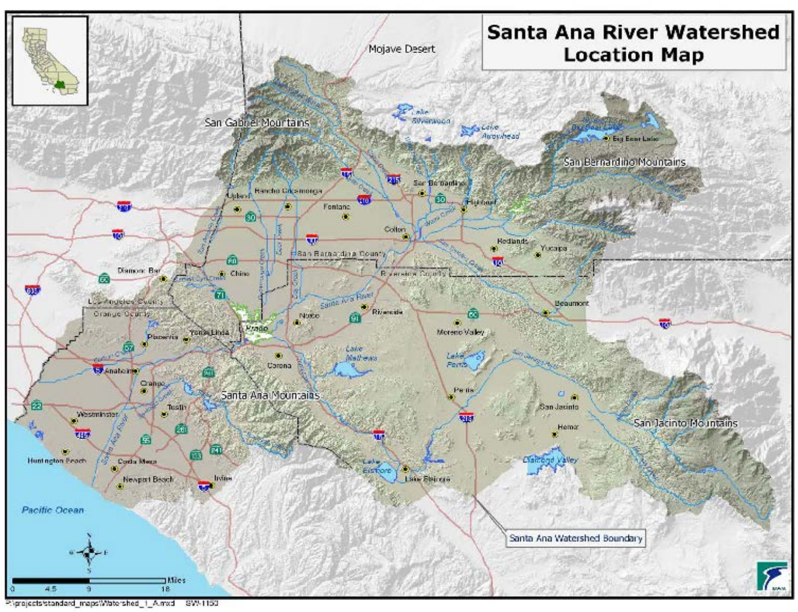
RECLAMATION

Managing Water in the West

SANTA ANA WATERSHED BASIN STUDY

INLAND EMPIRE INTERCEPTOR APPRAISAL ANALYSIS
TECHNICAL MEMORANDUM NO. 3
SUMMARY OF OPTIONS & STRATEGIES
JANUARY 2013 (FINAL - MAY 2013)



U.S. Department of the Interior
Bureau of Reclamation

Santa Ana Watershed
Project Authority

PROJECT INFORMATION	
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PROJECT NAME:	Santa Ana Watershed Basin Study Inland Empire Interceptor Appraisal Analysis
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LIST OF ACRONYMS & ABBREVIATIONS

ORGANIZATIONS:

Caltrans	State of California Department of Transportation
CRWQCB	California Regional Water Quality Control Board, Colorado River Basin Region
CDM	Camp, Dresser & McKee
CVWD	Coachella Valley Water District
EMWD	Eastern Municipal Water District
EPA	US Environmental Protection Agency
ESO	Bureau of Reclamation Engineering Services Office
IEUA	Inland Empire Utilities Agency
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
Reclamation	Bureau of Reclamation
SAWPA	Santa Ana Watershed Project Authority
SBVMWD	San Bernardino Valley Municipal Water District
SCAO	Bureau of Reclamation Southern California Area Office
WMWD	Western Municipal Water District

DOCUMENTS:

Appraisal Analysis	Inland Empire Interceptor Appraisal Analysis
Basin Plan	Water Quality Control Plan: Colorado River Basin - Region 7
Basin Study	Santa Ana Watershed Basin Study
CWA	US Clean Water Act
OWOW	One Water One Watershed
Porter-Cologne	California Porter-Cologne Water Quality Control Act
SAWPA Investigation	Inland Empire Brine Line Disposal Option Concept Investigation
TM	Technical Memorandum

FACILITIES and PROCESSES:

ALR	Area Loading Rate
Brine Line	Inland Empire Brine Line
CVSC	Coachella Valley Storm Water Channel
CW	Constructed Wetland

EPF	Evaporation Pond Facility
FTP	Facultative Treatment Pond
FWS	Free Water Surface
IEI	Inland Empire Interceptor
IEBL	Inland Empire Brine Line
NPDES	National Pollutant Discharge Elimination System
SARI	Santa Ana Regional Interceptor
TF	Treatment Facility

PARAMETERS and UNITS of MEASURE:

AFY	Acre-Feet per Year
ALR	Area Loading Rate
cfs	Cubic Feet per Second
ft	Feet
in	Inches
HGL	Hydraulic Grade Line
HRT	Hydraulic Residence Time
BOD	Biochemical Oxygen Demand
gpm	Gallons per Minute
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
PRF	Peak Rate Factor
psi	Pounds per Square Inch
TDS	Total Dissolved Solids
TSS	Total Suspended Solids

REFERENCES

[1] ***Santa Ana Watershed Salinity Management Program, Phase 2 SARI Planning Technical Memorandum***, Camp, Dresser & McKee (CDM), et al for Santa Ana Watershed Project Authority, May 2010.

[2] ***Santa Ana Watershed Salinity Management Program, Summary Report***, CDM, et al for Santa Ana Watershed Project Authority, July 2010.

[3] ***Inland Empire Brine Line Disposal Option Concept Investigation*** (Draft), Santa Ana Watershed Project Authority, October 2011.

[4] ***DRAFT Memorandum, Subject: Santa Ana Regional Interceptor (SARI) Solids Control Alternatives Conceptual Costs***, CDM for Santa Ana Watershed Project Authority, April 1 2011.

[5] ***Central Arizona Salinity Study, Strategic Alternatives for Brine Management in the Valley of the Sun***, U.S. Department of Interior Bureau of Reclamation, January 2010.

[6] ***Restoration of the Salton Sea, Summary Report***, U.S. Department of Interior Bureau of Reclamation, September 2007.

[7] ***Salton Sea Species Conservation Habitat Project Draft Environmental Impact Report***, for U.S. Army Corps of Engineers and California Natural Resources Agency, by California Department of Fish and Game and California Department of Water Resources with assistance from Cardno ENTRIX, August 2011.

[8] ***Salton Sea Ecosystem Restoration Program Draft Programmatic Environmental Impact Report***, for California Natural Resources Agency, by California Department of Fish and Game and California Department of Water Resources with assistance from CDM, June 2007.

[9] ***Salton Sea Revitalization & Restoration, Salton Sea Authority Plan for Multi-Purpose Project, Executive Summary***, Salton Sea Authority, June 2006.

[10] ***Manual: Constructed Wetlands Treatment of Municipal Wastewaters***, U.S. Environmental Protection Agency, 1999.

[11] ***Water Quality Control Plan: Colorado River Basin - Region 7***, Colorado River Basin Regional Water Quality Control Board, 2006.

[12] ***Evaporation Pond Sizing with Water Balance and Make-up Water Calculations***, Idaho National Engineering and Environmental Laboratory, Engineering Design File, 2001.

[13] ***Hydrologic Regimen of Salton Sea, California***, U.S. Department of Interior Geological Survey, Professional Paper 486-C, 1966.

[14] ***Membrane Concentrate Disposal: Practices and Regulation***, U.S. Department of Interior Bureau of Reclamation, Desalination and Water Purification Research and Development Program Report No. 69, September 2001.

[15] ***Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers***, U.S. Environmental Protection Agency, 2001.

[16] ***Recommended Standards for Wastewater Facilities,*** ("Ten States Standards") Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers ("GLUMRB"), 1990.

INTRODUCTION

Santa Ana Watershed Project Authority

The Santa Ana Watershed Project Authority (SAWPA) is a joint powers authority comprised of five member water districts that serve the vast majority of the Santa Ana Watershed. The area served by SAWPA is located within Orange, Riverside and San Bernardino Counties of California, bounded by the Pacific Ocean on the west, the San Bernardino Mountains to the north, and the San Jacinto Mountains to the east.

The five SAWPA Member Agencies are

- Eastern Municipal Water District (EMWD),
- Western Municipal Water District (WMWD),
- Inland Empire Utilities Agency (IEUA),
- San Bernardino Valley Municipal Water District (SBVMWD), and
- Orange County Water District (OCWD).

Inland Empire Brine Line

SAWPA’s mission is to protect water quality and enhance the water supply within the Santa Ana River Watershed. For these purposes, SAWPA developed the Inland Empire Brine Line (Brine Line), which is also known as the Santa Ana Regional Interceptor (SARI), for the purpose of exporting salt from the Santa Ana Watershed. The Brine Line includes approximately 72 miles of pipeline in multiple branches which converge in the vicinity of Prado Dam near the City of Corona. It has a planned capacity of approximately 32.5 MGD and was planned for collection and exportation of approximately 271,000 tons of salt per year from the upper Santa Ana Watershed, east of the Santa Ana Mountains. Currently (2010 & 2011), average system flows are approximately 11.7 MGD and over 75,000 tons of salt are exported per year.

Another 21 miles of pipeline convey the combined flows to Orange County Sanitation District (OCSD) facilities for treatment and disposal by discharge to the Pacific Ocean. This pipeline has a nominal capacity of 30 MGD. The planned capacity of the Brine Line system (32.5 MGD) exceeds the hydraulic capacity of the pipeline from the Brine Line convergence near Prado Dam to the OCSD facilities. Furthermore, the agreement between SAWPA and OCSD allows Brine Line flows to the OCSD system up to only 17.0 MGD, with a contractual right to purchase up to 30.0 MGD capacity.

Project Background

The One Water One Watershed (OWOW) Plan is the integrated water management plan for the Santa Ana Watershed. The OWOW Plan is administered by SAWPA. The Bureau of Reclamation (Reclamation) Southern California Area Office (SCAO) and SAWPA submitted a proposal in June 2010 for funding of a Santa Ana Watershed Basin Study (Basin Study) in support of the OWOW Plan update, known as One Water One Watershed 2.0. In August 2010, this Basin Study was selected by Reclamation for funding. This Inland Empire Interceptor Appraisal Analysis (Appraisal Analysis) is one component of the Basin Study.

A study entitled ***Santa Ana Watershed Salinity Management Program*** [1] [2] (Salinity Management Program) was completed in 2010 by a team of consultants led by Camp, Dresser & McKee (CDM), which addressed the Brine Line capacity limitations. The Salinity Management Program identified and evaluated several potential system configuration changes to address the capacity limitations. One of the alternatives considered is a proposed new Brine Line outfall to the Salton Sea, which was identified as Option 4 in the Salinity Management Program. The Salinity Management Program did not include a comprehensive review of Option 4, which would replace the existing outfall from the Brine Line system convergence near Prado Dam in western Riverside County near the Orange County boundary to the OCSD system. This Option 4 is the subject of this Appraisal Analysis and is identified herein as the Inland Empire Interceptor (IEI).

Appraisal Analysis Objectives

Under Reclamation criteria (Reclamation Manual FAC 09-01), appraisal analyses “are intended to be used as an aid in selecting the most economical plan by comparing alternative features”. Several alternative conceptual designs for the proposed Inland Empire Interceptor (IEI) have been developed and evaluated for this Appraisal Analysis for the purpose of comparison.

Reclamation Manual FAC 09-01 also states that appraisal analyses are to be prepared “using the available site-specific data.” A literature review of previous studies and other available site-specific data was addressed in Technical Memorandum No. 1 (TM1).

The system flows and brine characteristics were addressed in TM2. The route of the proposed IEI represents an opportunity for SAWPA to expand the Brine Line service area to include the San Gorgonio Pass and Coachella Valley areas; and TM2 also addressed this opportunity and the associated additional flows.

This TM3 presents a conceptual design for each of several alternatives under consideration for the proposed IEI. These alternatives begin at a common point in western Riverside County near Prado Dam in upper Santa Ana Watershed, running generally eastward to a common point in San Gorgonio Pass. Two alternatives continue eastward from the common point in San Gorgonio Pass and through Coachella Valley to a common end point near the north edge of the Salton Sea in eastern Riverside County.

Estimated costs associated with the alternative conceptual designs developed for the proposed IEI will be addressed in TM4. Opportunities associated with the proposed IEI and suggested Optimization Strategies for further investigation of the project will also be addressed in TM4.

These Technical Memoranda will be summarized in a final report.

Technical Memorandum No. 3 – Options and Strategies

This TM3 presents conceptual designs and results of hydraulic analyses for the various alternatives under consideration in this IEI Appraisal Analysis and addresses various options and strategies, including:

- Proposed modification to the existing Brine Line system.
- Existing easements and rights-of-way.
- Salton Sea considerations, including:
    - Salton Sea restoration plans.
    - Increased water supply to the Salton Sea.
    - Water quality (Total Suspended Solids and Biochemical Oxygen Demand concentrations).
    - Salt load (Total Dissolved Solids concentration).
- Brine pre-treatment strategies.
- Alternative alignments considered.
- Alternative designs considered.
- Pumping requirements.
- Energy recovery strategies.
- Permit requirements.

PROPOSED BRINE LINE SYSTEM MODIFICATIONS and INLAND EMPIRE INTERCEPTOR

Background

As noted above, appraisal analyses “are intended to be used as an aid in selecting the most economical and viable plan by comparing alternative features”. Various alternatives were developed for the purpose of this comparative analysis; and the purpose of this TM3 is to present the conceptual designs for the alternatives under consideration for this Appraisal Analysis.

After delivery of the Santa Ana Watershed Salinity Management Program report by CDM described above, SAWPA staff prepared a report entitled ***Inland Empire Brine Line Disposal Option Concept Investigation*** [3] (SAWPA Investigation) in which four alternative conceptual designs for the proposed IEI were developed and evaluated. The alternatives considered in this Appraisal Analysis for the portion in the upper Santa Ana Watershed (west of San Gorgonio Pass) were based upon those investigated by SAWPA staff and were refined using available satellite imagery and mapping of the area.

The SAWPA Investigation did not include a comprehensive review of the portion of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas. Two alignments were developed for this portion for consideration in this Appraisal Analysis.

Modifications to the Existing Brine Line Gravity Collection System

The proposed IEI would alter the design and operation of the existing Brine Line system. The existing Brine Line system operates by gravity-flow, including the existing outfall to the Orange County Sanitation District (OCSD) system. Each of the alternatives developed by SAWPA staff for the portion in upper Santa Ana Watershed (west of San Gorgonio Pass) would replace the existing outfall. All the brine that currently flows to OCSD facilities for treatment and disposal would be intercepted and re-routed toward San Gorgonio Pass.

For each alternative under consideration, the proposed IEI begins near the convergence of the existing system gravity mains at Prado Dam in western Riverside County. The portion of the existing outfall from the convergence to the point of beginning of the proposed IEI would need to be replaced, or supplemented by a new parallel main. This length of this portion is approximately 13,000 feet. The rest of the existing outfall to OCSD would need to be removed or abandoned in-place. If this portion of the system could be converted to some other beneficial use, the cost of abandonment could be reduced or eliminated.

Other modifications to the existing Brine Line system would be somewhat different for each alternative under consideration. These are described later in this report in the section entitled "Inland Empire Interceptor Alternatives in Santa Ana Watershed".

From the eastern edge of the upper Santa Ana Watershed at San Gorgonio Pass, the proposed IEI would continue eastward through San Gorgonio Pass and Coachella Valley to the Salton Sea. Two alternatives were developed for this portion for consideration in this Appraisal Analysis. These are described later in this report in the section entitled "Inland Empire Interceptor Alternatives in San Gorgonio Pass and Coachella Valley".

Easements and Rights-of-Way

The alignment alternatives considered in this Appraisal Analysis are generally proposed to be located in or adjoining existing transportation, drainage and/or utility corridors (public or private) wherever possible to minimize acquisition costs for easements or right-of-way necessary for the proposed IEI.

In the case of facilities that may be reasonably compatible and where sufficient room may be available, the proposed IEI alignments are located within the existing easements or right-of-way. These facilities include streets, drainage channels, drainage facility access roads, aqueduct access roads, etc.

In the case of facilities that are less likely to be compatible or where sufficient space would likely not be available, the proposed IEI alignments are located adjoining (but outside of) the existing rights-of-way or easements. These facilities include freeways, railroads, gas mains (except as otherwise identified), etc.

Rights-of-way and easements for facilities that would likely be incompatible were avoided altogether, except where crossings would be necessary. These facilities include riparian areas, electrical power transmission lines, windmill power generator facilities, etc. Such crossings would be unavoidable for a project of this type and appropriate consideration for these crossings will be a necessary part of planning and design for the project.

Brine Pre-treatment Strategies

Six strategies for managing flows in the Brine Line system were addressed by CDM in the Salinity Management Program [1] [2]. These six strategies were identified as follows:

- Option 1: Baseline Condition – continued discharge to OCSD.
- Option 2a: SARI (IEBL) flow reduction via a centralized treatment, concentration, and reclamation plant.
- Option 2b: SARI (IEBL) flow reduction via a decentralized brine minimization projects installed at each groundwater desalter.
- Option 3a: Direct ocean discharge of SARI (IEBL) brine without brine minimization.
- Option 3b: Direct ocean discharge of SARI (IEBL) brine with brine minimization projects as described under Option 2b.
- Option 4: Rerouting all SARI (IEBL) system flows for discharge to Salton Sea.

The Salinity Management Program technical memoranda, which were reviewed for this Appraisal Analysis, included discussions of each of these strategies and estimated costs for each. Four of these Options (2a, 2b, 3a and 3b) involve changes to the method and/or degree of treatment of Brine Line flows. Two of these Options (3a and 3b) involve pre-treatment of brine prior to discharge to the Brine Line system to reduce BOD loads.

The brine minimization strategies discussed in the Salinity Management Program would be ineffective at reducing impacts associated with accumulation of salts in the Salton Sea due to TDS concentrations in IEI flows. Brine minimization would reduce the rate of flows in the IEI, allowing for reduced pipe sizes and pumping costs. However, the smaller flows would convey the same TDS mass loads at higher concentrations.

Option 4 is the subject of this Appraisal Analysis. The discussion of Option 4 in the Salinity Management Program identified a need for treatment of Brine Line flows prior to discharge to the Salton Sea; but the estimated costs presented for Option 4 include only those associated with the pipeline itself. Estimated costs for treatment of Brine Line flows for Option 4 were not included.

Potential strategies for treatment of the Brine Line (IEI) flows are presented in this TM3 as alternatives to the brine pre-treatment strategies discussed in the Salinity Management Program. The use of wastewater treatment ponds and/or constructed wetlands is considered as a centralized treatment mechanism to reduce

TSS and BOD concentrations in the flows prior to discharge to the Salton Sea. Potential salt management strategies for addressing increased accumulation of salts in the Salton Sea due to TDS concentrations in the IEI flows are also presented in this TM3.

Various other alternative strategies for treatment of the Brine Line (IEI) flows may warrant consideration as part of future planning and design efforts for the proposed IEI. Alternative strategies may include hybrids of the brine pre-treatment strategies with various configurations of constructed wetlands, wastewater treatment ponds, and/or salt management strategies.

Salton Sea Restoration

Issues associated with existing and projected water quality in the Salton Sea have been the subject of much scientific study and public discussion. The water quality issues in the Salton Sea and the associated environmental impacts result primarily from the existing water mass imbalance and accumulation of salts, nutrients and other contaminants. The Salton Sea is a terminal water body and, as such, no outlet is available for the salts and other contaminants conveyed by water flowing into the Sea. It is typical of such terminal water bodies that salts and other contaminants accumulate, causing water quality to change over time. Several plans have been proposed in recent years for restoration of the Sea [6] [7] [8] [9] in response to the deteriorating water budget imbalance and associated deteriorating water quality. Implementation of any of these restoration plans has been impeded by the estimated costs.

The alternatives presented in the Salton Sea restoration plans typically segregate the Sea into multiple segments separated by embankments. These segments are planned to serve different water quality and wildlife habitat functions and vary in areal size and depth. Under most alternatives, surface water flows from Coachella Valley would first enter a “habitat complex”, a network of shallow wetland areas that would provide habitat for fish and wildlife. This habitat complex would also provide water treatment to reduce concentrations of Total Suspended Solids (TSS) and Biochemical Oxygen Demand (BOD) in the flows and trap silt, nitrogen, heavy metals, and other undesirable constituents. The habitat complex would not significantly reduce concentrations of Total Dissolved Solids (TDS) in the flows, which is a measure of salinity in water.

Under the various Salton Sea restoration plan alternatives, after release from the habitat complex, the flows would typically travel through two (or more) progressively deeper segments. The last segment in this train is typically a brine pool where the salts could accumulate to super-saturated concentrations. The salts would precipitate from the water column under those super-saturated conditions and accumulate in the bottom sediments.

It is not within the scope of this Appraisal Analysis to thoroughly address either Salton Sea water quality issues or other aspects of the various proposed Salton Sea restoration plans. But it is necessary to address the influence of the proposed IEI flows on Salton Sea water quality and the regulatory considerations of the proposed IEI in this Appraisal Analysis. Therefore, selected aspects of the Salton Sea restoration plans and of water quality in the Sea are discussed in general terms in this TM3.

Colorado River Basin Region Basin Plan

The US Clean Water Act (CWA) protects surface water bodies in the USA by regulating the water quality of discharges. In addition to the CWA, surface waters in California are also protected by the Porter-Cologne Water Quality Control Act (Porter-Cologne). Under the provisions of Porter-Cologne, the California Regional Water Quality Control Board, Colorado River Basin Region (CRWQCB) has a lead role in the regulatory framework established to protect water quality in the Colorado River Basin Region of California, which includes the Salton Sea. The CRWQCB adopted the ***Water Quality Control Plan: Colorado River Basin - Region 7*** [11] (Basin Plan), with the intent "to provide definitive guidelines" and to "optimize the beneficial uses of state waters within the Colorado River Basin Region of California by preserving and protecting the quality of these waters."

The Basin Plan has three major components: "Beneficial Uses", "Water Quality Objectives" and "Implementation Program". The second of these establishes "General Surface Water Objectives" regarding controllable sources of discharge to the Salton Sea, which state that "discharges of wastes or wastewater shall not increase the Total Dissolved Solids content of receiving waters, unless it can be demonstrated to the satisfaction of the Regional Board [CRWQCB] that such an increase in Total Dissolved Solids does not adversely affect beneficial uses of receiving waters." The "General Surface Water Objectives" also stipulate that for "Coachella Valley Drains", discharges "shall not cause concentration of Total Dissolved Solids (TDS) in surface water to exceed" 2,000 mg/L, annual average, or 2,500 mg/L, maximum.

The "Water Quality Objectives" in the Basin Plan also identify "Specific Surface Water Objectives" for the Salton Sea, which identifies the "present level of salinity" (TDS concentration) as approximately 44,000 mg/L (1992) and includes a goal of stabilizing the TDS concentration at 35,000 mg/L. However, salinity in the Salton Sea has continued to increase. The ***Salton Sea Ecosystem Restoration Program Draft***

Programmatic Environmental Impact Report [8] reported that the average TDS concentration in the Salton Sea was approximately 48,000 mg/L in 2006; and the ***Salton Sea Species Conservation Habitat Project Draft Environmental Impact Report*** [7] reported that the average TDS concentration was nearly 52,000 mg/L in 2010.

The "Specific Surface Water Objectives" section of the Basin Plan also states that "because of economic considerations, 35,000 mg/L may not be achievable" and "in such case, any reduction in salinity which still allows for survival of the Sea's aquatic life shall be deemed an acceptable alternative or interim objective."

The "General Surface Water Objectives" in the Basin Plan are less specific about limitations on concentrations of TSS and BOD. However, these constituents would be expected to influence concentrations of turbidity, dissolved oxygen, bacteria, and other water quality parameters in the Sea for which "General Surface Water Objectives" are identified in the Basin Plan. In reference to municipal wastewater treatment plants, the "Implementation Program" in the Basin Plan states that "the discharge of wastewater effluent to surface water will meet the effluent limitations prescribed by the US Environmental Protection Agency (EPA)." The EPA effluent standard for both TSS and BOD (30-day arithmetic mean) is currently 30 mg/L.

If implemented, the proposed IEI would impact the Salton Sea in various ways, some of which may be considered beneficial and others negative. The projected flows in the proposed IEI present an opportunity to provide a reliable new source of water to the Salton Sea. Though small in comparison to the loss of water from the Sea to evaporation, the IEI flows could offset a portion of the imbalance in the Salton Sea water budget. However, the projected TDS, TSS and BOD concentrations in the IEI flows would not comply with the adopted Basin Plan standards for those parameters. The Basin Plan would be the basis for evaluation by the CRWQCB of the impacts of the project on the Salton Sea and other affected surface water bodies within the Colorado River Basin Region.

Basin Plan Amendment Process

The Basin Plan [11] describes a process for preparation and approval of amendments to the Plan; and amendments to the Basin Plan have previously been approved for specific circumstances in which discharges to the Sea have not met adopted water quality standards. It is anticipated that approval of a Basin Plan Amendment would be necessary for implementation of the proposed IEI.

It is clear from the discussion above of the "Specific Surface Water Objectives" in the Basin Plan for the Salton Sea that the water quality standards established for flows entering the Sea are much higher than the existing and projected conditions in the Sea. The intent of these higher water quality standards is to improve the quality of the receiving water body. The existing imbalance in the Salton Sea water budget is central to the water quality issues in the Sea; and new sources of water supply could be beneficial to efforts to improve Salton Sea water quality.

However, in an arid climate like that of the area tributary to the Salton Sea, water treated to EPA effluent standards is typically a highly valued resource with many potential uses. The cost of treating water to those standards is significant. It is difficult to justify that cost for water intended for discharge to a surface water body with much lower quality from which that water cannot be recovered. Any water supplies that comply with the requirements of the Basin Plan would certainly have greater value for potential uses other than discharge to the Sea. Therefore, the high water quality standards in the Basin Plan are a deterrent to any potential new sources of water to the Salton Sea.

If new sources of water to the Sea are to be encouraged in support of restoration efforts, then a change to the regulatory approach to water quality standards warrants serious consideration.

Water Quality (TSS and BOD) Impacts

Beneficial impacts from the proposed IEI would include delivery of a new reliable source of water to the Salton Sea. Of course, those flows would convey significant concentrations of TSS and BOD. These constituents would influence concentrations of dissolved oxygen, bacteria, and other water quality parameters in the Sea for which specific standards are addressed in the Basin Plan [11]. Therefore, management of these brine constituents would be an important consideration in planning and design of the proposed IEI.

Treatment of the flows to reduce TSS and BOD concentrations could be most effectively accomplished prior to release to the Sea, using any of several approaches involving various levels of technological complexity. The use of wastewater treatment ponds and/or constructed wetlands to treat flows for TSS and BOD is offered for consideration as a centralized treatment mechanism as an alternative to pre-treatment of the brine, which was considered in the Salinity Management Plan discussed above. This approach is identified in this TM3 as the Inland Empire Interceptor Water Quality Treatment Facility (TF) and is discussed in the section entitled "Water Quality Treatment".

A Treatment Facility (TF) utilizing wastewater treatment ponds and/or constructed wetlands would be a "green" approach to treatment of the brine well suited to the Salton Sea area. It is envisioned to be located at the downstream end of the IEI near the shore of the Salton Sea, a rural area with relatively low land costs. And it would use a treatment process with relatively low energy requirements and overall operational costs.

The TF could be developed as a separate facility from the "habitat complex" included in the various Salton Sea restoration plan alternatives described above; or it could be part of a combined habitat complex facility. In the latter case, the IEI flows could provide a reliable water supply to the habitat complex, and the wetland plant and aquatic life communities of the habitat complex could be designed for the combined TSS and BOD mass loads associated with the Coachella Valley flows and the IEI flows.

It should be noted that the TF, if needed, would represent a substantial portion of the cost of implementation of the proposed IEI. If further study or design development for the proposed IEI is performed, those efforts should include more detailed investigation and analysis of the specific water quality characteristics of the projected IEI flows, of the water quality standards established in the Basin Plan, of water quality projections for the Salton Sea, of the influence of Salton Sea restoration planning on the design of the proposed IEI and associated treatment facility.

Salinity (TDS) Impacts

Though the projected concentrations of TDS in the IEI flows (up to 6,800mg/L) are much lower than existing TDS concentrations in the Sea (approximately 48,000 mg/L), the salts in the IEI flows would add to the existing rate of accumulation of salts in the Sea. Whether the salts in the IEI flows would cause the TDS concentrations in the Sea to increase will depend on factors beyond the scope of the project, such as the magnitude of the Salton Sea water budget imbalance over time and progress (if any) toward implementation of a Salton Sea restoration plan.

As discussed above in this TM3, a brine pool has been proposed as part of the various Salton Sea restoration plan alternatives. If implemented, this brine pool would offer a reasonable solution to the increased salt loads in the Salton Sea resulting from the proposed IEI flows. Salts from the IEI flows could accumulate in the brine pool along with the other salts entering the Sea reaching super-saturated levels. The salts would precipitate from the water column under those super-saturated conditions and accumulate in the bottom sediments. However, as noted previously, implementation of a Salton Sea restoration plan and the associated brine pool has been impeded by the estimated costs.

Treatment processes used to reduce TSS and BOD concentrations in water are not effective at significantly reducing TDS concentrations (removal of salt). If removal of salt from IEI flows (separate from the brine pool) were deemed necessary to reduce or mitigate for accumulation in the Salton Sea of that salt, then this treatment could best be accomplished using a separate process.

An evaporation pond facility (EPF) is discussed in Appendix C of this TM3 as an alternative approach to removal of salt. This EPF could serve in lieu of the brine pool as a treatment mechanism for removal from the Salton Sea of salts attributable to the IEI flows.

It should be noted that (like the TF discussed above) the EPF, if needed, would represent a substantial portion of the cost of implementation of the proposed IEI. If further study or design development for the proposed IEI is performed, those efforts should include more detailed investigation and analysis of the brine characteristics of the projected IEI flows, of the TDS standards in the Basin Plan, of Salton Sea water budget projections, of the influence of Salton Sea restoration planning on the design of the proposed IEI and associated treatment technologies under consideration.

Economic Development Considerations

The history of economic development in the Santa Ana Watershed demonstrates that brine management infrastructure is a valuable tool for economic development. That history suggests that the proposed IEI also has great potential as a tool for economic development in the San Gorgonio Pass and Coachella Valley areas along the route. Industrial facilities in the upper Santa Ana Watershed are major contributors of flow to the existing Brine Line. If implemented, the proposed IEI would make similar brine management infrastructure available to prospective employers located in the San Gorgonio Pass and Coachella Valley areas.

Implementation of one of the various Salton Sea restoration plan alternatives (or a hybrid of two or more alternatives) could facilitate implementation of the proposed IEI. Conversely, economic development in the San Gorgonio Pass and Coachella Valley areas encouraged by availability of brine disposal infrastructure may facilitate Salton Sea restoration.

INLAND EMPIRE INTERCEPTOR ALTERNATIVES in SANTA ANA WATERSHED

General Description

As noted above, the proposed IEI would alter the design and operation of the existing Brine Line system in Santa Ana Watershed. The purpose of this section of this report is to describe those modifications to the existing system.

The SAWPA Investigation described four alternative conceptual designs for the portion of the IEI in the upper Santa Ana Watershed, identified herein as SAW Alternatives 1 through 4. Three of these (also identified herein as SAW Alternatives 1, 2 and 4) were selected for consideration in this Appraisal Analysis. The specific alignments are generally the same as those developed for the SAWPA Investigation, with only minor differences. If further study or design development for the proposed IEI is performed, those efforts should include resolution of any such differences as a part of selection and refinement of the preferred alignments.

All three SAW Alternatives selected for consideration terminate at a common point located in the City of Beaumont at the west end of San Gorgonio Pass. This common point is located near the highest point along the proposed IEI route. The ground elevation at this location is approximately 2,600 feet above mean sea level and more than 2,100 feet above the lowest ground elevation on the route in Santa Ana Watershed, located near Prado Dam (approximately 440 feet above mean sea level). Therefore, pumping of the system flows to the Pass would be necessary and this portion of the proposed IEI would operate under pressure. A pump station, identified herein as PS 1-BL, would be necessary at the beginning point near Prado Dam and the County Line Master Meter. Additional pump stations would be needed for each SAW Alternative. A discussion of each SAW Alternative is presented in the section below entitled “Alignments”.

If further planning and design development for the proposed IEI is performed, a major consideration should be maintenance of service to existing Brine Line customers, including avoiding unnecessary disruptions of service during construction of the project and minimizing the impact of any unavoidable disruptions of service on the operations of customers. It is likely that maintenance of service considerations would dictate the sequencing of construction of IEI facilities, of connections of those new facilities to the Brine Line, and of any associated modifications to existing Brine Line facilities. The major existing Brine Line facilities would remain largely intact and continue to operate as gravity mains under all three SAW Alternatives under consideration, delivering flows to the proposed pump station PS 1-BL near Prado Dam and near the County Line Master Meter.

If future study or design development for the proposed IEI indicates that economies could be realized by converting existing gravity mains to some alternative use as part of the proposed IEI, then any such conversions should be planned and implemented with appropriate consideration for maintenance of service. Of course, abandonment of the existing Brine Line outfall to OCSD below the proposed pump station PS 1-BL cannot occur until the proposed IEI has been constructed and is fully functional.

Alternative 3 from the SAWPA Investigation was not selected for further consideration in this Appraisal Analysis. This alternative was used to evaluate a conceptual design developed to minimize system pumping costs. Under this alternative, flows would be intercepted at multiple locations as far upstream in the existing gravity system as possible using several pressure mains in a manifold configuration. Compared to the other three alternatives considered, this approach reduced the sizes of pipes and pump stations; but the total length of pipes and the number of pump stations was increased. As a result, the estimated construction costs for Alternative 3 were significantly higher than those of the other alternatives in amounts too great to be offset by the estimated operating cost savings within an acceptable period of time.

Another alternative route via Borrego Springs area was also briefly considered for this Appraisal Analysis. This alternative was ruled out after only minimal investigation due to substantially greater length and pumping requirements. The Borrego Springs route would be at least 20 miles longer than the proposed IEI alternatives under consideration. The increased pumping requirements result from greater variation of grades along the route and a much larger grade change from the starting point to the high point on the route (approximately 3,800 feet, versus approximately 2,100 feet for the proposed IEI alternatives). These factors would have resulted in significantly larger estimated costs.

Alignments

The three SAW Alternatives considered in this Appraisal Analysis are based upon two Primary Alignments, which are identified as the Gas Main Alignment and the North Alignment. These two Primary Alignments were identified in the SAWPA Investigation by the same designations. They are complemented by various combinations of Secondary Alignments to form the three SAW Alternatives.

The Secondary Alignments are identified as the IEBL Alignment, the EMWD North Alignment, and the IEUA Alignment. The IEBL Alignment corresponds with the segment identified in the SAWPA Investigation as Reach IV-B to Reach IV-D. Because this IEBL Alignment connects to the Primary Alignments at different locations, the portion in the Prado Dam area is split into two segments identified as BL-1a (or IEBL-1a) and BL-1b (or IEBL-1b). The EMWD North Alignment and the IEUA Alignment were identified in the SAWPA Investigation by the same designations.

Exhibits depicting the routes of the two Primary Alignments in plan-view with matching profile of the existing ground elevations along the route are provided in **Appendix A**. The routes of the Primary Alignments are generally described as follows, with associated Exhibits identified:

Gas Main Alignment: This Primary Alignment is used in two of the alternatives considered (SAW Alternatives 1 and 2). It begins at PS 1-BL in the vicinity of the Green River Golf Club maintenance facility near Prado Dam in the Corona area. It runs generally northeast to the west end of Prado Dam, then generally east through Corona , Riverside, Moreno Valley and through the hills east of Moreno Valley to the point of termination common with the North Alignment in Beaumont at the west end of San Gorgonio Pass. The Gas Main Alignment considered in this Appraisal Analysis is depicted on **Exhibit 1** in **Appendix A**.

North Alignment: This Primary Alignment is used in only one of the SAW alternatives considered (SAW Alternative 4). It begins at the Chino 1 Desalter north of Prado Dam in the Chino area. It runs generally east through Colton, Redlands and Yucaipa to the point of termination common with the Gas Main Alignment in Beaumont at the west end of San Gorgonio Pass. The North Alignment is depicted on **Exhibit 2** in **Appendix A**.

The three Secondary Alignments are generally described as follows:

IEBL Alignment: This Secondary Alignment is used in all three of the SAW alternatives considered. This alignment was identified in the SAWPA Investigation as the segment from Reach IV-B to Reach IV-D. Because it connects to the Primary Alignments at different locations, it is split into two segments, BL-1a and BL-1b. Segment BL-1a begins at Pump Station PS 1-BL at the proposed point of connection to the existing Brine Line gravity system near the Green River Golf Club maintenance facility near Prado Dam. It runs generally northeast to the west end of Prado Dam, where it either connects to the Gas Main Alignment (SAW Alternative 1 & 2) or continues north as segment BL-1b (SAW Alternative 4). For SAW Alternative

4, segment BL-1b continues north along the west side of the Prado Flood Control Basin to Chino, where it connects with the North Alignment. The IEBL Alignment is depicted on **Exhibit 3** in **Appendix A**.

EMWD North Alignment: This Secondary Alignment is used in only one of the alternatives considered (SAW Alternative 1). This alignment begins at the Menifee and Perris Desalters in the Menifee area. It generally runs north through Sun City and Perris to the Moreno Valley area, where it connects to the Gas Main Alignment. The EMWD North Alignment is depicted on **Exhibit 4** in **Appendix A**.

IEUA Alignment: This Secondary Alignment is used in only one of the alternatives considered (SAW Alternative 4). The IEUA Alignment is a short segment that conveys flows from the Inland Empire Utilities Agency (IEUA) service area east along Kimball Avenue in Chino and connects to the point of beginning of the North Alignment. The IEUA Alignment is depicted on **Exhibit 5** in **Appendix A**.

As noted previously, if further study or design development for the proposed IEI is performed, those efforts should include a route study to verify the preferred alternative(s) and refine the preferred alignment(s). For example, a portion of the Gas Main Alignment (SAW Alternatives 1 and 2) considered in this Appraisal Analysis is located in the impoundment above Prado Dam. This route may introduce environmental and construction constraints that might be avoided by relocating that portion to the area between the Prado Dam impoundment and the Riverside Freeway (CA 91).

Alternatives Considered

These three SAW Alternatives under consideration in this Appraisal Analysis (SAW Alternatives 1, 2 and 4) are summarized in tabular form, with the plan & profile Exhibit and the length of each associated Primary and Secondary Alignment, in **Table 1** below.

Table 1 – Proposed Santa Ana Watershed Alternatives

Alignment	**Plan & Profile Exhibit**	**SAW Alternative No. with Alignment Length (Feet)**		
		1	**2**	**4**
Primary Alignments:				
Gas Main	1	228,700	228,700	0
North	2	0	0	278,900
Secondary Alignments:				
IEBL:	3			
BL-1a		12,500	12,500	12,500
BL-1b		0	0	24,000
EMWD North	4	94,100	0	0
IEUA	5	0	0	9,000
Total Length (Ft)		**335,300**	**241,200**	**324,400**

Note: SAW Alternative 3 was not selected for further consideration due to large estimated construction costs.

All three of these SAW Alternatives begin with the IEBL Alignment at proposed pump station PS 1-BL near Prado Dam. Similarly, all three of these SAW Alternatives have a common point of termination located in the vicinity of the intersection of S. California Avenue and W. 4th Street in the City of Beaumont in San Gorgonio Pass. This location is common with the point of beginning of both Coachella Valley Alignments discussed in this TM3.

SAW Alternative 1: The combined length of the alignments that comprise SAW Alternative 1 is the greatest of the three alternatives considered. Space within the existing rights-of-way to accommodate major new infrastructure may be limited, especially in the more densely urbanized portions. SAW Alternative 1 has a reasonably continuous grade change from beginning to end. The portion of the Gas Main Alignment in Moreno Valley does “sag” (approximately 150 feet) from the vicinity of I-215 to the hills west of

Beaumont, which influenced the designs for the nearest pump stations. The EMWD North Alignment would intercept brine flows from the EMWD service area, reducing flows in that portion of the gravity Brine Line system.

SAW Alternative 2: The combined length of the alignments that comprise SAW Alternative 2 is substantially shorter than the lengths of both SAW Alternatives 1 and 4. Existing right-of-way constraints would be similar to those of SAW Alternative 1 but reduced by the shorter length. SAW Alternative 2, like SAW Alternative 1, has a reasonably continuous grade change from beginning to end, except for the "sag" on the Gas Main Alignment in Moreno Valley.

SAW Alternative 4: SAW Alternative 4 is similar in length to SAW Alternative 1 and substantially longer than that of SAW Alternative 2. Existing right-of-way constraints would likely be similar to those of the other SAW Alternatives. SAW Alternative 4 also has a reasonably continuous grade change from beginning to end with only local "peaks" and "valleys" that had some influence on the locations of pump stations. The North Alignment would intercept brine flows from the existing gravity Brine Line main that generally parallels this alignment (Reaches IV-D and IV-E), reducing flows in those Reaches. Those gravity flows could be captured at the proposed pump stations along this alignment.

Design Flows

Projections of Brine Line flows in the proposed IEI were addressed in TM2 of this Appraisal Analysis, as average flows. The projected average flows used for the conceptual design and hydraulic analysis of each of the three SAW Alternatives under consideration in this Appraisal Analysis match those developed by SAWPA staff in the SAWPA Investigation report [3] discussed previously herein.

A Peak Rate Factor (PRF) of 1.16 was applied to the average flows to calculate the peak flows used to develop the conceptual design for each of the SAW Alternatives and to perform the hydraulic analysis of each. This PRF is the same as that used by CDM in the Salinity Management Program and by SAWPA staff in the SAWPA Investigation report.

Pressure System Design

As noted above, the three SAW Alternatives under consideration would operate under pressure. The highest point along the proposed IEI route is located near the common point of termination of all three SAW

Alternatives in the City of Beaumont. The ground elevation at the high point is nearly 2,100 feet above the lowest ground elevation on the IEI route near Prado Dam. Therefore, a series of pump stations is proposed along the alignments of all three SAW Alternatives.

The following considerations were addressed in the development of the conceptual design for each SAW Alternative:

Hydraulic Grade Line: Hydraulic Grade Line (HGL) represents the piezometric head in a fluid conveyance facility, such as the proposed IEI. In the case of the pressurized portion of the proposed IEI in Santa Ana Watershed, the HGL represents the pressure in the pipe. The HGL is determined by various system hydraulic considerations including design flow, pipe size, velocity of flow and associated friction loss, locations and sizes of pump stations, and topography along the alignment.

In a pressurized system running uphill, like the proposed IEI in Santa Ana Watershed, pump stations are used to add energy to the flows; and the HGL resembles a series of steps. Like a stairway in a building, the height of the steps (i.e. the preferred HGL design) should be tailored to the circumstances, within a preferred range (neither too high, nor too short); and the HGL design should match into the elevation of the "landing" at the end of the steps (i.e. the ground elevation at the end of the system).

Operating Pressure: Optimizing the system design includes consideration of the relationship between operating pressures and system construction, maintenance and operational costs. A system designed for low operating pressures would typically require a large number of pump stations with smaller steps to overcome the large elevation change (2,100 feet). An alternative design for the same system with a smaller number of pump stations would typically have larger steps. Larger pumps would be needed at those pump stations to deliver higher operating pressures to overcome those larger steps. Higher operating pressures in the pipeline require pipe materials with correspondingly higher pressure ratings. Higher operating pressures would also tend to increase the construction and operating costs of connections to the pipeline.

The conceptual designs for the three SAW Alternatives were developed with a goal of limiting system operating pressures to minimize construction and operating costs. In general, operating pressures in the SAW Alternatives would range up to 100 psi. However, steep terrain causes substantially greater operating pressures (nearly 300 psi) on the outlet side of certain pump stations in the conceptual design for all three SAW Alternatives. Pipe materials with appropriate pressure ratings must be addressed in the project planning, design and construction.

Pumping Requirements: For all three SAW Alternatives, the location of the first pump station, identified herein as PS 1-BL, coincides with the proposed point of connection to the existing Brine Line gravity system near the County Line Master Meter. The additional pump stations necessary for each alternative were located for this Appraisal Analysis based on system hydraulic considerations. The system design flows and topography along each alignment were the primary considerations in selecting the locations and sizes of these additional pump stations, with the objective of minimizing system operating pressures for the site conditions.

The conceptual designs for pump stations developed for the three SAW Alternatives are based on generalized pump performance curves available in WaterCad using 80% pump efficiency. The pump sizes were calculated using the same methodology used in the SAWPA Investigation.

Pipe Sizes, Velocity of Flow and Friction Losses: Similarly, the system design flows were the primary considerations in selecting the pipe sizes for the IEI, with the objective of establishing appropriate velocities of flow in the pipe. The velocity of pipe flow must be sufficient to help flush the lines and low enough to avoid the need for unnecessarily high system operating pressures or friction losses. Pipe sizes were generally selected to achieve average velocities ranging between 3 feet per second and 4 feet per second. Pipe roughness coefficients were selected based on smooth-walled pipe materials such as cement-lined ductile iron pipe or concrete pipe.

INLAND EMPIRE INTERCEPTOR ALTERNATIVES in SAN GORGONIO PASS & COACHELLA VALLEY

General Description

The SAWPA Investigation did not include a detailed evaluation of the alignment of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas. Therefore, two alternative alignments were developed for this portion for consideration in this Appraisal Analysis. These are identified in this TM3 as Coachella Valley (CV) Alignment A and Coachella Valley (CV) Alignment B. These alignments are depicted on **Exhibits 6** and **7** in **Appendix A**.

The point of beginning of both alignments is located in the City of Beaumont, common with the point of termination of the three SAW Alternatives discussed in the previous section of this TM3. And the point of termination common to both alignments is located near the north edge of the Salton Sea. As noted earlier in this TM3, the point of beginning is near the highest point along the proposed IEI route, over 2,800 feet above the current level of the Salton Sea, which is approximately 230 feet below mean sea level. Therefore, both CV Alignments would operate by gravity flow.

The San Gorgonio Pass area is the location of the communities of Beaumont, Banning and Cabazon and of tribal lands of the Morongo Band of Mission Indians. The area is dominated by major transportation and utility corridors. Land use in the Pass is predominantly low density residential, with some commercial and light industrial uses attracted by the highway and railroad transportation corridors. The east end of the Pass is dominated by expansive fields of wind turbine electrical generators, which extend into the uppermost portion of Coachella Valley.

The Coachella Valley is characterized by two distinct areas, the West Valley and the East Valley. The West Valley, the upper portion, extends from the Palm Springs area eastward to the communities of La Quinta and Indio. Land use in this area is predominately low-density urban, characterized by numerous resort residential golf course communities. The East Valley, the lower portion, extends from the Coachella community southeastward to the Salton Sea. Land use in this area is predominately agricultural.

Though the San Gorgonio Pass and Coachella Valley areas are less densely urbanized than the upper Santa Ana Watershed, alignment opportunities for a major new utility are similarly limited by terrain and existing land use patterns. The proposed CV Alignments were developed with a goal of making the best possible use of likely "paths of least resistance". Therefore, CV Alignment A follows Coachella Canal for a substantial portion of the length and CV Alignment B follows the Whitewater River / Coachella Wash Storm Water Channel (CVSC). And, as discussed in TM2 of this Appraisal Analysis, the proposed IEI presents an opportunity for SAWPA to expand the Brine Line service area to include these areas. Therefore, the CV Alignments were also developed with consideration to facilitating future service connections.

If the results of this Appraisal Analysis support further investigation of the proposed IEI, then selection and refinement of the preferred alignment(s) should be included in the scope of subsequent design reports. The preferred alignment through the San Gorgonio Pass and Coachella Valley areas may be a hybrid of both CV Alignments. For example, while CV Alignment B may be preferred in the Coachella Valley area, constraints associated with that alignment in the San Gorgonio Pass area (e.g. proximity to existing electrical power transmission and/or generating facilities) may favor portions of CV Alignment A.

Alignments

Exhibits depicting the routes of the two CV Alignments in plan-view with matching profile of the existing ground elevations along the route are provided in **Appendix A**. The alignments are summarized, with the plan & profile Exhibit and the length of each Alignment, in **Table 2** below:

Table 2 – Proposed Coachella Valley Alignments

Alignment	Plan & Profile Exhibit	CV Alignment Length (Feet)
CV Alignment A	6	448,000
CV Alignment B	7	377,000

The routes of the CV Alignments are generally described as follows, with associated Exhibits identified:

<u>CV Alignment A:</u> CV Alignment A is depicted on **Exhibit 6** in **Appendix A**. It begins at the point of termination of the three SAW Alternatives in the vicinity of the intersection of S. California Avenue and W. 4th Street in the City of Beaumont in the San Gorgonio Pass area. It generally runs east in the 1st Street and Westward Avenue alignments through Beaumont and Banning. Between Banning and Cabazon, it crosses to the north side of I-10, where it runs in or alongside of an existing gas main easement to the Whitewater

River area. It then crosses back to the south side of I-10 to the vicinity of N. Indian Canyon Drive in the Palm Springs area, where it crosses once again to the north side of I-10. From there, it continues generally southeast toward the City of Indio where it intersects with the Coachella Canal. It runs southeast alongside of the Coachella Canal to the 60th Avenue alignment north of Mecca, then south in the 60th Avenue alignment to the Whitewater River / Coachella Wash Storm Channel (CVSC) in the vicinity of Salton Sea.

CV Alignment A is approximately 13 miles longer than CV Alignment B. Much of the portion in the San Gorgonio Pass area, is located in areas that are somewhat more rural in character (and possibly less encumbered by existing infrastructure) than CV Alignment B. However, in the Coachella Valley area, the route of CV Alignment A is likely much more constrained than CV Alignment B. For example, available space in the Coachella Canal right-of-way is limited, especially in the more urbanized portions to the north, with numerous potential conflicts with existing irrigation turn-outs, drop structures, drainage crossings and other facilities.

Because Coachella Canal delivers water to Coachella Valley in the direction opposite of the proposed direction of flow in the proposed CV Alignment A, the pipe slope for this portion of CV Alignment A is adverse to existing grade. And, because the elevation of Coachella Canal is above adjoining areas of Coachella Valley, CV Alignment A would also typically be above future direct service connections in the Valley.

Therefore, prospective future Brine Line customers would need either to pump their flows to connect to the proposed IEI at the nearest possible location or to extend their service line some distance downstream to make a gravity connection.

<u>CV Alignment B:</u> Like CV Alignment A, CV Alignment B begins in the vicinity of the intersection of S. California Avenue and W. 4th Street in the City of Beaumont in the San Gorgonio Pass area. It generally runs east in the unimproved frontage road alignment between the south side of I-10 and the north side of the UPRR to the vicinity of S.R. 111. It continues to run alongside of the UPRR to N. Indian Canyon Drive in the Palm Springs area, then south to the CVSC. It then follows the CVSC corridor to the vicinity of Salton Sea. CV Alignment B is depicted on **Exhibit 7** in **Appendix A**.

As noted above, the length of the proposed CV Alignment B is substantially shorter than that of CV Alignment A. The portion of CV Alignment B in the Coachella Valley area is located in the Whitewater River / CVSC right-of-way, which is wide with few longitudinal constraints. CVWD staff has indicated to

Reclamation representatives that space could be made available in the south side of that right-of-way for the proposed IEI. The proposed IEI would need to be constructed with minimum cover of 20 feet due to the potential for scour during major storm events and encasement or rock matting may be necessary. Portions of that facility are located on tribal lands in easements specific to flood conveyance and it would be necessary to obtain additional easement rights. Wetland impacts may influence the IEI design, especially in the southerly (downstream) portion of the CVSD.

Largely because it follows the Whitewater River / CVSC, CV Alignment B has a nearly continuous grade change from beginning to end with minimal "humps" and "sags". And, because the Whitewater River / CVSC is "downhill" from adjoining areas of Coachella Valley, CV Alignment B would also likely be down-gradient from future direct service connections in Coachella Valley. Prospective future Brine Line customers would be more likely able to use gravity connections to the proposed IEI in Alignment B than in Alignment A. Conversely, IEI manhole covers in the Whitewater River / CVSC right-of-way would need to be sealed to prevent infiltration of water in the channel.

Alternatives Considered & Design Flows

Projections of Brine Line flows in the proposed IEI were addressed in TM2 of this Appraisal Analysis, as Average Flows, both with and without projected flows from the potential service area expansion in the San Gorgonio Pass and Coachella Valley areas. For purpose of comparison, conceptual designs were developed for both of the CV Alignments using both sets of flow projections with Energy Recovery Facilities designed to maintain full pipe flow. The CV Alternatives with flows from the potential Expanded Service Area are identified as A-1 and B-1. The CV Alternatives with flows from only the Existing Service Area are identified as A-2 and B-2.

Each Alignment was also investigated for flows from the potential Expanded Service Area with no Energy Recovery Facilities or other design measures to help maintain full pipe flow. The hydraulic analysis results for these alternatives (using SewerCAD) indicated unacceptably high velocities (greater than approximately 10 feet per second) in numerous pipe segments in the system. These CV Alternatives are identified as A-3 and B-3.

These CV Alternatives and the projected Average Flows for each are summarized in **Table 3** on the next page.

Table 3 – Coachella Valley Alternatives – Average Flows

Alignment	Alternative	Energy Recovery	Service Area	Projected Average Flows at Salton Sea (2060)		
				(MGD)	(gpm)	(cfs)
CV Alignment A	A-1	With	Expanded	75.1	52,150	N.A.
	A-2	With	Existing	32.1	22,292	N.A.
	A-3	Without	Existing	32.1	N.A.	49.7
CV Alignment B	B-1	With	Expanded	75.1	52,150	N.A.
	B-2	With	Existing	32.1	22,292	N.A.
	B-3	Without	Existing	32.1	N.A.	49.7

A Peak Rate Factor (PRF) of 1.16 was applied to the Average Flows tabulated above to calculate the Peak Flows used to develop the conceptual design for each of the CV Alternatives and to perform the hydraulic analysis of each. This PRF is the same as that used by CDM in the Salinity Management Program and by SAWPA staff in the SAWPA Investigation report. The Peak Flows are summarized in **Table 4** below.

Table 4 – Coachella Valley Alternatives – Peak Flows

Alignment	Alternative	Energy Recovery	Service Area	Projected Peak Flows at Salton Sea (2060)		
				(MGD)	(gpm)	(cfs)
CV Alignment A	A-1	With	Expanded	87.4	60,636	N.A.
	A-2	With	Existing	37.3	25,937	N.A.
	A-3	Without	Existing	37.3	N.A.	57.8
CV Alignment B	B-1	With	Expanded	87.4	60,636	N.A.
	B-2	With	Existing	37.3	25,937	N.A.
	B-3	Without	Existing	37.3	N.A.	57.8

Gravity System Design

As noted previously in this TM3, the ground elevation at the highest point along the proposed IEI route is over 2,800 feet above the current level of the Salton Sea. Therefore, the IEI would operate by gravity flow for both of the CV Alignments under consideration.

Because hydraulic conditions in gravity mains are generally best when the pipes are flowing full, the conceptual IEI designs for both CV Alignments presented in this Appraisal Analysis were developed with full pipe flow as a goal. However, this full pipe flow design goal was made difficult by the large grade change from the San Gorgonio Pass area to the Salton Sea. Pipe slopes were steep in portions of both CV Alignments as a result of this grade change. The initial hydraulic analyses of both CV Alignments revealed that high velocities of flow would occur in the system as a result of those steep pipe slopes that would cause significant operational issues, if allowed to occur.

These high flow velocities represent surplus energy in the system. Various system design adjustments, such as grade adjustments and alternative pipe sizes, were considered when the system hydraulic analyses were being performed in an effort to achieve the desired hydraulic characteristics in the system. Hydraulic analyses of the various designs considered revealed that the level of energy in the system could not be adequately controlled without removing some portion of that energy. Removal of this surplus energy could be accomplished either by dissipating energy or by capturing it for some beneficial use.

Considerations addressed in the development of the conceptual design for each CV Alternative and in performing the system hydraulic analyses of those conceptual designs include the following:

Hydraulic Grade Line: In the case of a gravity system, the hydraulic grade line (HGL) represents the piezometric head in the system. This represents the elevation of the water surface that would be observed in manholes on the system under design flow conditions. The HGL is calculated based on various system hydraulic considerations including design flow, pipe size, pipe elevation and slope, velocity of flow and friction losses. The pipe elevation and slope is largely dictated by the topography along the alignment. For full pipe flow, the preferred HGL design would be above the elevation of the top of the pipe but below ground elevation wherever possible.

Pressure system situations occur where the HGL is above the ground elevation. Pressurized segments are more expensive to construct, operate and maintain than conventional (unpressurized) gravity systems. For such pressurized segments, manholes must be sealed to operate under pressure; pipe must be appropriately pressure-rated; and service connections must be pumped. Therefore, pressurized segments were initially avoided during development of conceptual designs for the IEI. However, the need to control the energy in the system discussed below was assigned a higher priority; and the HGL is typically above ground elevations in segments upstream of the proposed energy recovery facility locations.

Pipe Sizes and Velocity of Flow: Selection of pipe sizes for a gravity system is typically based on design flows and pipe slopes with the objective of achieving the best possible hydraulic characteristics. Optimal hydraulic efficiency typically occurs in gravity mains when the depth of flow is at least 80% of the pipe diameter (for circular pipe). Therefore, the conceptual IEI designs for both CV Alignments were developed with full pipe flow as a goal.

The desired range of velocity of flow in gravity mains is typically great enough to provide flushing of the lines, but low enough to avoid turbulence and scour. Conceptual designs were developed to provide average velocities under full pipe flow conditions in the range between 3 feet per second and 10 feet per second.

Energy Recovery Facilities (Turbine Generators):

As discussed above, hydraulic analyses of the various IEI alternatives considered revealed surplus energy in the flows causing unacceptably high velocities and preventing full pipe flow. The desired hydraulic characteristics could not be achieved without removing energy, which can be accomplished either by restricting the flows to dissipate energy or by capturing the energy for some beneficial use. Both solutions introduce construction and operational costs, which indicates suggests the proposed IEI is a good opportunity to design for energy recovery. Turbine generators could be used to capture of the surplus energy to produce electrical power to help offset the cost of pumping the IEI flows in upper Santa Ana Watershed.

Strategic locations were selected for turbine generators based on the system hydraulic characteristics. The HGL in the IEI was allowed to rise above ground elevations upstream of those locations to maximize the available potential energy at the turbine generators. As a result, pipe segments upstream of turbine generators would function as pressure mains with the associated design, construction and operational considerations noted above. The conceptual designs were developed with a goal of limiting operating pressure at the turbine generators to approximately 100 psi. However, higher pressures occur under design conditions in select locations. This design approach is consistent with the hydraulic characteristics of commercially available turbine generators.

Alternative Turbine Generators:

Low-head turbine generators have recently been introduced into the energy recovery equipment marketplace. This technology was considered for this Appraisal Analysis as an alternative to the more traditional energy recovery design described above to avoid added costs associated with pressurized pipe segments. Low-head turbine generators could allow placement of turbine generators at more widely distributed and strategic locations along the CV Alignment(s). This would allow more effective distribution of the potential energy capture in the system.

An example of a low-head turbine generator is the "LucidPipe Power System" recently developed by Lucid Energy, Inc. The "LucidPipe Power System" was developed to capture energy from flows in large diameter gravity pipelines. Lucid Energy, Inc. conducted a pilot project in a water pipeline in Riverside, CA belonging to WMWD, a SAWPA member agency, and completed its first commercial installation at Riverside Public Utilities. However, the technical information available for the "LucidPipe Power System" was not sufficient to incorporate this alternative in the conceptual designs or hydraulic analyses; and Lucid Energy, Inc. did not respond to a Reclamation request for additional technical information and cost data. Therefore, this technology was not included among the alternative conceptual designs developed for this Appraisal Analysis.

The potential for reduced construction and operational costs warrants further consideration of available low-head turbine generator technologies. If further study or design development for the proposed IEI is performed, SAWPA may wish to include a more detailed investigation of the technical considerations and costs of available low-head turbine generators. This investigation should consideration of durability of low-head turbine generator in response to potential brine scale formation in the proposed IEI.

Brine Scale Formation: Operational issues have been experienced in the existing gravity-flow Brine Line system due to scale formation. The information available from SAWPA regarding this scale formation indicates that it is from both organic and inorganic sources. CDM reported to SAWPA in ***"DRAFT Memorandum, Subject: Santa Ana Regional Interceptor (SARI) Solids Control Alternatives Conceptual Costs"*** [5] dated April, 2011, that bench testing of desalination brine samples with no air-to-water contact "did not exhibit the inorganic solids formation seen in the open containers." CDM also reported that it "has been observed with pressurized brine lines operated in Texas and Florida that scale formation can be prevented by maintaining full pipe flows with no air-to-water contact." This information, though inconclusive, suggests that full pipe flow operation in the proposed IEI may help to reduce inorganic scale formation.

However, CDM also noted in the cited memorandum that pressurization “should not be expected to have an impact on formation of organic suspended solids.” And the information available from SAWPA on this topic also suggests that organic material represents a large percentage of the suspended solids in the Brine Line flows. Therefore, while full pipe flow may help to reduce scale formation, it should not be expected to prevent it.

HYDRAULIC ANALYSES

Background

As discussed previously in this TM3, the various alternatives under consideration were developed for the purpose of comparative analysis; and the purpose of this TM3 is to present the conceptual designs for each of the alternatives under consideration. Hydraulic analysis was a necessary part of development of the conceptual design for each alternative. The hydraulic analyses were used to determine conceptual design components, such as pipe sizes for each segment, locations and sizes of pump stations, locations and sizes of turbine generators, etc.

Methodology

WaterCAD and SewerCAD design software were both used to perform hydraulic analyses and conceptual design for the various alternatives under consideration. WaterCAD and SewerCAD are both marketed by Bentley Systems, Inc. WaterCAD can be used to perform hydraulic analysis and design of pressurized transmission systems; and SewerCAD can be used to perform these tasks for conventional gravity sewer mains.

The highest point along the proposed IEI route is nearly 2,100 feet above the lowest point in the upper Santa Ana Watershed. Each of the three alternatives considered for the portion of the proposed IEI in the upper Santa Ana Watershed would include a series of pump stations to lift flows to the high point in San Gorgonio Pass and would operate as a transmission main under pressure. Therefore, WaterCAD was used to perform the hydraulic analysis and design for all three SAW Alternatives.

The highest point along the proposed IEI route is nearly 2,800 feet above the current level of the Salton Sea approximately 230 feet below mean sea level. As discussed previously in this TM, both alignments considered for the portion of the proposed IEI through San Gorgonio Pass and Coachella Valley would operate by gravity flow. However, as discussed previously herein, for the alternatives for which energy recovery facilities (turbine generators) are proposed, the full pipe flow conditions are the hydraulic equivalent of pressure mains. Therefore, WaterCAD was also used for the hydraulic analysis of the two alternatives for each of the CV Alignments for which turbine generators are proposed (Alternatives A-1, A-2, B-1 and B-2).

For purpose of comparison, hydraulic analyses and conceptual design were performed for a third scenario for each of the two CV Alignments in which turbine generators were **not** used. SewerCAD was used to perform these hydraulic analyses (Alternatives A-3 and B-3). These results are presented to illustrate the need to design for the surplus energy and high velocities of flow in the system. Because of the unacceptably high velocities, CV Alternatives A-3 and B-3 will be given no further consideration in this Appraisal Analysis.

Santa Ana Watershed Alternatives Hydraulic Analyses

A hydraulic analysis was performed in conjunction with development of the conceptual design for each SAW Alternative. The results of the hydraulic analysis for each SAW Alternative considered are presented in **Tables** in **Appendix B**, which are listed in **Table 5** below. The hydraulic grade line (HGL) for the SAW Alternatives are depicted graphically on **Exhibits** in **Appendix B**, which are also listed in **Table 5**.

Table 5 –Santa Ana Watershed Alternatives Hydraulic Analyses

SAW Alternative No.	Hydraulic Analysis Results Table No.	Pump Stations Design Table No.	HGL Profile Exhibit Nos.
1	12	13	8 & 9
2	14	15	10
4	16	17	11, 12 & 13

Note: SAW Alternative 3 was not selected for further consideration due to large estimated construction costs.

Coachella Valley Alternatives Hydraulic Analyses

A hydraulic analysis was performed in conjunction with development of the conceptual design for each alternative for each CV Alignment. The results of the hydraulic analysis for each of the CV Alternatives are presented in **Tables** in **Appendix B**, which are listed in **Table 6** on the next page. The hydraulic grade line (HGL) for the CV Alternatives are depicted graphically on **Exhibits** in **Appendix B**, which are also listed in **Table 6**.

Table 6 – Coachella Valley Alternatives Hydraulic Analyses

CV Alternative No.	Hydraulic Analysis Results Table No.	Energy Recovery Facility Design Table No.	HGL Profile Exhibit Nos.
A-1	18	19	14
A-2	20	21	14 *
A-3	22	N.A.	15
B-1	23	24	16
B-2	25	26	16 *
B-3	27	N.A.	17

* Notes: The hydraulic grade line (HGL) profile for CV Alternative A-2 is graphically similar to that of CV Alternative A-1; and the HGL profile for CV Alternative B-2 is graphically similar to that of CV Alternative B-1.

WATER QUALITY TREATMENT

Background

The water quality issues in the Salton Sea and the associated environmental impacts result primarily from the existing water mass imbalance and accumulation of salts, nutrients and other contaminants. These issues are common among terminal water bodies in arid climates. Several plans have been proposed in recent years for restoration of the Salton Sea [6] [7] [8] [9] in response to the deteriorating water mass imbalance and associated deteriorating water quality. Implementation of these restoration plans has been impeded by the estimated costs.

The Basin Plan [11] was adopted with the intent to "optimize the beneficial uses of state waters within the Colorado River Basin Region of California by preserving and protecting the quality of these waters." It is clear from the discussion of the Specific Surface Water Objectives for the Salton Sea in the Basin Plan (and various other information sources) that the water quality standards established in the Basin Plan for flows entering the Sea are much higher than the existing and projected conditions in the Sea.

The proposed IEI has the potential to provide significant benefits to the Salton Sea, including delivery of a new reliable source of water to the Salton Sea to help improve the overall Salton Sea water mass balance. Of course, those flows would convey significant concentrations of TSS, BOD and TDS, which would be expected to influence concentrations of dissolved oxygen, bacteria, dissolved oxygen, and other water quality parameters in the Sea for which specific standards are addressed in the Basin Plan. Therefore, management of the TSS, BOD and TDS in the flows is an important consideration in the planning and design of the proposed IEI.

Treatment of the flows to reduce TSS and BOD concentrations could be most effectively accomplished prior to release to the Sea. Wastewater treatment ponds and constructed wetlands are two approaches that are both potentially well suited to the proposed IEI for this purpose. Various combinations of wastewater treatment ponds and constructed wetlands were considered for treatment of the IEI flows for TSS and BOD in this Appraisal Analysis. These alternatives are collectively identified herein as the Inland Empire Interceptor Treatment Facility (TF).

The proposed TF is envisioned to be located at the downstream end of the IEI near the north shore of the Sea. In addition to reducing TSS and BOD concentrations, the TF could trap heavy metals, nitrogen and other undesirable constituents in the IEI flows. It could also help to restore fish and wildlife habitat that have been displaced from the Sea as water quality conditions have deteriorated. It could be developed as a separate facility from the "habitat complex" included in the various Salton Sea restoration plan alternatives; or it could be part of a combined habitat complex. The proposed TF is treated as a separate facility in this TM3.

Constructed wetland facilities already exist in Coachella Valley. For example, Valley Sanitary District developed a constructed wetland in the Indio area known as the Coachella Valley Wild Bird Center to provide post-secondary treatment of effluent from the Valley Sanitary District Water Reclamation Facility. Effluent from the Wild Bird Center is discharged to the Whitewater River / CVSC. And the Torres-Martinez Band of Mission Indians has also developed a constructed wetland alongside the Whitewater River / CVSC near the Salton Sea.

Water treatment processes used to reduce TSS and BOD concentrations are not effective at significantly reducing TDS concentrations. Therefore, if removal of salt from IEI flows were deemed necessary to reduce or mitigate for accumulation of salts from the IEI in the Salton Sea, then this treatment could best be accomplished using a separate process.

The brine pool proposed as part of the Salton Sea restoration plan alternatives discussed previously, if implemented, offers a reasonable solution to the increased salt loads in the Salton Sea resulting from the proposed IEI flows. The salts could accumulate in the brine pool, where they could be precipitated under super-saturated conditions.

However, as also noted previously, implementation of a Salton Sea restoration plan and the associated brine pool has been impeded by the estimated costs. Therefore, a salt evaporation pond facility is presented in this TM3 in Appendix C as an alternative approach for removal from the Salton Sea of salts attributable to the IEI flows. It could serve as a centralized treatment mechanism for salt removal in lieu of the brine pool.

The discussion in the rest of this section is limited to TSS and BOD considerations.

Effluent Standards

The EPA effluent standards for secondary wastewater treatment cited in the Basin Plan [11] limits TSS and BOD concentrations in flows entering the Salton Sea to 30 mg/L. These EPA effluent standards were promulgated for surface water bodies throughout the US and correspond to a level of water quality much better than existing conditions at the Salton Sea. Thus, the current Basin Plan limits would require treatment of the IEI flows to higher quality than the receiving water body.

In an arid climate like that of the Salton Sea area, water treated to EPA effluent standards would typically have many uses. Water of that quality would typically be valued too highly to justify discharging it to a water body with much lower quality from which it could not be recovered. As a result, the Basin Plan discourages effluent discharges to the Sea that could improve the water mass imbalance. Therefore, if restoration of the Salton Sea is to be encourage, more flexible standards should be considered for TSS and BOD concentrations in discharges to the Sea.

Under the EPA National Pollutant Discharge Elimination System (NPDES) program, the conditions of a permit may allow concentrations of TSS, BOD and other contaminants in discharges greater than the EPA effluent standards for secondary wastewater treatment. Effluent limitations less restrictive than the EPA effluent standards have been allowed in NPDES permits issued for certain facilities located in Coachella Valley. Average TSS concentrations up to 95 mg/L and monthly average BOD concentrations up to 45 mg/L have been approved.

The Basin Plan includes an amendment process. Amendments to the Basin Plan have been adopted previously for specific circumstances in which discharges to the Sea do not meet the water quality standards established in the Plan. For example, the CRWQCB amended the Basin Plan by adoption of Sedimentation/Siltation Total Maximum Daily Loads (TMDLs) for discharges to the Sea from the Alamo River and the New River. The adopted TMDLs correspond with annual average TSS concentrations of 200 mg/L in those flows, which is a significant increase over the EPA effluent standards cited in the Basin Plan (30 mg/L). Therefore, it seems reasonable to speculate that the CRWQCB may approve an amendment to the Basin Plan to allow discharges from the proposed IEI that would not comply with all applicable water quality standards in the Plan but would offer substantial offsetting benefits.

IEI effluent standards for TSS and BOD should ultimately be determined based on more detailed investigations and through coordination with other Salton Sea stakeholders. Coordination with other Salton Sea stakeholders could also facilitate collaborative implementation of Salton Sea restoration plan facilities, improved Salton Sea water mass balance, improved Salton Sea water quality, restoration of wildlife habitat, mitigation for IEI environmental impacts, etc.

Constructed Wetlands Description

The US Environmental Protection Agency (EPA) publication entitled ***Manual: Constructed Wetlands Treatment of Municipal Wastewaters*** [10] (CW Manual) describes "the capabilities of constructed wetlands" and "a functional design approach" for treatment of municipal wastewater. It also indicates that a constructed wetland may be used for treatment of industrial effluents. A constructed wetland can perform many of the functions of a conventional wastewater treatment system with low operational and maintenance requirements. A constructed wetland can also provide other benefits, including removal of pathogens, heavy metals (e.g. cadmium, chromium, iron, lead, manganese, selenium and zinc) and nitrogen.

The CW Manual identifies two types of constructed wetland treatment systems: "Free Water Surface" wetland and "Vegetated Submerged Bed" subsurface flow wetland. A Free Water Surface constructed wetland is a shallow wetland, which can utilize either a single zone planted with emergent aquatic plants, or a sequential treatment process with three distinct wetland zone categories.

The proposed Treatment Facility (TF) is envisioned to include a Free Water Surface constructed wetland. A Free Water Surface constructed wetland (FWS CW) uses a sequential treatment process with at least three zones. Each of the three sequential zones performs a specific function in the treatment process as follows:

- Zone 1 is a shallow-water area with floating and emergent vegetation and anaerobic conditions that removes TSS by sedimentation and flocculation. It also removes BOD, heavy metals, pathogens and nitrogen.
- Zone 2 is a deeper open-water area with submergent vegetation that uses sunlight exposure, aeration, digestion, oxidation and reduction to remove BOD and pathogens. It also removes pathogens and suspends new TSS resulting from wetland biological processes.
- Zone 3 is a "polishing compartment", which like Zone 1 is a shallow-water area with floating and emergent vegetation and anaerobic conditions. Zone 3 provides denitrification and removal of the new TSS from Zone 2 by sedimentation and flocculation and, like Zone 1, also provides some removal of BOD and pathogens.

Using the CW Manual [10], a Free Water Surface constructed wetland (FWS CW) can be designed to provide treatment for flows with specific influent concentrations of TSS and BOD for which effluent concentrations would meet or exceed EPA effluent standards (30 mg/L). The Introduction to the CW Manual indicates that constructed wetlands "require large land areas, 4 to 25 acres per million gallons of flow per day." These data suggest that, if a stand-alone FWS CW was used for the proposed TF, the surface area would range in size up to approximately 1,880 acres for the projected average daily flow of 75.1 MGD in Year 2060. This large land area suggests a location in a rural area with relatively low land costs; and the relatively low operational costs and low energy requirements of a CW may help offset costs associated with the large land area.

The intent of the conceptual TF design in this Appraisal Analysis is that it would operate by gravity flow to make use of the energy available in the IEI flows. Multiple sets of the sequential series of zones, or "trains", designed to operate in parallel are recommended to accommodate project phasing and to facilitate operational aspects. Multiple trains could also facilitate dispersal of flows to the Sea or to the "habitat complex" at the north end of the Sea proposed in various Salton Sea restoration plans. And extra trains that provide TF capacity greater than the design flows could allow the system to operate without interruption when a train needs to be removed from service for maintenance. The area calculations for the conceptual TF design in this Appraisal Analysis do not include any such extra trains.

Coordination with other Salton Sea stakeholders could facilitate incorporating the proposed FWS CW directly into the "habitat complex" of the Salton Sea restoration plans. Site specific factors that should be taken into consideration in the design of a FWS CW include rates of flow entering the facility, water quality characteristics of flows entering the facility (e.g. TSS and BOD concentrations), topography, climate (e.g. temperature variation, evapotranspiration rates and precipitation) and wildlife activity. The effectiveness of a FWS CW is a function of plant density; and the minimum start-up time is typically at least one growing season to attain sufficient plant density. Mosquito breeding can be managed through development of a balanced ecosystem supplemented, if necessary, by intervention with biological or chemical agents.

Constructed Wetland Pre-treatment

The CW Manual [10] presupposes that wastewater entering a CW has undergone primary or secondary treatment. Primary treatment is a sedimentation process; and secondary treatment is a biological process. Like in Zone 1 of a CW, the primary treatment sedimentation process provides effective TSS removal and solids accumulation, which are maximized under low velocity, laminar flow conditions. The maximum projected TSS concentrations in the IEI flows are in excess of 500 mg/L, which is greater than TSS concentrations typically expected in primary treatment effluent. The secondary treatment biological process primarily removes BOD.

Wastewater treatment ponds (also known as stabilization ponds or oxidation ponds) are widely used to perform primary and secondary treatment processes. The TSS concentrations in the IEI flows entering the CW could be reduced by first routing those flows through wastewater treatment ponds. Using wastewater treatment ponds as the first stage of the TF train could improve the effectiveness of the CW and reduce the need for redundancy in the design (thus potentially reducing the overall size of the facility). Therefore, wastewater treatment ponds were included among the conceptual designs developed for the TF for this Appraisal Analysis.

Constructed Wetland Inlet Settling Zone

The bulk of the TSS removal and solids accumulation in a FWS CW occurs during the first 2 days at the influent end of Zone 1. Some accumulation of litter and settled non-degradable solids in that area is likely. Therefore, the CW Manual [10] suggests incorporating an inlet settling zone at the upstream end of Zone 1.

The inlet settling zone would be an open water area deeper than the adjoining emergent wetland area of Zone 1. It would facilitate the initial TSS removal process, distribute the flows into the wetlands, and facilitate access for periodic maintenance (mechanical solids removal). The size of the inlet settling zone suggested in the CW Manual is 10 to 25 percent of the areal size of the CW. Pre-treatment in wastewater treatment ponds would likely fulfill the TSS removal function of the CW inlet settling zone, minimizing the size of the inlet settling zone.

Wastewater Treatment Pond Description

The US Environmental Protection Agency (EPA) publication entitled ***Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers*** [15] (WTP Manual) "provides an overview of wastewater treatment pond systems through the discussion of factors affecting treatment, process design principles and applications, aspects of physical design and construction, effluent total suspended solids (TSS), algae, nutrient removal alternatives and cost and energy requirements." Wastewater treatment ponds can be used alone or in combination with other processes for the treatment of domestic or industrial wastewater to reduce concentrations of TSS and BOD with low operational and maintenance requirements.

The WTP Manual identifies three types of treatment ponds: Anaerobic, Facultative, and Aerobic. The most commonly used treatment pond type is the facultative pond. Facultative Treatment Ponds (FTP) can be either aerobic or anaerobic and, without mechanical aeration, typically has an aerobic layer overlying an anaerobic layer.

As noted previously, the proposed FTP, as conceptually designed for this Appraisal Analysis, would be a part of the TF train located immediately upstream of the inlet settling zone at Zone 1. The primary function of the FTP would be TSS removal and solids accumulation to reduce TSS loading rates in the CW.

Like the CW Manual, the recommended design criteria in the WTP Manual are intended to produce a design for which FTP effluent TSS and BOD concentrations would meet or exceed EPA effluent standards (30 mg/L).

Wastewater Treatment Pond and Constructed Wetland Design Methodologies

The WTP Manual cites the ***Recommended Standards for Wastewater Facilities*** [16] (Ten States Standards) in addressing design methodology and criteria for FTP facilities. The WTP Manual and Ten States Standards identify the primary variables in the design of a FTP as Area Loading Rate (ALR) and detention time or Hydraulic Residence Time (HRT). ALR represents the maximum loading rates of TSS or BOD in a FTP associated with specific effluent concentrations. HRT is the length of time it would take for a water particle to travel through the FTP and is calculated as the ratio of the volume of water in the FTP and the average rate of flow.

The maximum ALR for a FTP varies with temperature and is greater in warm climates and lower in colder climates. The minimum HRT for a FTP also varies with temperature and is shorter in warm climates and longer in colder climates. For design purposes, intermediate climates are generally identified with average air temperature during coldest month between 0°C (32°F) and 15°C (59°F). Though the Salton Sea is located in a desert area with high temperatures during summer months, the average temperature during the coldest month is approximately 12°C (54°F), which categorizes the area climate as intermediate.

The ALR and HRT design criteria in both the WTP Manual and the CW Manual were developed to produce conceptual designs for which effluent TSS and BOD concentrations would meet or exceed EPA effluent standards (30 mg/L). These criteria were used for conceptual design of TF alternatives for which either a FTP or a CW would discharge to the Salton Sea. The minimum surface area of a FTP or CW is the larger of the areas calculated separately using ALR and HRT. A multiplier of 1.30 was applied to the calculated FTP and CW surface areas to account for necessary buffers, containment berms, access roads, etc. However, this multiplier was not developed to include extra trains that could provide TF capacity greater than the design flows, which may be desired for operational purposes.

As noted above, the CW Manual presupposes that wastewater entering a CW has undergone primary or secondary treatment. And a FTP can be used alone or in combination with other processes to reduce concentrations of TSS and BOD in wastewater. Therefore, alternative conceptual TF designs were also considered in this Appraisal Analysis for which a FTP would be used to pre-treat IEI flows, followed by treatment in a CW.

The conceptual design of these hybrid treatment facilities was hindered by a lack of available design criteria specific to wastewater treatment ponds operating in series with constructed wetland facilities. This approach was used with the objective of optimizing the properties of both processes to minimize the total area of the TF. Since the CW would provide the level of treatment necessary to meet or exceed EPA effluent standards for TSS and BOD for discharge to receiving waters, it would not be necessary for the FTP discharges to the CW to meet those standards. The WTP Manual presupposes that wastewater treatment ponds could function as stand-alone facilities and produce effluent that would meet or exceed EPA effluent standards. Use of the WTP Manual criteria for conceptual design of the FTP without modifications to account for the subsequent treatment in the CW would result in unnecessary system redundancy.

Therefore, it was necessary to develop “modified” ALR and HRT criteria for design of these hybrid treatment facilities. Specifically, it was necessary to develop “modified” ALR and HRT criteria for FTP design that would result in effluent with concentrations of TSS and BOD higher than EPA effluent standards. The “modified” FTP criteria used for conceptual design of these hybrid TF alternatives were estimated from descriptions in the WTP Manual of facultative wastewater treatment pond performance characteristics and supporting data.

Wastewater Treatment Pond Design Criteria

The ALR for BOD identified in the WTP Manual ranges from 11 to 90 kg/ha per day (9.8 to 80.1 lbs/acre per day) at average flow to meet or exceed EPA effluent standards (30 mg/L). In intermediate climates, the range narrows from approximately 22 to 45 kg/ha per day (19.6 to 40.1 lbs/acre per day). The conceptual TF design calculations for a stand-alone FTP were performed using ALR for BOD of 40 kg/ha per day (35.6 lbs/acre per day).

Neither the WTP Manual nor ***Recommended Standards for Wastewater Facilities*** [16] (Ten States Standards) provide a recommended ALR range for TSS. The conceptual TF design calculations for a stand-alone FTP were performed using ALR for TSS of 30 kg/ha per day (26.8 lbs/acre per day).

The HRT identified in the WTP Manual ranges from 5 to 180 days at average flow. In intermediate climates, the range narrows from approximately 50 days to 90 days. The conceptual TF design calculations for a stand-alone FTP were performed using minimum HRT of 90 days.

The depth of a FTP typically ranges from 0.9 m (3 ft) to 2.4 m (8 ft). An average depth of 8 feet was used for the FTP for this Appraisal Analysis to discourage growth of aquatic vegetation that could impede laminar flow and cause localized increases of velocity of flow. Ten States Standards recommends that a FTP should have at least three cells designed to facilitate both series and parallel operation. The maximum size of a cell should be approximately 16 ha (40 acres).

The ALR for BOD used for FTP conceptual design in hybrid alternatives (in which the FTP would be used to pre-treat IEI flows to the CW) was 80 kg/ha per day (71.3 lbs/acre per day) to achieve approximately 60% BOD removal. The minimum HRT used for FTP conceptual design in hybrid alternatives was 45 days to achieve approximately 80% TSS removal and approximately 44% BOD removal. These design criteria were estimated from discussion of treatment pond performance characteristics and supporting data in the WTP Manual.

As noted above, a multiplier of 1.30 was applied to the calculated FTP surface areas to account for necessary buffers, containment berms, access roads, etc. This multiplier was not developed to include extra trains that could provide FTP capacity greater than the design flows.

Constructed Wetland Design Criteria

The treatment process varies between the three Zones of a CW. Nevertheless, the Area Loading Rates recommended for BOD and TSS in the CW Manual [10] for a stand-alone FWS CW apply system-wide and do not vary by Zone. Similarly, though some seasonal variation in treatment effectiveness can occur in a CW, especially in colder climates, the Area Loading Rates recommended in the CW Manual for BOD and TSS for a stand-alone FWS CW are not specific to climate type or to seasonal factors.

The ALR range for BOD recommended in the CW Manual for a stand-alone FWS CW to treat average flow to meet or exceed EPA effluent standards (30 mg/L) is 40 to 60 kg/ha per day (35.6 to 53.6 lbs/acre per day). The conceptual TF design calculations for FWS CW were performed using 60 kg/ha per day (53.4 lbs/acre per day).

Similarly, the ALR range for TSS recommended in the CW Manual for a stand-alone FWS CW to treat average flow to meet or exceed EPA effluent standards (30 mg/L) is 30 to 50 kg/ha per day (26.8 to 44.5 lbs/acre per day). The conceptual TF design calculations for FWS CW were performed using 50 kg/ha per day (44.5 lbs/acre per day).

The treatment process variations between the three Zones of a CW do influence the recommended HRT in the CW Manual. For the emergent vegetative wetlands of Zones 1 and 3, the CW Manual recommends a maximum HRT of two days at average flow. HRT greater than two days in either Zone is not considered beneficial since the sedimentation and flocculation process has been effectively completed in that time and further removal of soluble constituents would not be expected due to anaerobic conditions in both Zones. For the submergent vegetation and open water surface wetlands of Zone 2, treatment is a function of both detention time and temperature. Algal growth generally starts to occur after two to three days and warmer climates favor short HRT at the low end of that range.

Therefore, the conceptual TF design calculations for a stand-alone FWS CW were performed using the sum of the HRT described for each of the three Zones, or six (6) days.

Zone 2 and Zone 3 may be repeated within a CW treatment train if additional Zone 2 detention time is necessary or desired to achieve the desired level of treatment. If Zone 2 and Zone 3 are repeated, then the total design HRT would increase to include the additional detention time in the repeated Zones.

The CW Manual recommends an outlet collection zone at the downstream end of Zone 3 (similar to the inlet settling zone in Zone 1 discussed above) to collect flows from the shallow, vegetated area for discharge to receiving waters. And, due to the anaerobic conditions that prevail in Zone 3, the CW Manual also recommends incorporating a mechanism for re-aeration of the flows prior to discharge to receiving waters. The greater depth and open water surface of an outlet collection zone could facilitate measures for aerating the flows.

As noted above, a multiplier of 1.30 was applied to the calculated CW surface areas to account for necessary buffers, containment berms, access roads, etc. This multiplier was not developed to include extra trains that could provide CW capacity greater than the design flows.

Constructed Wetland Facility Conceptual Design

Projections of flows in the proposed IEI and of the associated concentrations of BOD and TSS (as well as TDS) were discussed in Technical Memorandum No. 2 of this Appraisal Analysis. Projections were developed for the existing SAWPA service area in upper Santa Ana Watershed and for the potential SAWPA service area expansion in the San Gorgonio Pass and Coachella Valley areas.

The projected average flows, the average concentrations of BOD and TSS, and the associated annual BOD and TSS loads from TM2 for Year 2060 are presented in **Table 7** below.

Table 7 – Forecasted 2060 Inland Empire Interceptor BOD & TSS Loads

	Average Flow (2060)	BOD		TSS	
		Concen-tration	Load	Concen-tration	Load
	(MGD)	(mg/L)	(Tons/ Year)	(mg/L)	(Tons/ Year)
Existing SAWPA Service Area	32.1	285	13,942	510	24,937
Potential Coachella Valley Service Area Expansion	43.0	156	10,232	352	23,094
TOTAL	**75.1**	**211**	**24,174**	**420**	**48,031**

Calculations were performed to determine the minimum surface area of a stand-alone Free Water Surface Constructed Wetland (FWS CW) (TF Alternative 1) for the proposed Treatment Facility (TF) to meet or exceed EPA effluent standards (30 mg/L) for the flows and the TSS and BOD loads presented in **Table 7** above. Calculations were also performed to determine the minimum surface area of a stand-alone Facultative Wastewater Treatment Pond (FTP) (TF Alternative 2). These conceptual design calculations were performed for each TF alternative for each ALR and HRT discussed above. The results are summarized in **Table 8** below.

Table 8 – Stand-alone Constructed Wetland (TF Alternative 1) and Stand-alone Facultative Treatment Pond (TF Alternative 2) Discharges Treated to EPA Effluent Standards

	Avg. Flow (2060)	Minimum Surface Area (Acres)					
		Facultative Treatment Pond (2)			Constructed Wetland (1)		
		BOD	TSS	HRT	BOD	TSS	HRT
	(MGD)	ALR = 40 kg/ ha-day	ALR = 30 kg/ ha-day	90 days	ALR = 60 kg/ ha-day	ALR = 50 kg/ ha-day	6 days
Existing SAWPA Service Area	32.1	2,781	6,633	1,463	1,854	3,979	351
Expanded Service Area	**75.1**	**4,822**	**12,774**	**3,424**	**3,215**	**7,665**	**822**

The minimum surface area for either the stand-alone FWS CW (TF Alternative 1) or the stand-alone FTP (TF Alternative 2) for a given flow condition would be the largest calculated area for the given flow. For example, the minimum surface area for a FWS CW to treat the flows from the expanded service area (Alternative 1) would be approximately 7,665 acres or 12 square miles. Alternative designs were developed for consideration based on these results with the objective of optimizing the minimum surface area of the proposed TF.

The results presented in **Table 8** indicated the following:

- Facultative Treatment Pond (FTP) areas are smaller than the comparable FWS CW areas, which is reflective of the higher design area loading rates (ALR) for a FTP.
- Area loading rates (ALR) have a greater influence on the surface area of the proposed TF than hydraulic retention time (HRT).
- The surface area of the proposed TF could be reduced if higher area loading rates could be used.

- The ALR for TSS has a greater influence on the surface area of the proposed TF than the ALR for BOD.
- Because the TSS concentrations are higher and the ALR for TSS is lower than for BOD, TSS is the controlling parameter for determining the surface area of the proposed TF.
- The surface area of the proposed TF could be reduced if TSS concentrations in the flows could be reduced.

An alternative conceptual TF design (TF Alternative 3) was considered for which a FTP would be used to provide limited TSS and BOD removal (pre-treatment) prior to treatment of flows in a FWS CW, which would then discharge to the Salton Sea with TSS and BOD concentrations that would meet or exceed EPA effluent standards. Calculations were performed to determine the minimum surface areas of both the FTP and the FWS CW for this hybrid TF Alternative 3. The results are summarized in **Table 9** below.

Table 9 – Facultative Treatment Pond in Series with Constructed Wetland (TF Alternative 3) Discharges Treated to EPA Effluent Standards

	Avg. Flow (2060)	Minimum Surface Area (Acres)					
		Facultative Treatment Pond (3.1)			Constructed Wetland (3.2)		
		BOD	TSS	HRT	BOD	TSS	HRT
	(MGD)	ALR = 80 kg/ ha-day	N.A.	45 days	ALR = 60 kg/ ha-day	ALR = 50 kg/ ha-day	6 days
Existing SAWPA Service Area	32.1	1,391	N.A.	731	1,039	796	351
Expanded Service Area	**75.1**	**2,411**	**N.A.**	**1,712**	**1,800**	**1,533**	**822**

The combined minimum surface area for a FTP (2,411 acres) and FWS CW (1,800 acres) operating in series to treat the flows from the expanded service area would be approximately 4,211 acres or nearly 7 square miles. Though large, this hybrid TF area would be significantly less than the area of either a stand-alone FTP or a stand-alone FWS CW as presented in **Table 8**.

As discussed previously in this TM3, the water quality standards in the Basin Plan for discharges to the Salton Sea discourage new flows to the Sea that could contribute to its restoration. This concept gave rise to consideration in this Appraisal Analysis of TF alternatives under which effluent TSS and BOD concentrations would be higher than EPA effluent standards but lower than existing concentrations in the Salton Sea.

One such TF alternative would be a stand-alone FWS CW designed to treat a portion of the IEI flows with the effluent then blended with the balance of the IEI flows to provide discharge with average TSS concentration of approximately 200 mg/L. Calculations were performed to determine the minimum surface areas of the wastewater treatment pond and the constructed wetland for this alternative (TF Alternative 4). The results are summarized in **Table 10** below.

Table 10 – Stand-alone Constructed Wetland Treatment of Partial Flow (TF Alternative 4) Blended Discharges with 200 mg/L± TSS Concentration

	Avg. Flow (2060)	Minimum Surface Area (Acres)		
		BOD	TSS	HRT
	(MGD)	ALR = 60 kg/ha-day	ALR = 50 kg/ha-day	6 days
Existing SAWPA Service Area	32.1	1,106	2,653	234
Expanded Service Area	**75.1**	**1,641**	**4,560**	**489**

The minimum surface area for the stand-alone FWS CW to provide treatment of partial flows from the expanded service area for blending to produce discharges with average TSS concentration of approximately 200 mg/L (TF Alternative 4) would be approximately 4,560 acres, over 7 square miles. This area is similar to the combined area of a FTP and FWS CW operating in series to meet or exceed EPA effluent standards (TF Alternative 3) as presented in **Table 9**.

TF Alternative 5 was considered to incorporate aspects of TF Alternatives 3 and 4. As in TF Alternative 3, a FTP would be used to provide pre-treatment of partial flows prior to treatment in a FWS CW. As in TF Alternative 4, the partial flows would be blended with the balance of the IEI flows to produce discharges with average TSS concentration of approximately 200 mg/L. Calculations were performed to determine the minimum surface areas of both the FTP and the FWS CW for this hybrid design (TF Alternative 5). The results are summarized in **Table 11** on the next page.

Table 11 – Facultative Treatment Pond in Series with Constructed Wetland Treatment of Partial Flow (TF Alternative 5)
Blended Discharges with 200 mg/L± TSS Concentration

	Avg. Flow (2060)	Minimum Surface Area (Acres)					
		Facultative Treatment Pond (5.1)			Constructed Wetland (5.2)		
		BOD ALR	TSS ALR	HRT	BOD ALR	TSS ALR	HRT
	(MGD)	80 kg/ ha-day	N.A.	45 days	60 kg/ ha-day	50 kg/ ha-day	6 days
Existing SAWPA Service Area	32.1	927	N.A.	488	693	312	234
Expanded Service Area	**75.1**	**1,434**	**N.A.**	**1,019**	**1,071**	**731**	**489**

The combined minimum surface area for a FTP (1,434 acres) and FWS CW (1,071 acres) operating in series to treat the flows from the expanded service area would be approximately 2,505 acres or nearly 4 square miles. Though large, the TF Alternative 5 surface area is significantly less than the areas of the other TF alternatives considered above.

The wide range of the calculated minimum surface areas for the TF alternatives considered suggests that adoption of flexible standards for TSS and BOD concentrations in discharges to the Salton Sea could dramatically affect the size of facilities necessary to treat the proposed IEI flows.

PERMIT REQUIREMENTS

Background

The proposed Inland Empire Interceptor (IEI) is located in the upper Santa Ana Watershed and in areas tributary to the Salton Sea, which is a part of the Colorado River Watershed. The Salton Sea would be the receiving water body for the proposed IEI; and the discharges from the project would be subject to the requirements of the US Clean Water Act and the California Porter-Cologne Water Quality Control Act.

Categories

Various permits, certifications, agreements and other approvals are typically necessary to construct major utility projects like the proposed IEI. These approvals fall into several major categories, which include the following:

- Legal considerations.
- Environmental and drainage permits, certifications and other approvals.
- Rights-of-way and easements acquisition.
- Encroachment permits for existing easements and rights-of-way.
- Land use approvals.
- Construction permits and approvals.

Legal Considerations

Legal considerations would likely include a water rights decision from the State of California under the Porter-Cologne regarding the proposed transfer of brine from the Santa Ana Watershed to the Salton Sea. This water rights decision would likely be a significant factor in the review by California Regional Water Quality Control Board, Colorado River Basin Region (CRWQCB) of an amendment to the Colorado River Basin Water Quality Control Plan (Basin Plan) for the proposed IEI.

Environmental and Drainage Approvals

Permits, certifications and other approvals required from federal, state and local governmental entities for environmental and drainage aspects of major utility projects like the proposed IEI typically include reviews and approvals of the project for potential environmental impacts. Federal permits and other approvals that may be required include:

- CWA Environmental Impact Review (EIR) process.
- CWA Section 404 permit(s).

Permits and other approvals that may be required from the State of California include:

- Basin Plan Amendment.
- NPDES permit(s).
- CWA Section 401 Certification(s).
- SWPP permit(s).
- Lake/Streambed Alteration Agreement(s) from California Department of Fish and Game.
- California Endangered Species Act Section 2081 Incidental Take permit(s).

Rights-of-Way and Easements Acquisition

The alignment alternatives considered in this Appraisal Analysis are generally proposed to be located in or adjoining existing transportation, drainage and/or utility corridors (public or private) wherever possible to minimize acquisition costs for easements or right-of-way necessary for the proposed IEI. Some portions of the proposed IEI alignments are located adjoining (but outside of) the existing rights-of-way or easements for existing facilities that are not likely to be compatible with the proposed IEI, including freeways, railroads, gas mains, etc. Acquisition of rights-of-way or easements would be necessary for those portions of the IEI project. Acquisition agreements may be required with governmental entities, sovereign entities, private organizations and/or individuals with ownership interest in lands along the alignments under consideration.

Sovereign entities with land ownership along the proposed alignments include the Morongo Band of Mission Indians and the Torres-Martinez Band of Mission Indians. Both of the proposed CV Alignments cross Morongo Band lands. The preferred location of the proposed TF may be on Torres-Martinez Band lands. There may also be other sovereign entities with ownership interests in lands along the alignments under consideration for this project from whom easements or rights-of-way may need to be acquired.

Encroachment Permits for Existing Rights-of-Way and Easements

As noted above, the alignment alternatives considered in this Appraisal Analysis are generally proposed to be located in or adjoining existing transportation, drainage and/or utility corridors (public or private) wherever possible. Crossings of existing easements or right-of-way for those facilities or other encroachments are certain to be necessary for a project of this type. Appropriate consideration for these crossings will be a necessary part of planning and design for the project.

Encroachment agreements or permits would be required for such crossings other encroachments for the proposed IEI from the public, private and/or sovereign entities with ownership and/or easement rights in any such existing easements or rights-of-way. The encroachment approvals required for this IEI project would likely include:

- Caltrans encroachment permit(s).
- Local governmental entity encroachment permit(s).
- Special district encroachment permit(s).
- UPRR right-of-way encroachment agreement(s).
- Right-of-way or easement encroachment agreement(s) with privately (or publicly) owned utilities, including power companies and gas companies.

Land Use Approvals

Land use approvals would typically be required from local governmental entities for a project of this type, in particular for above-ground facilities, such as pump stations, that would be located on land parcels distinct from public rights-of-way and easements. Land use approvals that may be required from local governmental entities for this IEI project include:

- Comprehensive Plan Amendment(s)
- Zoning Variance(s) and Waiver(s)
- Special Use Permit(s)
- Conditional Use Permit(s)

Construction Permits and Approvals

Various other construction permits and approvals are typically required from local governmental entities and special districts for major utility projects like the proposed IEI. These approvals typically include review of improvement plans and maps.

APPENDIX A – GIS EXHIBITS

Santa Ana Watershed Alignments

The routes for each of the SAW Alignments are depicted on separate 11” X 17” **Exhibits** in plan view on GIS base maps with stationing and matching profile of the existing topography along the route. These **Exhibits** are provided as pdf files separate from this TM3 due to the large file sizes and are identified as follows:

Exhibit 1 – Gas Main Alignment	(6 pages)
Exhibit 2 – North Alignment	(7 pages)
Exhibit 3 – EMWD North Alignment	(3 pages)
Exhibit 4 – IEBL Alignment	(1 page)
Exhibit 5 – IEUA Alignment	(1 page)

Coachella Valley Alignments Exhibits

Like the SAW Alignments, the routes for each of the two CV Alignments are depicted on separate 11” X 17” **Exhibits** in plan view on GIS base maps with stationing and matching profile of the existing topography along the route. These **Exhibits** are provided as pdf files separate from this TM3 due to the large file sizes and are identified as follows:

Exhibit 6 – CV Alignment A (Coachella Canal)	(11 pages)
Exhibit 7 – CV Alignment B (CV Stormwater Channel)	(11 pages)

APPENDIX B – CONCEPTUAL DESIGNS & HYDRAULIC ANALYSES RESULTS

Santa Ana Watershed Alternatives

As discussed in the "Hydraulic Analysis" section of this TM3, the results of the hydraulic analysis and the profile of the hydraulic grade line (HGL) for each of the SAW Alternatives considered are summarized in **Tables** and on **Exhibits** provided in this **Appendix B**. **Table 5** from the "Hydraulic Analyses" section of this TM3 is repeated below for convenience.

Table 5 – Santa Ana Watershed Alternatives Hydraulic Analyses

SAW Alternative No.	Hydraulic Analysis Results Table No.	Pump Stations Design Table No.	HGL Profile Exhibit Nos.
1	12	13	8 & 9
2	14	15	10
4	16	17	11, 12 & 13

Note: SAW Alternative 3 was not selected for further consideration due to large estimated construction costs.

Table 12 – SAW Alternative 1 - Summary of WaterCAD Results for Pipe Segments

Pipe Segment Label	Segment Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Segment End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)	Seg-ment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
IEBL-1a	0 + 02	424.7	590.0	71.6	23 + 21	445.5	587.9	61.6	2,321	42	15,312	3.55	0.00089
IEBL-1b	23 + 21	445.5	587.9	61.6	107 + 24	468.5	580.5	48.4	8,403	42	15,312	3.55	0.00089
IEBL-1c	107 + 24	468.5	580.5	48.4	123 + 51	546.3	579.0	14.2	1,627	42	15,312	3.55	0.00089
IEBL-1d	123 + 51	546.3	579.0	14.2	125 + 84	477.5	578.8	43.8	233	42	15,312	3.55	0.00089
G-1a	125 + 84	477.5	578.8	43.8	286 + 96	543.4	564.5	9.1	16,112	42	15,312	3.55	0.00089
G-1b	286 + 96	543.4	734.5	82.8	650 + 05	693.3	702.3	3.8	36,309	42	15,312	3.55	0.00089
G-2a	650 + 05	693.3	1,102.3	177.2	871 + 17	890.2	1,082.6	83.3	22,112	42	15,312	3.55	0.00089
G-2b	871 + 17	890.2	1,082.6	83.3	947 + 74	1,063.2	1,075.8	5.4	7,657	42	15,312	3.55	0.00089
G-3a	947 + 74	1,063.2	1,355.8	126.8	1020 + 48	1,335.8	1,349.4	5.9	7,275	42	15,312	3.55	0.00089
G-3b	1020 + 48	1,335.8	1,349.4	5.9	1070 + 15	1,095.4	1,345.0	108.0	4,967	42	15,312	3.55	0.00089
G-3c	1070 + 15	1,095.4	1,345.0	108.0	1100 + 00	1,124.3	1,342.3	94.4	2,985	42	15,312	3.55	0.00089
G-4a	1100 + 00	1,124.3	1,712.3	254.8	1167 + 92	1,599.0	1,706.3	46.4	6,792	42	15,312	3.55	0.00089
G-4b	1167 + 92	1,599.0	1,706.3	46.4	1276 + 09	1,690.4	1,696.7	2.7	10,817	42	15,312	3.55	0.00089
G-4c	1276 + 09	1,690.4	1,696.7	2.7	1416 + 07	1,512.5	1,684.3	74.3	13,998	42	15,312	3.55	0.00089
G-4d	1416 + 07	1,512.5	1,684.3	74.3	1750 + 80	1,584.3	1,654.5	30.4	33,473	42	15,312	3.63	0.00089
G-4e	1750 + 80	1,584.3	1,654.5	30.4	1911 + 42	1,570.5	1,649.9	34.3	16,062	54	25,937	3.63	0.00069
G-5a	1911 + 42	1,570.5	1,993.4	183.2	2045 + 50	1,783.0	1,984.1	89.9	13,408	54	25,937	3.63	0.00069
G-5b	2045 + 50	1,783.0	1,984.1	89.9	2070 + 00	1,951.9	1,982.4	13.1	2,450	54	25,937	3.63	0.00069
G-6a	2070 + 00	1,951.9	2,632.4	294.9	2124 + 47	2,490.0	2,628.6	60.0	5,447	54	25,937	3.63	0.00069
G-6b	2124 + 47	2,490.0	2,628.6	60.0	2165 + 65	2,217.8	2,625.8	176.5	4,119	54	25,937	3.63	0.00069
G-6c	2165 + 65	2,217.8	2,625.8	176.5	2348 + 70	2,488.2	2,613.1	54.0	18,305	54	25,937	3.63	0.00069
G-6d	2348 + 70	2,488.2	2,613.1	54.0	2412 + 38	2,576.0	2,608.7	14.1	6,365	54	25,937	3.63	0.00069
EN-1a	0 + 02	1,412.5	1487.5	32.4	126 + 60	1,436.5	1,467.4	13.4	12,660	30	8,650	3.93	0.00159
EN-1b	126 + 60	1,436.5	1,467.4	13.4	300 + 00	1,405.5	1,439.8	14.9	17,353	30	8,650	3.93	0.00159
EN-1c	300 + 00	1,405.5	1,439.8	14.9	440 + 00	1,413.4	1,417.6	1.7	13,986	30	8,650	3.93	0.00159
EN-2a	440 + 00	1,413.4	1,734.0	138.9	800 + 06	1,488.7	1,676.8	81.5	36,006	30	8,650	3.93	0.00159
EN-2b	800 + 06	1,488.7	1,676.8	81.5	871 + 18	1,601.1	1,665.4	27.8	7,178	30	8,650	3.93	0.00159
EN-2c	871 + 18	1,601.1	1,665.4	27.8	941 + 01	1,584.3	1,654.5	30.3	6,917	30	8,650	3.93	0.00159

Note: Segment G-4e Start at Station 1750+80 is the point of connection of EMWD North Alignment (Segment EN-2c End) at Station 941+01.

Table 13 – SAW Alternative 1 - Summary of WaterCAD Results for Pump Stations

Pipe Segment Label	Pump Station Label	P. S. Location (Station)	Pipe Elevation (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Pump Design Head (ft)	Pump Size (HP)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
IEBL-1a	**1-BL**	0 + 02	424.7	440.0	6.6	15,312	150	725	590.0	71.6
G-1b	**1-G**	286 + 96	543.4	564.5	9.1	15,312	170	822	734.5	82.8
G-2a	**2-G**	650 + 05	693.3	702.3	3.8	15,312	400	1,933	1,102.3	177.2
G-3a	**3-G**	947 + 74	1,063.2	1,075.8	5.4	15,312	280	1,353	1,355.8	126.8
G-4a	**4-G**	1100 + 00	1,124.3	1,342.3	94.4	15,312	370	1,788	1,712.3	254.8
G-5a	**5-G**	1911 + 42	1,570.5	1,649.9	34.3	25,937	344	2,812	1,993.4	183.2
G-6a	**6-G**	2070 + 00	1,951.9	1,982.4	13.1	25,937	650	5,322	2,632.4	294.9
EN-1a	**1-EN**	0 + 02	1,412.5	1,422.5	4.3	8,650	65	177	1,487.5	32.4
EN-2a	**2-EN**	440 + 00	1,413.4	1,417.6	1.7	8,650	316	864	1,734.0	138.9

Exhibit 8 - SAW Alternative 1 - Profile of Gas Main & IEBL Alignments

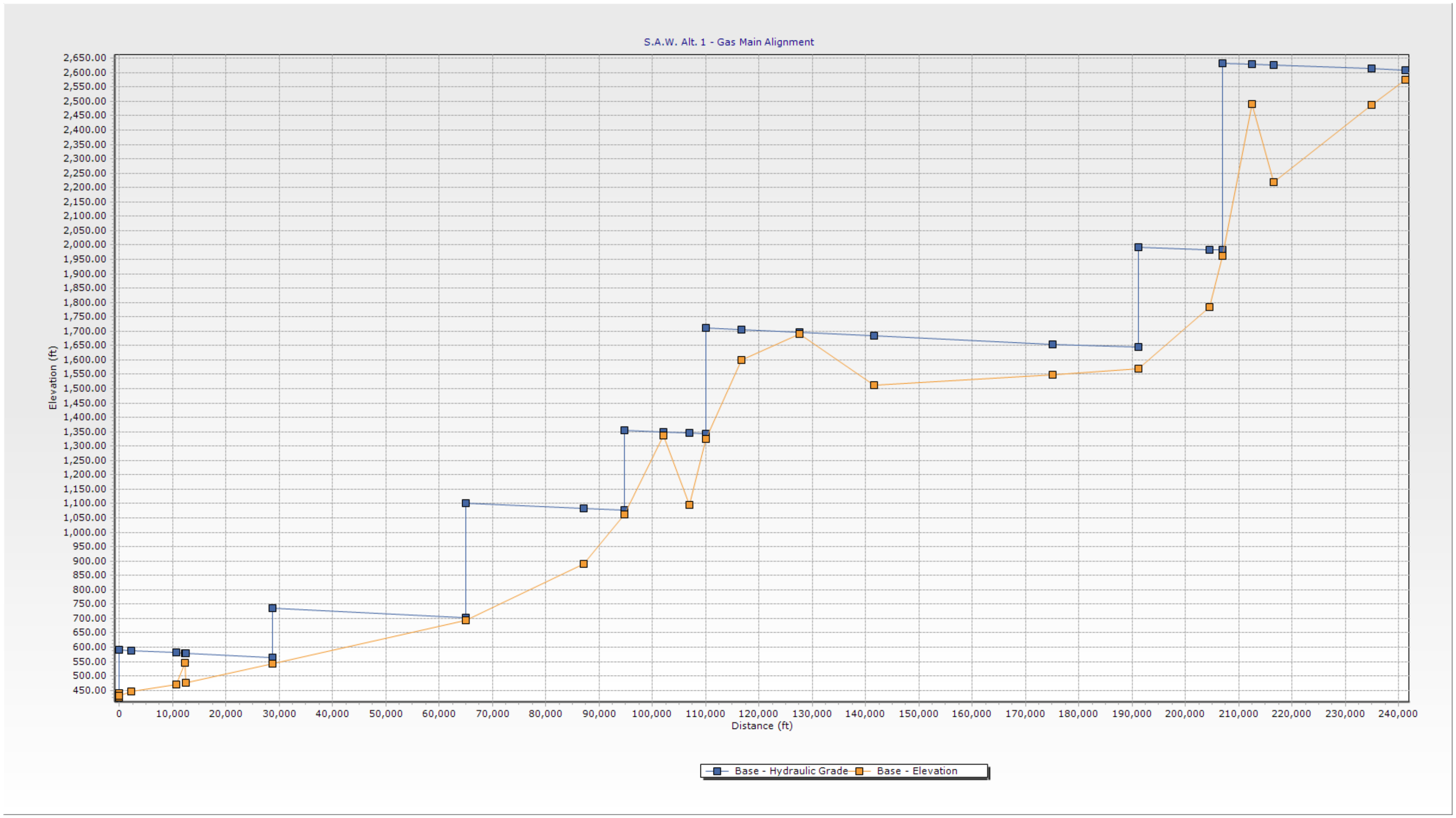


Exhibit 9 - SAW Alternative 1 – Profile of EMWD Alignment

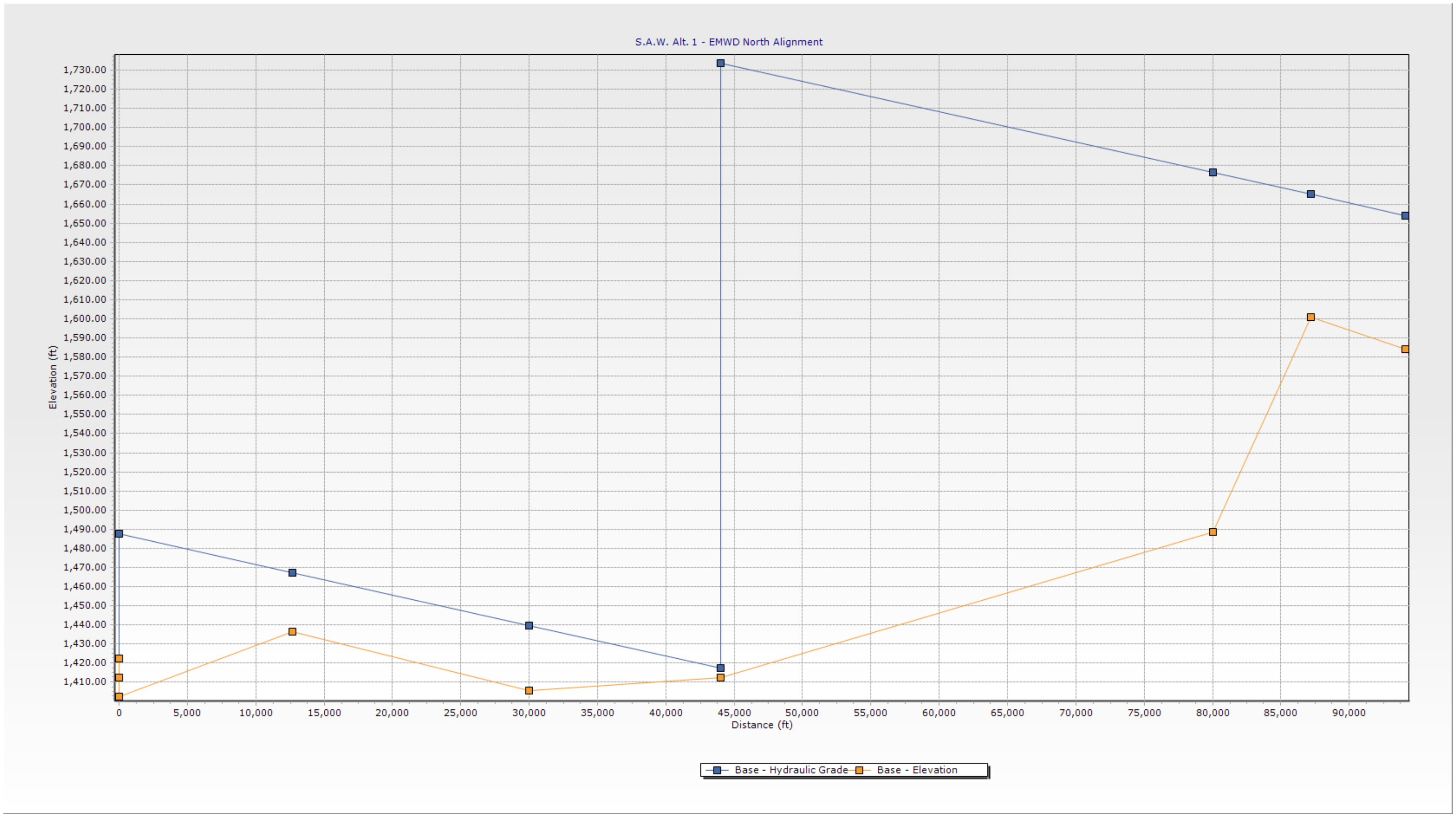


Table 14 – SAW Alternative 2 - Summary of WaterCAD Results for Pipe Segments

Pipe Segment Label	Segment Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Segment End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)	Seg-ment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
IEBL-1a	0 + 02	424.7	590.0	71.6	23 + 21	445.5	588.4	61.8	2,321	54	25,937	3.63	0.00069
IEBL-1b	23 + 21	445.5	588.4	61.8	107 + 24	468.5	582.6	49.4	8,403	54	25,937	3.63	0.00069
IEBL-1c	107 + 24	468.5	582.6	49.4	123 + 51	546.3	581.4	15.2	1,627	54	25,937	3.63	0.00069
IEBL-1d	123 + 51	546.3	581.4	15.2	125 + 84	477.5	581.3	44.9	233	54	25,937	3.63	0.00069
G-1a	125 + 84	477.5	581.3	44.9	286 + 96	543.4	570.1	11.5	16,112	54	25,937	3.63	0.00069
G-1b	286 + 96	543.4	720.1	76.5	650 + 05	693.3	695.0	0.6	36,309	54	25,937	3.63	0.00069
G-2a	650 + 05	693.3	1,085.0	169.7	871 + 17	890.2	1,069.6	77.6	22,112	54	25,937	3.63	0.00069
G-2b	871 + 17	890.2	1,069.6	77.6	947 + 74	1,063.2	1,064.3	0.4	7,657	54	25,937	3.63	0.00069
G-3a	947 + 74	1,063.2	1,344.3	121.8	1020 + 48	1,335.8	1,339.3	1.5	7,275	54	25,937	3.63	0.00069
G-3b	1020 + 48	1,335.8	1,339.3	1.5	1070 + 15	1,095.4	1,335.9	104.0	4,967	54	25,937	3.63	0.00069
G-3c	1070 + 15	1,095.4	1,335.9	104.0	1100 + 00	1,124.3	1,333.8	90.7	2,985	54	25,937	3.63	0.00069
G-4a	1100 + 00	1,124.3	1,703.8	251.1	1167 + 92	1,599.0	1,699.1	43.3	6,792	54	25,937	3.63	0.00069
G-4b	1167 + 92	1,599.0	1,699.1	43.3	1276 + 9	1,690.4	1,691.6	0.5	10,817	54	25,937	3.63	0.00069
G-4c	1276 + 09	1,690.4	1,691.6	0.5	1354 + 56	1,602.7	1,686.1	36.1	7,848	54	25,937	3.63	0.00069
G-4d	1354 + 56	1,602.7	1,686.1	36.1	1416 + 07	1,512.5	1,681.9	73.3	6,151	54	25,937	3.63	0.00069
G-4e	1416 + 07	1,512.5	1,681.9	73.3	1750 + 80	1,549.7	1,658.7	47.2	33,473	54	25,937	3.63	0.00069
G-4f	1750 + 80	1,549.7	1,658.7	47.2	1911 + 42	1,570.5	1,647.5	33.3	16,062	54	25,937	3.63	0.00069
G-5a	1911 + 42	1,570.5	1,987.5	180.7	2045 + 50	1,783.0	1,978.3	89.9	13,408	54	25,937	3.63	0.00069
G-5b	2045 + 50	1,783.0	1,978.3	89.9	2070 + 00	1,951.9	1,976.6	10.6	2,450	54	25,937	3.63	0.00069
G-6a	2070 + 00	1,951.9	2,631.6	294.5	2111 + 99	2,390.4	2,628.7	103.1	4,199	54	25,937	3.63	0.00069
G-6b	2111 + 99	2,390.4	2,628.7	103.1	2124 + 47	2,490.0	2,627.8	59.6	1,248	54	25,937	3.63	0.00069
G-6c	2124 + 47	2,490.0	2,627.8	59.6	2165 + 65	2,217.8	2,624.9	176.1	4,119	54	25,937	3.63	0.00069
G-6d	2165 + 65	2,217.8	2,624.9	176.1	2348 + 70	2,488.2	2,612.3	53.7	18,305	54	25,937	3.63	0.00069
G-6e	2348 + 70	2,488.2	2,612.3	53.7	2412 + 38	2,576.0	2607.8	13.8	6,365	54	25,937	3.63	0.00069

Table 15 – SAW Alternative 2 - Summary of WaterCAD Results for Pump Stations

Pipe Segment Label	Pump Station Label	P. S. Location (Station)			Pipe Elevation (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Pump Design Head (ft)	Pump Size (HP)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
IEBL-1a	**1-BL**	0	+	02	424.7	440.0	6.6	25,937	150	1,228	590.0	71.6
G-1b	**1-G**	286	+	96	543.4	570.1	11.5	25,937	150	1,228	720.1	76.5
G-2a	**2-G**	650	+	05	693.3	695.0	0.6	25,937	390	3,193	1,085.0	169.7
G-3a	**3-G**	947	+	74	1,063.2	1,064.3	0.4	25,937	280	2,292	1,344.3	121.8
G-4a	**4-G**	1100	+	00	1,124.3	1,333.8	90.7	25,937	370	3,029	1,703.8	251.1
G-5a	**5-G**	1911	+	42	1,570.5	1,647.5	33.3	25,937	340	2,784	1,987.5	180.7
G-6a	**6-G**	2070	+	00	1,951.9	1,988.9	16.0	25,937	655	5,363	2,631.6	294.5

Exhibit 10 - SAW Alternative 2 - Profile of Gas Main & IEBL Alignments

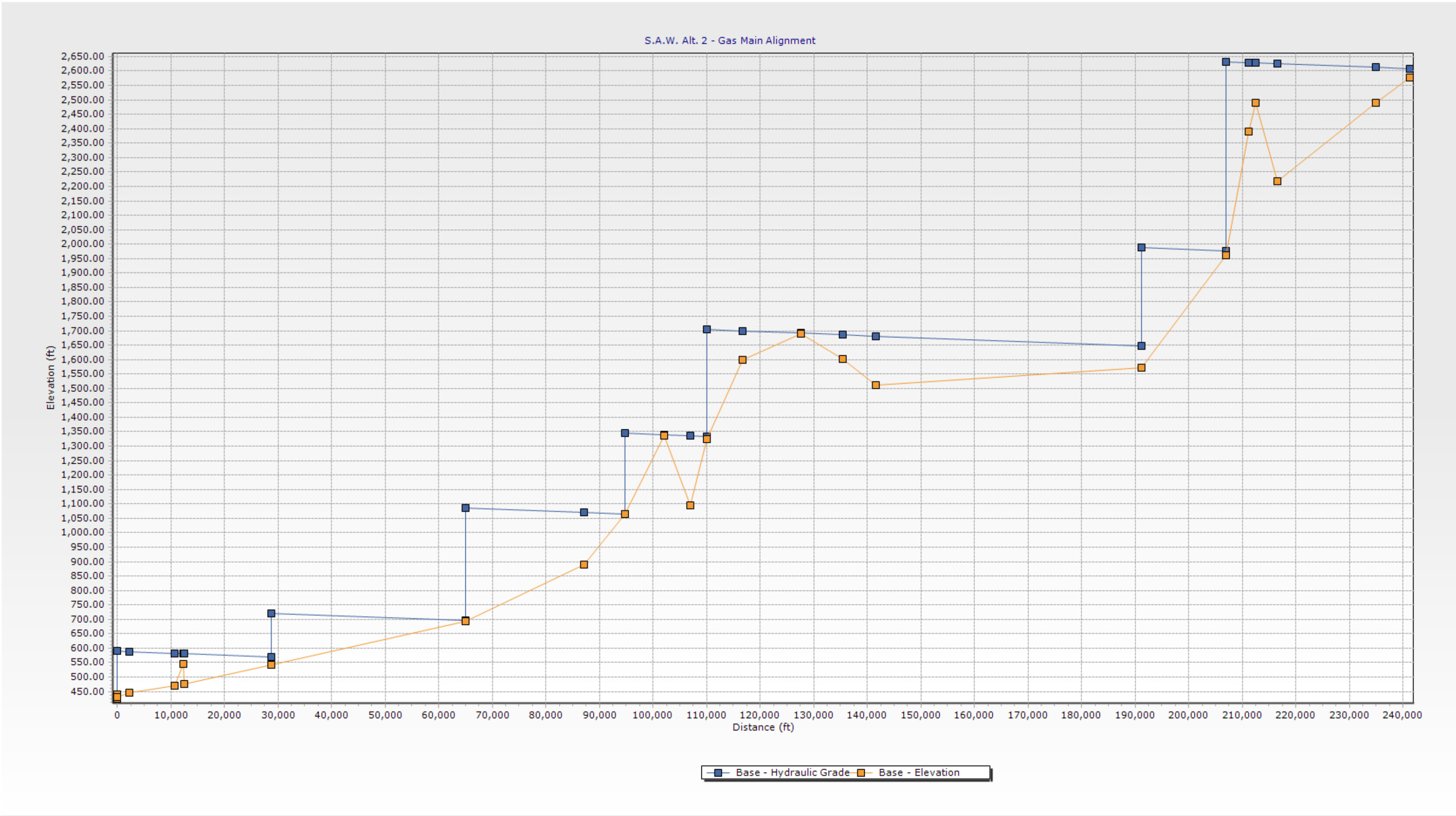


Table 16 – SAW Alternative 4 - Summary of WaterCAD Results for Pipe Segments

Pipe Segment Label	Segment Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Segment End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)	Seg-ment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
IEBL-1a	0 + 02	424.7	663.3	55.6	23 + 21	445.5	660.9	93.3	2,321	42	15,590	3.61	0.00092
IEBL-1b	23 + 21	445.5	661.9	93.3	107 + 24	468.5	653.2	80.0	8,403	42	15,590	3.61	0.00092
IEBL-1c	107 + 24	468.5	653.2	80.0	123 + 51	546.3	651.7	45.6	1,627	42	15,590	3.61	0.00092
IEBL-1d	123 + 51	546.3	651.7	45.6	125 + 84	477.5	651.4	75.3	233	42	15,590	3.61	0.00092
IEBL-2	125 + 84	477.5	651.4	75.3	365 + 47	548.4	629.8	35.2	23,963	42	15,590	3.61	0.00092
IEUA-1	0 + 01	570.9	640.0	29.9	89 + 99	586.6	639.2	22.8	8,999	16	347	0.55	0.000088
N-1a	0 + 00	586.6	639.2	22.8	54 + 34	548.4	629.8	35.2	5,434	16	1,736	2.77	0.00173
N-1b	54 + 34	548.4	629.8	35.2	60 + 20	539.1	629.1	39.0	586	42	17,326	4.01	0.00112
N-1c	60 + 20	539.1	854.1	136.5	580 + 00	734.4	787.2	22.8	51,980	42	18,715	4.33	0.00129
N-1d	580 + 00	734.4	787.2	22.8	705 + 00	740.2	767.6	11.8	12,500	42	20,798	4.82	0.00157
N-2a	705 + 00	740.2	1,067.6	141.8	715 + 00	754.1	1,066.1	135.2	1,000	42	20,798	4.82	0.00157
N-2b	715 + 00	754.1	1,066.1	135.2	839 + 33	907.6	1,046.0	59.9	12,433	42	21,145	4.9	0.00161
N-2c	839 + 33	907.6	1,046.0	59.9	878 + 75	824.7	1,039.6	93.0	3,942	42	21,145	4.9	0.00161
N-2d	878 + 75	824.7	1,039.6	93.0	1020 + 00	873.8	1,016.8	61.9	14,125	42	21,145	4.9	0.00161
N-2e	1020 + 00	873.8	1,016.8	61.9	1350 + 19	926.4	952.3	11.2	33,019	42	23,437	5.43	0.00195
N-3a	1350 + 19	926.4	1,427.3	217.1	1424 + 00	953.6	1,412.9	199.0	7,381	42	23,437	5.43	0.00195
N-3b	1424 + 00	953.6	1,412.9	199.0	1800 + 16	1,303.8	1,324.2	8.8	37,616	42	25,937	6.01	0.00236
N-4a	1800 + 16	1,303.8	1,824.2	225.5	2020 + 00	1,667.4	1,772.4	45.4	21,984	42	25,937	6.01	0.00236
N-4b	2020 + 00	1,667.4	1,772.4	45.4	2050 + 18	1,758.8	1,770.3	4.9	3,018	54	25,937	3.63	0.00069
N-5	2050 + 18	1,758.8	2,210.3	195.7	2300 + 18	2,174.5	2,193.0	7.9	25,000	54	25,937	3.63	0.00069
N-6a	2300 + 18	2,174.5	2,413.0	103.3	2402 + 87	2,402.3	2,405.9	1.6	10,269	54	25,937	3.63	0.00069
N-6b	2402 + 87	2,402.3	2,405.9	1.6	2498 + 01	2,268.1	2,399.3	56.7	9,514	54	25,937	3.63	0.00069
N-6c	2498 + 01	2,268.1	2,399.3	56.7	2530 + 39	2,339.1	2,397.1	25.0	3,238	54	25,937	3.63	0.00069
N-7	2530 + 39	2,339.1	2,627.1	124.7	2789 + 24	2,576.0	2,609.8	14.6	25,885	54	25,937	3.63	0.00069

Notes: Segment N-1a Start at Station 0+00 is the point of connection of IEUA Alignment (Segment IEUA-1 End) at Station 89+99.
Segment N-1b Start at Station 54+34 is the point of connection of IEBL Alignment (Segment IEBL-2 End) at Station 365+47.

Table 17 – SAW Alternative 4 - Summary of WaterCAD Results for Pump Stations

Pipe Segment Label	Pump Station Label	P. S. Location (Station)	Pipe Elevation (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Pump Design Head (ft)	Pump Size (HP)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
IEBL-1a	**1-BL**	0 + 02	424.7	440.3	6.6	15,590	223	1,097	660.3	55.6
IEUA-1	**1-IE**	0 + 01	570.9	590.0	8.2	347	50	5	640.0	29.9
N-1c	**1-N**	60 + 20	539.1	629.1	39.0	18,715	225	1,329	854.1	136.5
N-2a	**2-N**	705 + 00	740.2	767.6	11.8	20,798	300	1,970	1,067.6	141.8
N-3a	**3-N**	1350 + 19	926.4	952.3	11.2	23,437	475	3,514	1,427.3	217.1
N-4a	**4-N**	1800 + 16	1,303.8	1,324.2	8.8	25,937	500	4,094	1,824.2	225.5
N-5	**5-N**	2050 + 18	1,758.8	1,770.3	4.9	25,937	440	3,602	2,210.3	195.7
N-6a	**6-N**	2300 + 18	2,174.5	2,193.0	7.9	25,937	220	1,801	24,13.0	103.3
N-7	**7-N**	2530 + 39	2,339.1	2,397.1	25.0	25,937	230	1,883	2,627.1	124.7

Exhibit 11 - SAW Alternative 4 - Profile of North Alignment

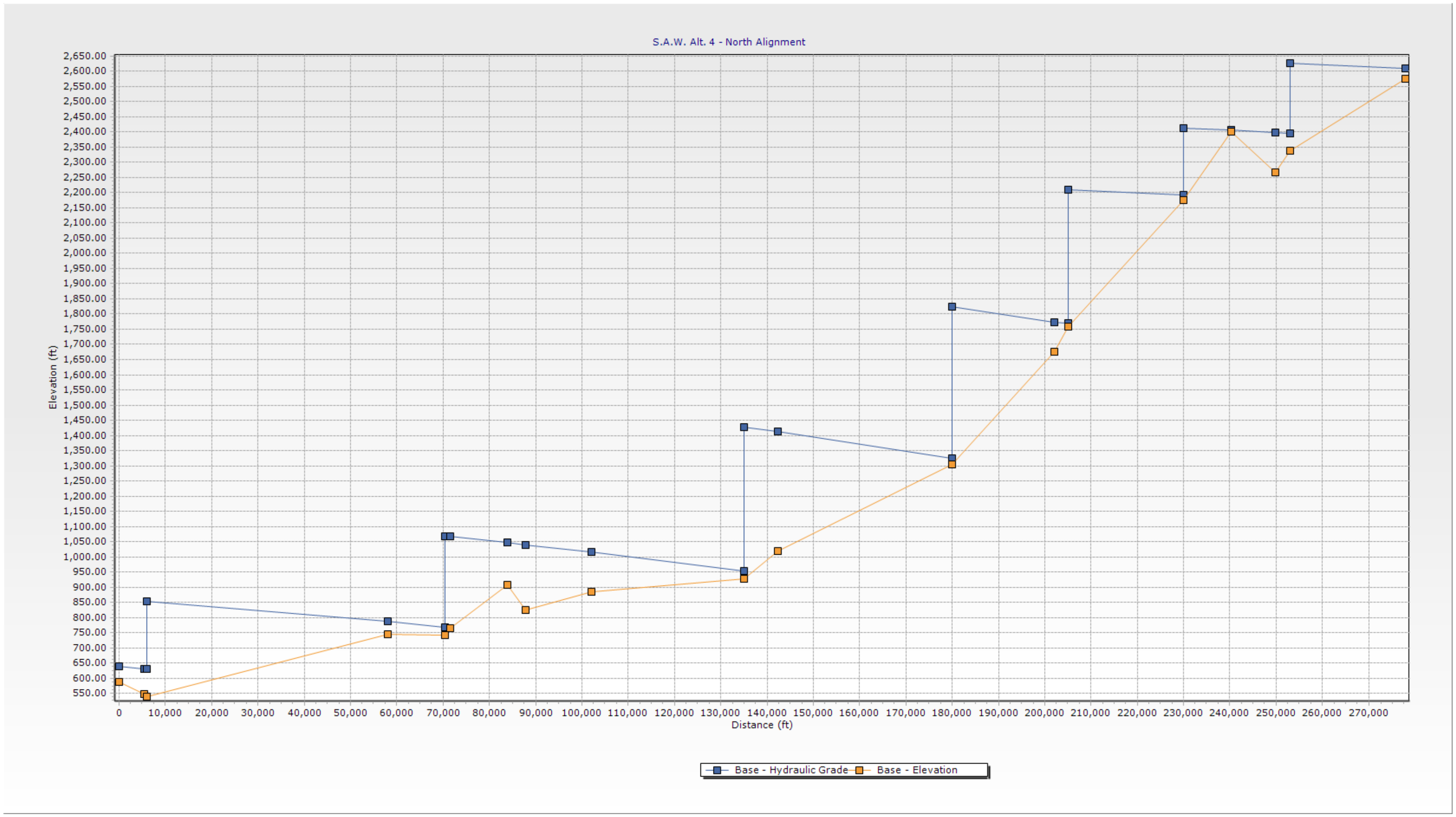


Exhibit 12 - SAW Alternative 4 - Profile of IEBL Alignment

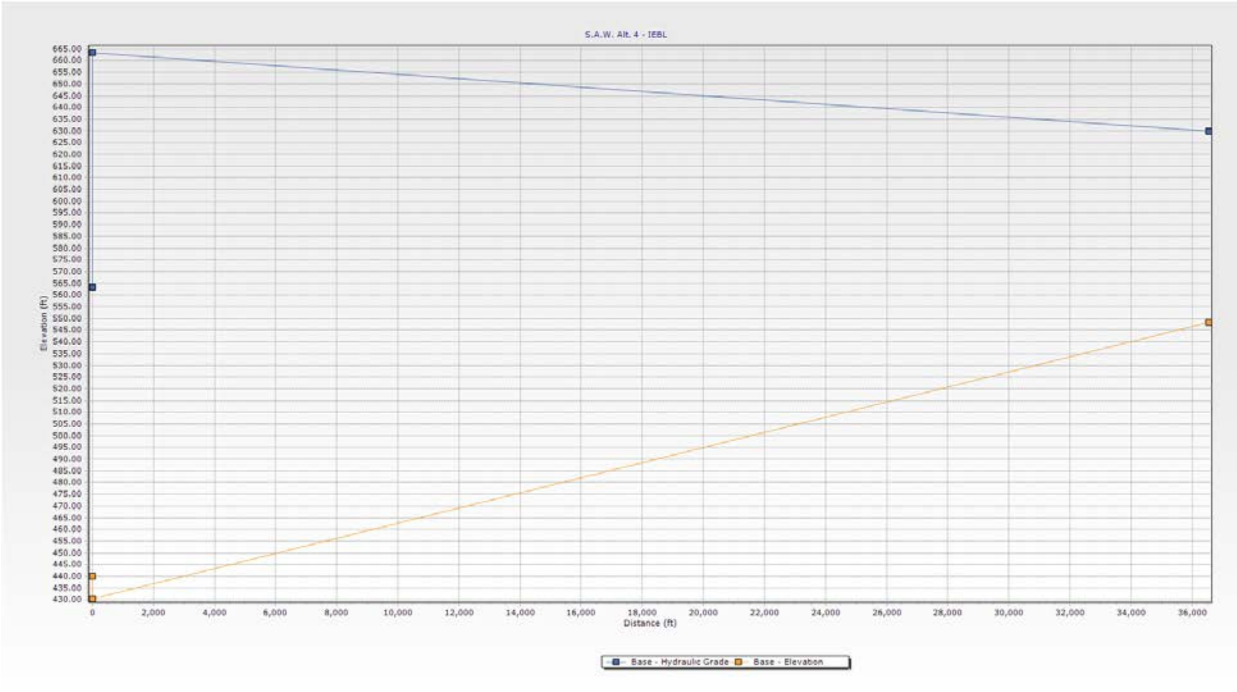
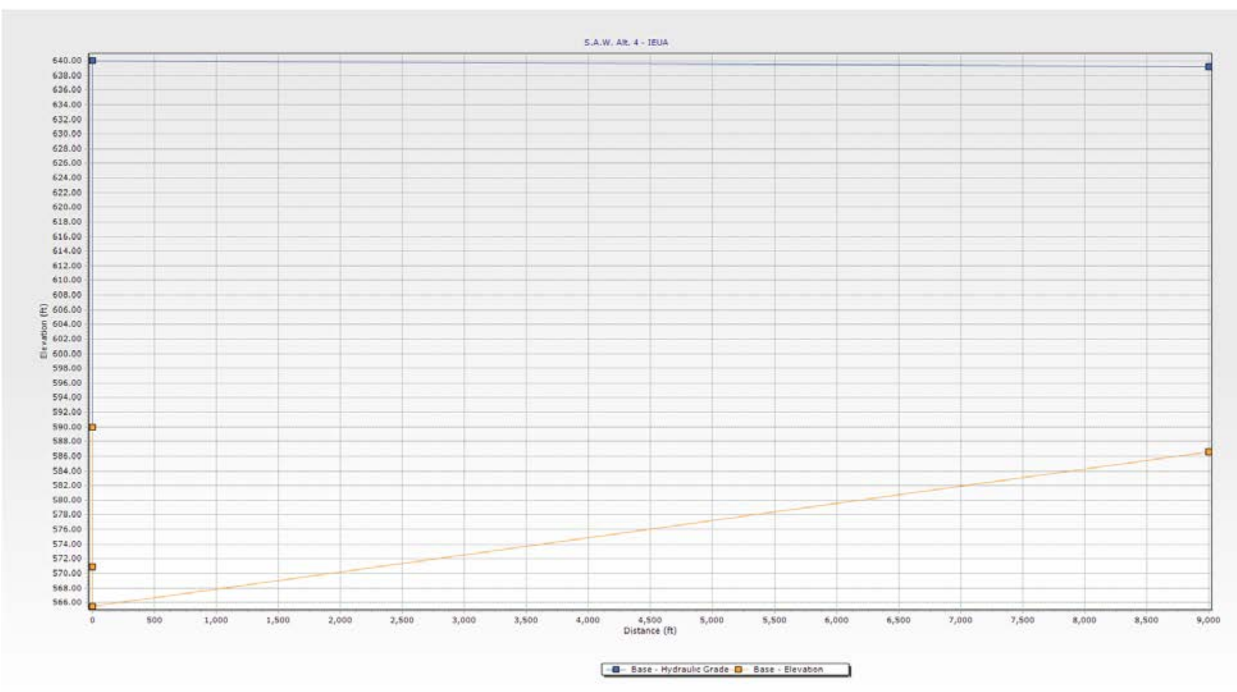


Exhibit 13 - SAW Alternative 4 - Profile of IEUA Alignment



Coachella Valley Alternatives

As discussed in the "Hydraulic Analysis" section of this TM3, the results of the hydraulic analysis and the profile of the hydraulic grade line (HGL) for each of the CV Alternatives considered are summarized in **Tables** and on **Exhibits** provided in this **Appendix B**. **Table 6** from the "Hydraulic Analyses" section of this TM3 is repeated below for convenience.

Table 6 – Coachella Valley Alternatives Hydraulic Analyses

CV Alternative No.	Hydraulic Analysis Results Table No.	Energy Recovery Facility Design Table No.	HGL Profile Exhibit Nos.
A-1	18	19	14
A-2	20	21	
A-3	22	N.A.	15
B-1	23	24	16
B-2	25	26	
B-3	27	N.A.	17

Table 18 – CV Alternative A-1* Summary of WaterCAD Results for Pipe Segments

Start Station			Pipe Elev. (Start) (ft)	Hydraulic Grade Line (Start) (ft)	Pressure (Start) (psi)	End Station			Pipe Elev. (End) (ft)	Hydraulic Grade Line (End) (ft)	Pressure (End) (psi)	Segment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
0	+	00	2,570.0	2,600.0	13.0	47	+	50	2,551.0	2,576.0	10.9	4,750	36	25,937	8.18	0.004994
47	+	50	2,551.0	2,576.0	10.9	272	+	26	2,389.9	2,464.0	32.1	22,476	36	25,937	8.18	0.004994
272	+	26	2,389.9	2,464.0	32.1	781	+	23	1,983.9	2,209.8	97.8	50,897	36	25,937	8.18	0.004994
781	+	23	1,983.9	1,989.8	2.6	929	+	96	1,583.9	1,915.5	143.5	14,873	36	25,937	8.18	0.004994
929	+	96	1,583.9	1,650.5	28.9	1095	+	45	1,385.0	1,567.9	79.2	16,549	36	25,937	8.18	0.004994
1095	+	45	1,385.0	1,492.9	46.7	1136	+	60	1,383.9	1,472.4	38.3	4,115	36	25,937	8.18	0.004994
1136	+	60	1,383.9	1,472.4	38.3	1180	+	00	1,320.5	1,450.7	56.3	4,340	36	25,937	8.18	0.004994
1180	+	00	1,320.5	1,450.7	56.3	1219	+	04	1,210.9	1,431.2	95.3	3,904	36	25,937	8.18	0.004994
1219	+	04	1,210.9	1,431.2	95.3	1258	+	60	1,368.0	1,411.5	18.8	3,956	36	25,937	8.18	0.004994
1258	+	60	1,368.0	1,411.5	18.8	1320	+	00	1,283.9	1,403.9	51.9	6,140	48	25,937	4.60	0.001230
1320	+	00	1,283.9	1,403.9	51.9	1880	+	51	591.1	1,254.2	286.9	56,051	48	39,428	6.99	0.002671
1880	+	51	591.1	654.2	27.3	1982	+	55	584.1	627.0	18.5	10,204	48	39,428	6.99	0.002671
1982	+	55	584.1	627.0	18.5	2827	+	63	84.0	401.3	137.2	84,508	48	39,428	6.99	0.002671
2827	+	63	84.0	261.3	76.7	2960	+	00	47.9	226.1	77.1	13,137	48	39,428	6.99	0.002671
2960	+	00	47.9	226.1	77.1	3120	+	83	-16.0	183.0	86.2	16,083	48	39,428	6.99	0.002671
3120	+	83	-16.0	183.0	86.2	3193	+	17	-17.0	156.7	75.2	9,917	48	39,428	6.99	0.002671
3220	+	00	-17.0	156.7	75.2	3254	+	55	24.1	150.7	54.8	3,455	54	42,509	5.96	0.001730
3254	+	55	24.1	150.7	54.8	3590	+	32	24.0	92.6	29.7	33,577	54	42,509	5.96	0.001730
3590	+	32	24.0	92.6	29.7	4060	+	00	-16.0	11.0	11.6	44,907	54	42,509	5.96	0.001730
4060	+	00	-16.0	11.0	11.6	4302	+	49	-215.7	-55.0	69.4	26,310	54	54,625	7.65	0.002753
4302	+	49	-215.7	-195.0	8.8	4410	+	50	-240.2	-225.0	6.5	11,847	54	54,625	7.65	0.002753
4410	+	50	-240.2	-225.0	6.5	4480	+	00	-240.2	-239.0	0.5	5,904	60	60,636	6.88	0.001999

* **Note:** CV Alternative A-1 represents Alignment A with flows from the potential Expanded Service Area **with** Energy Recovery facilities.

Table 19 – CV Alternative A-1* Summary of WaterCAD Results for Turbine Generators

Turbine Location (Station)	Pipe Inv. Elev. (In) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Turbine Head (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
781 + 23	1,983.9	2,209.8	97.8	25,937	220.0	1,989.8	2.6
929 + 96	1,583.9	1,915.5	143.5	25,937	265.0	1,650.5	28.9
1095 + 45	1,385.0	1,567.9	79.2	25,937	75.0	1,492.9	46.7
1880 + 51	591.1	1,254.2	286.9	25,937	600.0	654.2	27.3
2827 + 63	84.0	401.3	137.4	39,428	140.0	261.3	76.8
4302 + 49	-215.7	-55.0	69.4	42,509	140.0	-195.0	8.8

*** Note:** CV Alternative A-1 represents Alignment A with flows from the potential Expanded Service Area **with** Energy Recovery facilities.

Exhibit 14 - CV Alternative A-1 Profile

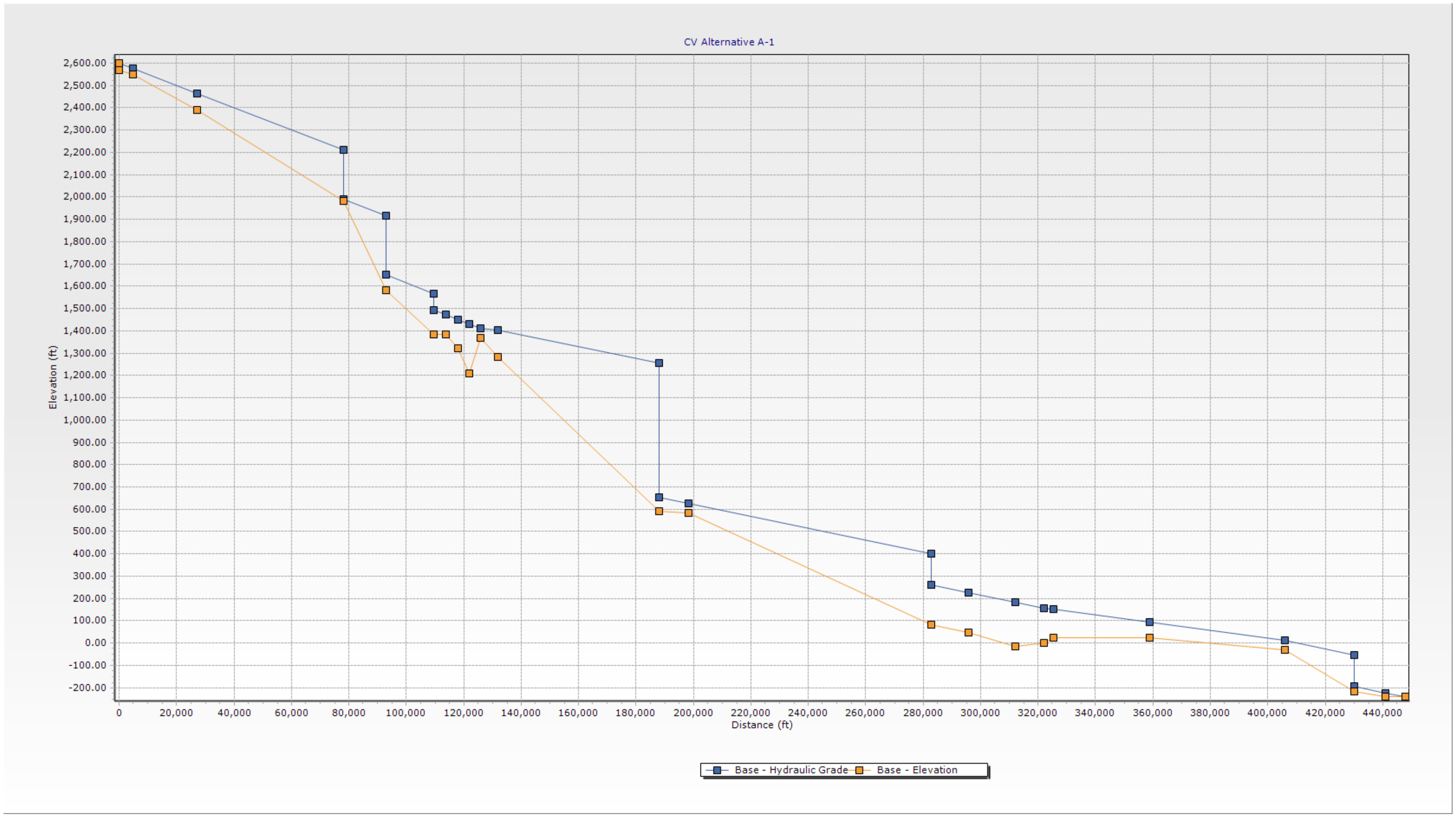


Table 20 – CV Alternative A-2* Summary of WaterCAD Results for Pipe Segments

Start Station			Pipe Elev. (Start) (ft)	Hydraulic Grade Line (Start) (ft)	Pressure (Start) (psi)	End Station			Pipe Elev. (End) (ft)	Hydraulic Grade Line (End) (ft)	Pressure (End) (psi)	Segment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
0	+	00	2,570.0	2,600.0	13.0	47	+	50	2,551.0	2,576.3	10.9	4,750	36	25,937	8.18	0.004994
47	+	50	2,551.0	2,576.3	10.9	272	+	26	2,389.9	2,464.0	32.1	22,476	36	25,937	8.18	0.004994
272	+	26	2,389.9	2,464.0	32.1	781	+	23	1,983.9	2,209.8	97.8	50,897	36	25,937	8.18	0.004994
781	+	23	1,983.9	2,009.8	11.2	929	+	96	1,583.9	1,935.5	152.2	14,873	36	25,937	8.18	0.004994
929	+	96	1,583.9	1,595.5	5.0	1095	+	45	1,385.0	1,512.9	55.4	16,549	36	25,937	8.18	0.004994
1095	+	45	1,385.0	1,452.9	29.3	1136	+	60	1,383.9	1,432.4	21.0	4,115	36	25,937	8.18	0.004994
1136	+	60	1,383.9	1,432.4	21.0	1180	+	00	1,320.5	1,410.7	39.0	4,340	36	25,937	8.18	0.004994
1180	+	00	1,320.5	1,410.7	39.0	1219	+	04	1,210.9	1,391.2	78.0	3,904	36	25,937	8.18	0.004994
1219	+	04	1,210.9	1,391.2	78.0	1258	+	60	1,368.0	1,371.5	1.5	3,956	36	25,937	8.18	0.004994
1258	+	60	1,368.0	1,371.5	1.5	1340	+	76	1,283.9	1,330.5	20.1	8,216	36	25,937	8.18	0.004994
1340	+	76	1,283.9	1,330.5	20.1	1880	+	51	591.1	1,060.9	203.3	53,975	36	25,937	8.18	0.004994
1880	+	51	591.1	620.9	12.9	1982	+	55	584.1	596.9	5.5	10,204	36	25,937	8.18	0.004994
1982	+	55	584.1	596.9	5.5	2233	+	83	284.3	537.7	109.6	25,128	42	25,937	6.01	0.002357
2233	+	83	284.3	477.7	83.8	2827	+	63	84.0	337.7	109.9	59,380	42	25,937	6.01	0.002357
2827	+	63	84.0	337.7	109.9	2960	+	00	47.9	306.7	112.0	13,137	42	25,937	6.01	0.002357
2960	+	00	47.9	306.7	112.0	3120	+	83	-16.0	268.8	123.2	16,083	42	25,937	6.01	0.002357
3120	+	83	-16.0	268.8	123.2	3193	+	17	-17.0	251.8	116.3	7,234	42	25,937	6.01	0.002357
3193	+	17	-17.0	251.8	116.3	3254	+	55	24.1	237.3	92.2	6,138	42	25,937	6.01	0.002357
3254	+	55	24.1	237.3	92.2	3590	+	32	24.0	158.0	58.1	33,577	42	25,937	6.01	0.002357
3590	+	32	24.0	158.0	58.1	3854	+	61	10.4	96.0	37.0	26,429	42	25,937	6.01	0.002357
3854	+	61	10.4	96.0	37.0	3967	+	40	49.1	69.0	8.7	11,279	42	25,937	6.01	0.002357
3967	+	40	49.1	69.0	8.7	4302	+	49	-215.7	-10.0	89.1	33,509	42	25,937	6.01	0.002357
4302	+	49	-215.7	-150.0	28.4	4420	+	96	-240.2	-178.0	27.1	11,847	42	25,937	6.01	0.002357
4420	+	96	-240.2	-178.0	27.1	4480	+	00	-240.2	-191.5	21.1	5,904	42	25,937	6.01	0.002357

*** Note:** CV Alternative A-2 represents Alignment A with flows from the Existing Service Area **with** Energy Recovery facilities.

Table 21 – CV Alternative A-2* Summary of WaterCAD Results for Turbine Generators

Turbine Location (Station)	Pipe Inv. Elev. (In) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Turbine Head (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
781 + 23	1,983.9	2,209.8	97.8	25,937	200.0	2,009.8	11.2
929 + 96	1,583.9	1,935.5	152.2	25,937	340.0	1,595.5	5.0
1095 + 45	1,385.0	1,512.9	55.4	25,937	60.0	1,452.9	29.3
1880 + 51	591.1	1,060.9	203.3	25,937	440.0	620.9	12.9
2827 + 63	284.3	537.7	109.6	25,937	60.0	477.7	83.8
4302 + 49	-215.7	-10.0	89.1	25,937	140.0	-150.0	28.4

*** Note:** CV Alternative A-2 represents Alignment A with flows from the Existing Service Area **with** Energy Recovery facilities.

Table 22 – CV Alternative A-3* Summary of SewerCAD Results for Pipe Segments (Sheet 1 of 3)

Start Station	Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (in)	End Station	Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Average Velocity (ft/s)	Capacity (Full Flow) (cfs)
0 + 00	2,586.0	2,570.0	2588.5	42	9 + 63	2,564.7	2,548.7	2,585.4	42	963	0.022	42	57.76	6.0	149.6
9 + 63	2,564.7	2,548.7	2585.4	42	16 + 45	2,575.3	2,559.3	2,583.1	42	682	-0.016	42	57.76	6.0	-125.4
16 + 45	2,575.3	2,559.3	2583.1	36	33 + 32	2,583.7	2,567.7	2,570.2	30	1,686	-0.005	36	57.76	8.2	-47.1
33 + 32	2,583.7	2,567.7	2570.2	30	47 + 52	2,611.4	2,550.0	2,552.6	31	1,420	0.012	36	57.76	11.6	74.5
47 + 52	2,611.4	2,550.0	2552.6	31	213 + 85	2,499.7	2,483.7	2,486.2	30	16,634	0.004	42	57.76	7.5	63.5
213 + 85	2,499.7	2,483.7	2486.2	30	272 + 26	2,405.9	2,391.0	2,392.8	22	5,840	0.016	36	57.76	12.8	84.0
272 + 26	2,405.9	2,391.0	2393.4	29	283 + 41	2,426.2	2,385.0	2,387.5	30	1,115	0.005	42	57.76	8.5	73.8
283 + 41	2,426.2	2,385.0	2387.5	30	384 + 08	2,300.6	2,284.6	2,286.8	26	10,068	0.010	36	57.76	10.6	66.6
384 + 08	2,300.6	2,284.6	2287.1	30	463 + 40	2,200.3	2,184.3	2,186.3	24	7,931	0.013	36	57.76	11.7	75.0
463 + 40	2,200.3	2,184.3	2186.8	30	518 + 05	2,100.3	2,084.3	2,087.5	36	5,465	0.018	36	57.76	13.5	90.2
518 + 05	2,100.3	2,084.3	2087.5	38	640 + 26	2,079.0	2,063.0	2,066.7	45	12,221	0.002	48	57.76	5.4	60.0
640 + 26	2,079.0	2,063.0	2066.7	45	698 + 23	2,159.2	2,055.0	2,057.5	30	5,797	0.001	48	57.76	4.6	53.4
698 + 23	2,159.2	2,055.0	2057.5	30	781 + 23	1,999.9	1,983.9	1,986.2	28	8,300	0.009	36	57.76	9.9	61.7
781 + 23	1,999.9	1,983.9	1986.3	29	809 + 97	1,899.7	1,883.7	1,885.3	19	2,875	0.035	30	57.76	17.1	76.6
809 + 97	1,899.7	1,883.7	1886.1	29	844 + 81	1,799.7	1,783.7	1,786.2	30	3,483	0.029	30	57.76	15.8	69.5
844 + 81	1,799.7	1,783.7	1786.2	30	897 + 54	1,700.4	1,684.4	1,686.1	21	5,274	0.019	36	57.76	13.7	91.5
897 + 54	1,700.4	1,684.4	1686.9	30	929 + 96	1,599.9	1,583.9	1,585.4	18	3,242	0.031	36	57.76	16.6	117.4
929 + 96	1,599.9	1,583.9	1586.4	30	1047 + 15	1,500.2	1,484.2	1,486.5	28	11,719	0.009	36	57.76	9.9	61.5
1047 + 15	1,500.2	1,484.2	1486.5	27	1095 + 45	1,399.7	1,385.0	1,388.2	39	4,830	0.021	48	57.76	14.1	205.9
1095 + 45	1,399.7	1,385.0	1388.2	39	1125 + 47	1,411.8	1,380.0	1,382.3	27	3,002	0.002	48	57.76	5.3	58.6
1125 + 47	1,411.8	1,380.0	1382.3	27	1136 + 60	1,399.9	1,375.0	1,377.2	27	1,113	0.004	48	57.76	8.0	96.3

*** Notes:** - CV Alternative A-3 represents Alignment A with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Table 22 - CV Alternative A-3* Summary of SewerCAD Results for Pipe Segments (Sheet 2 of 3)

Start Station			Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (in)	End Station			Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Average Velocity (ft/s)	Capacity (Full Flow) (cfs)
1136	+	60	1,399.9	1,375.0	1377.3	27	1207	+	88	1,300.6	1,284.6	1,330.8	48	7,128	0.013	48	57.76	11.8	161.8
1207	+	88	1,300.6	1,284.6	1330.8	60	1219	+	04	1,226.9	1,210.9	1,330.3	60	1,116	0.066	60	57.76	2.9	669.3
1219	+	04	1,226.9	1,210.9	1330.3	60	1235	+	27	1,301.1	1,285.1	1,329.5	60	1,623	-0.046	60	57.76	2.9	-556.8
1235	+	27	1,301.1	1,285.1	1329.5	60	1258	+	60	1,384.0	1,325.0	1,328.0	36	2,333	-0.017	60	57.76	2.9	-340.6
1258	+	60	1,384.0	1,325.0	1328.0	36	1273	+	14	1,332.5	1,322.0	1,325.6	43	1,454	0.002	48	57.76	5.9	65.2
1273	+	14	1,332.5	1,322.0	1325.6	43	1289	+	03	1,371.9	1,320.0	1,322.4	29	1,589	0.001	48	57.76	4.6	51.0
1289	+	03	1,371.9	1,320.0	1322.4	29	1340	+	76	1,299.9	1,283.9	1,286.0	26	5,172	0.007	42	57.76	9.4	84.1
1340	+	76	1,299.9	1,283.9	1286.3	29	1378	+	21	1,199.6	1,183.6	1,185.4	21	3,745	0.027	30	57.76	15.4	67.1
1378	+	21	1,199.6	1,183.6	1186.0	29	1415	+	53	1,100.2	1,084.2	1,086.0	21	3,732	0.027	30	57.76	15.3	66.9
1415	+	53	1,100.2	1,084.2	1086.6	29	1458	+	53	1,000.2	984.2	986.6	29	4,301	0.023	30	57.76	14.5	62.5
1458	+	53	1,000.2	984.2	986.6	29	1516	+	10	901.3	885.3	886.9	19	5,757	0.017	42	57.76	13.3	131.9
1516	+	10	901.3	885.3	887.7	29	1568	+	22	799.8	783.8	785.4	19	5,212	0.019	42	57.76	13.9	140.4
1568	+	22	799.8	783.8	786.1	27	1721	+	23	700.1	684.1	686.1	24	15,301	0.007	48	57.76	9.2	115.9
1721	+	23	700.1	684.1	686.4	27	1880	+	51	607.1	591.1	594.6	42	15,929	0.006	48	57.76	8.9	109.8
1880	+	51	607.1	591.1	594.6	42	1945	+	98	694.6	585.0	587.6	32	6,547	0.001	54	57.76	4.3	60.0
1945	+	98	694.6	585.0	587.6	32	1982	+	55	600.1	575.0	577.5	30	3,657	0.003	48	57.76	6.6	75.1
1982	+	55	600.1	575.0	577.5	30	2058	+	76	500.2	484.2	486.2	24	7,622	0.012	36	57.76	11.4	72.8
2058	+	76	500.2	484.2	486.7	30	2181	+	55	400.9	384.9	387.3	28	12,279	0.008	36	57.76	9.7	60.0
2181	+	55	400.9	384.9	387.4	30	2233	+	83	300.3	284.3	286.0	21	5,228	0.019	36	57.76	13.8	92.5
2233	+	83	300.3	284.3	286.5	27	2450	+	90	200.0	184.0	186.1	25	21,707	0.005	54	57.76	8.1	133.7
2450	+	90	200.0	184.0	186.2	26	2827	+	63	100.0	84.0	86.1	25	37,673	0.003	66	57.76	6.6	173.0

*** Notes:** - CV Alternative A-3 represents Alignment A with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Table 22 - CV Alternative A-3* Summary of SewerCAD Results for Pipe Segments (Sheet 3 of 3)

Start Station	Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (in)	End Station	Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Aver-age Vel-ocity (ft/s)	Capacity (Full Flow) (cfs)
2827 + 63	100.0	84.0	86.1	25	3120 + 83	0.0	-16.0	36.8	66	29,320	0.003	66	57.76	7.2	196.1
3120 + 83	0.0	-16.0	36.8	72	3193 + 17	-1.0	-17.0	35.4	72	7,234	0.000	72	57.76	2.0	49.8
3193 + 17	-1.0	-17.0	35.4	72	3254 + 55	40.1	24.1	34.3	72	6,138	-0.007	72	57.76	2.0	-346.5
3254 + 55	40.1	24.1	34.3	72	3590 + 32	40.0	24.0	27.8	45	33,577	0.000	72	57.76	2.0	0.0
3590 + 32	40.0	24.0	27.8	45	3796 + 69	41.0	12.0	16.7	56	20,637	0.001	60	57.76	3.6	62.8
3796 + 69	41.0	12.0	16.7	56	3808 + 25	47.4	11.0	16.2	60	1,156	0.001	60	57.76	4.3	76.6
3808 + 25	47.4	11.0	16.2	60	3854 + 61	26.4	10.4	13.6	38	4,636	0.000	60	57.76	2.9	29.6
3854 + 61	26.4	10.4	13.6	38	3967 + 40	49.1	0.0	2.8	34	11,280	0.001	60	57.76	4.4	79.1
3967 + 40	49.1	0.0	2.8	34	4039 + 39	0.0	-16.0	-13.5	30	7,198	0.002	48	57.76	6.1	67.7
4039 + 39	0.0	-16.0	-13.5	30	4150 + 08	-99.9	-115.9	-113.7	27	11,070	0.009	36	57.76	10.2	63.4
4150 + 08	-99.9	-115.9	-113.5	29	4302 + 49	-199.7	-215.7	-213.0	32	15,241	0.007	42	57.76	9.2	81.4
4302 + 49	-199.7	-215.7	-213.0	32	4420 + 96	-224.2	-240.2	-218.9	60	11,847	0.002	60	57.76	6.0	118.4
4420 + 96	-224.2	-240.2	-218.9	72	4480 + 00	-224.2	-236.2	-220.0	72	5,904	-0.001	72	57.76	2.0	-110.2

*** Notes:**
- CV Alternative A-3 represents Alignment A with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Exhibit 15 - CV Alternative A-3 Profile

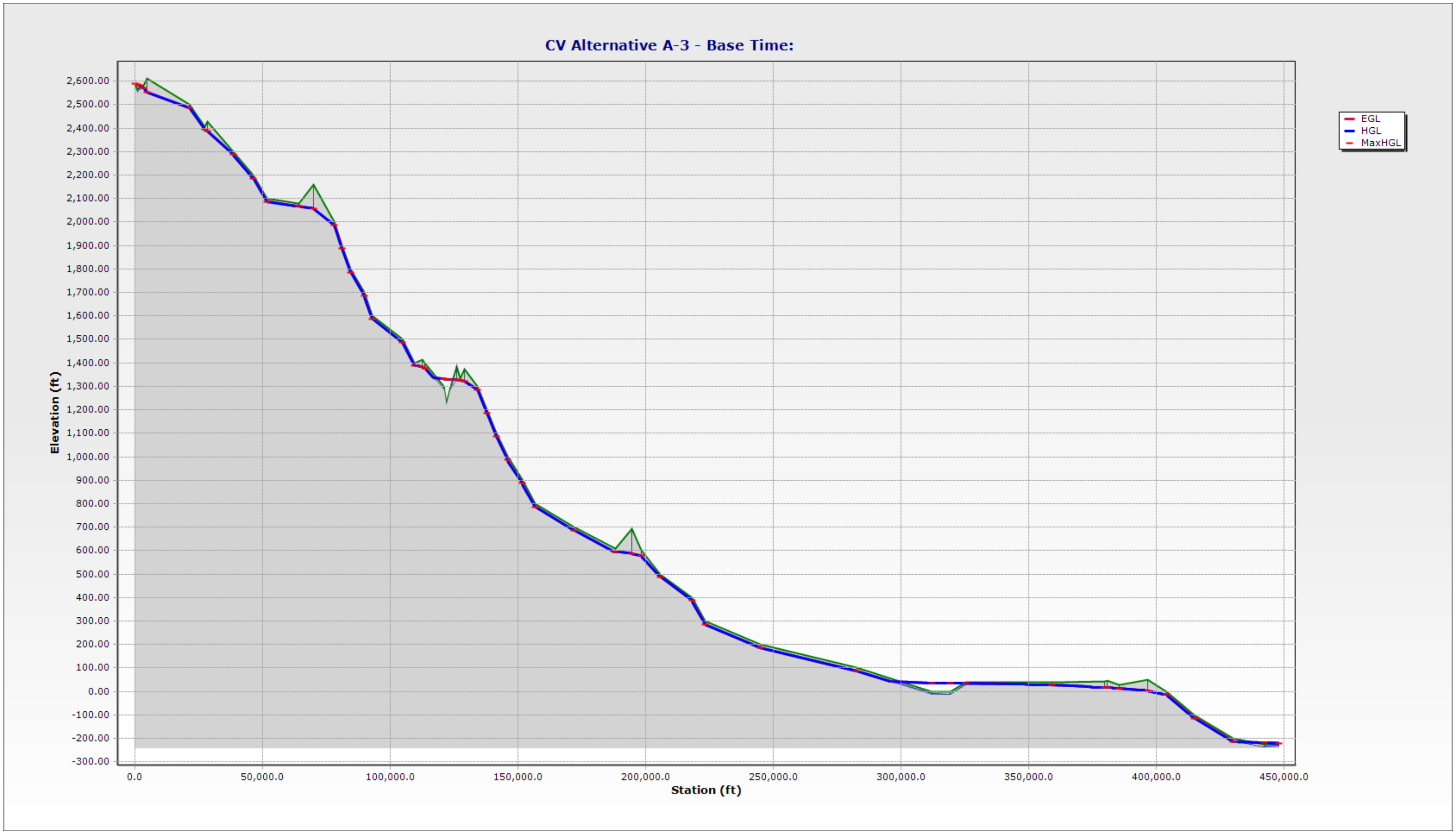


Table 23 – CV Alternative B-1* Summary of WaterCAD Results for Pipe Segments

Start Station			Pipe Elev. (Start) (ft)	Hydraulic Grade Line (Start) (ft)	Pressure (Start) (psi)	End Station			Pipe Elev. (End) (ft)	Hydraulic Grade Line (End) (ft)	Pressure (End) (psi)	Segment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
0	+	00	2,570.0	2,600.0	12.9	26	+	90	2,559.2	2,586.6	11.8	2,690	36	25,937	8.18	0.004994
26	+	90	2,559.2	2,586.6	11.8	272	+	99	2,383.8	2,463.7	34.6	24,609	36	25,937	8.18	0.004994
272	+	99	2,383.8	2,393.7	4.2	792	+	41	1,484.3	2,134.3	281.2	51,942	36	25,937	8.18	0.004994
792	+	41	1,484.3	1,494.3	4.3	978	+	36	1,184.2	1,401.4	94.0	18,595	36	25,937	8.18	0.004994
978	+	36	1,184.2	1,401.4	94.0	1110	+	00	1,111.8	1,335.7	96.9	13,164	36	25,937	8.18	0.004994
1110	+	00	1,111.8	1,115.7	1.6	1364	+	04	684.0	1,047.8	157.4	25,404	48	39,428	6.99	0.002671
1364	+	04	684.0	692.8	3.7	1403	+	39	634.0	682.0	20.9	3,935	48	39,428	6.99	0.002671
1403	+	39	634.0	682.0	20.9	1592	+	01	484.0	631.6	64.0	18,862	48	39,428	6.99	0.002671
1592	+	01	484.0	491.6	3.2	1725	+	33	384.2	456.3	31.2	13,332	48	39,428	6.99	0.002671
1725	+	33	384.2	456.3	31.2	1905	+	65	283.2	408.2	54.1	18,032	48	39,428	6.99	0.002671
1905	+	65	283.2	408.2	54.1	2038	+	20	224.1	372.8	64.3	13,255	48	39,428	6.99	0.002671
2038	+	20	224.1	227.8	1.5	2196	+	12	183.8	185.6	0.8	15,792	48	39,428	6.99	0.002671
2196	+	12	183.8	185.6	0.8	2292	+	48	145.7	159.8	6.1	9,636	48	39,428	6.99	0.002671
2292	+	48	145.7	159.8	6.1	2396	+	46	78.6	132.1	23.1	10,398	48	39,428	6.99	0.002671
2396	+	46	78.6	132.1	23.1	2518	+	59	58.6	99.4	17.7	12,213	48	39,428	6.99	0.002671
2518	+	59	58.6	99.4	17.7	2593	+	28	25.9	79.5	23.2	7,469	48	39,428	6.99	0.002671
2593	+	28	25.9	79.5	23.2	2729	+	09	-16.0	43.2	25.6	13,581	48	39,428	6.99	0.002671
2729	+	09	-16.0	43.2	25.6	2860	+	00	-49.2	8.2	24.9	13,091	48	39,428	6.99	0.002671
2860	+	00	-49.2	8.2	24.9	3380	+	50	-166.2	-81.8	36.5	52,050	54	42,509	5.96	0.001730
3380	+	50	-166.2	-81.8	36.5	3593	+	78	-216.0	-140.5	32.7	21,328	54	54,625	7.65	0.002753
3593	+	78	-216.0	-140.5	32.7	3690	+	00	-227.0	-167.0	26.0	9,622	54	54,625	7.65	0.002753
3690	+	00	-227.0	-167.0	26.0	3775	+	97	-240.2	-184.2	24.2	8,597	60	60,636	6.88	0.001999

* **Note:** CV Alternative B-1 represents Alignment B using flows from the potential Expanded Service Area **with** Energy Recovery facilities.

Table 24 – CV Alternative B-1* Summary of WaterCAD Results for Turbine Generators

Turbine Location (Station)	Pipe Elev. (In) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Turbine Head (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
272 + 99	2,383.8	2,463.7	34.6	25,937	70.0	2,393.7	4.2
792 + 41	1,484.3	2,134.3	281.2	25,937	640.0	1,494.3	4.3
1110 + 00	1,111.8	1,335.7	96.9	25,937	220.0	1,115.7	1.6
1364 + 04	684.0	1,047.8	157.4	25,937	355.0	692.8	3.7
1592 + 01	484.0	631.6	64.0	39,428	140.0	491.6	3.2
2038 + 20	224.1	372.8	64.3	39,428	145.0	227.8	1.5

*** Note:** CV Alternative B-1 represents Alignment B using flows from the potential Expanded Service Area **with** Energy Recovery facilities.

Exhibit 16 - CV Alternative B-1 Profile

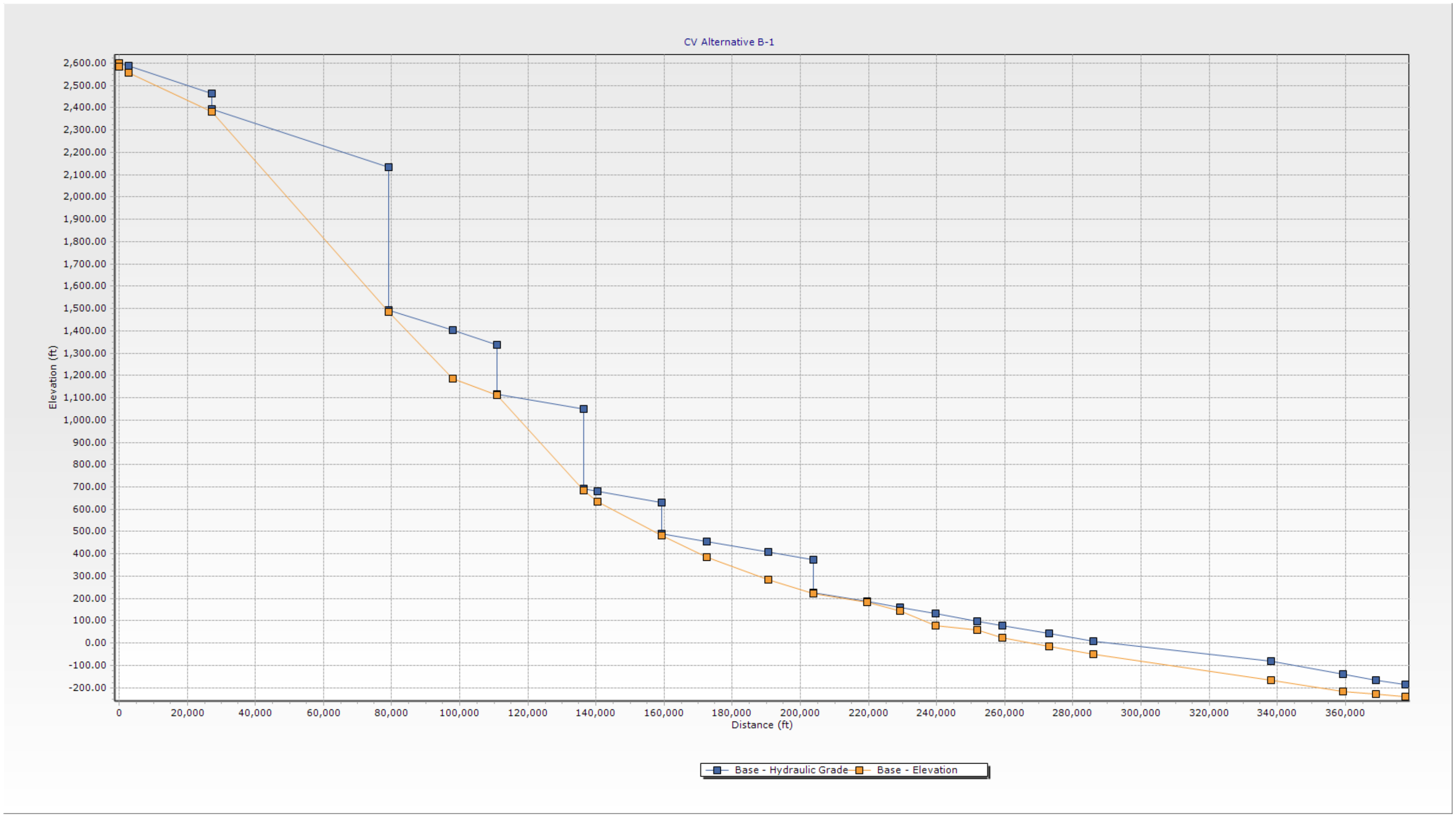


Table 25 – CV Alternative B-2* Summary of WaterCAD Results for Pipe Segments

Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (Start) (ft)	Pressure (Start) (psi)	End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (End) (ft)	Pressure (End) (psi)	Segment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
0 + 00	2,570.0	2,600.0	12.9	26 + 90	2,559.2	2,586.6	11.8	2,690	36	25,937	8.18	0.004994
26 + 90	2,559.2	2,586.6	11.8	272 + 99	2,383.8	2,463.7	34.6	24,609	36	25,937	8.18	0.004994
272 + 99	2,383.8	2,463.7	34.6	792 + 41	1,484.3	2,204.3	311.5	51,942	36	25,937	8.18	0.004994
792 + 41	1,484.3	1,504.3	8.6	932 + 11	1,184.2	1,434.5	108.3	13,970	36	25,937	8.18	0.004994
932 + 11	1,184.2	1,434.5	108.3	978 + 36	1,184.2	1,411.4	98.3	4,625	36	25,937	8.18	0.004994
978 + 36	1,184.2	1,211.4	11.7	1110 + 00	1,111.8	1,125.7	14.7	13,164	36	25,937	8.18	0.004994
1110 + 00	1,111.8	1,145.7	14.7	1364 + 04	684.0	1,018.8	144.9	25,404	36	25,937	8.18	0.004994
1364 + 04	684.0	718.8	15.0	1403 + 39	634.0	699.2	28.2	3,935	36	25,937	8.18	0.004994
1403 + 39	634.0	699.2	28.2	1592 + 01	484.0	605.0	52.3	18,862	36	25,937	8.18	0.004994
1592 + 01	484.0	605.0	52.3	1725 + 33	384.2	538.4	66.7	13,332	36	25,937	8.18	0.004994
1725 + 33	384.2	538.4	66.7	1905 + 65	283.2	495.9	92.0	18,032	42	25,937	6.01	0.002357
1905 + 65	283.2	495.9	92.0	2038 + 20	224.1	464.7	104.1	13,255	42	25,937	6.01	0.002357
2038 + 20	224.1	234.7	4.5	2196 + 12	183.8	197.5	5.9	15,792	42	25,937	6.01	0.002357
2196 + 12	183.8	197.5	5.9	2292 + 48	145.7	174.8	12.6	9,636	42	25,937	6.01	0.002357
2292 + 48	145.7	174.8	12.6	2396 + 46	78.6	150.2	31.0	10,398	42	25,937	6.01	0.002357
2396 + 46	78.6	150.2	31.0	2518 + 59	58.6	121.5	27.2	12,213	42	25,937	6.01	0.002357
2518 + 59	58.6	121.5	27.2	2593 + 28	25.9	103.9	33.7	7,469	42	25,937	6.01	0.002357
2593 + 28	25.9	103.9	33.7	2729 + 09	-16.0	71.8	38.0	13,581	42	25,937	6.01	0.002357
2729 + 09	-16.0	71.8	38.0	2860 + 00	-49.2	41.0	39.0	13,091	42	25,937	6.01	0.002357
2860 + 00	-49.2	41.0	39.0	3380 + 50	-166.2	-81.7	36.6	52,050	42	25,937	6.01	0.002357
3380 + 50	-166.2	-81.7	36.6	3593 + 78	-216.0	-132.0	36.4	21,328	42	25,937	6.01	0.002357
3593 + 78	-216.0	-132.0	36.4	3690 + 00	-227.0	-154.6	31.3	9,622	42	25,937	6.01	0.002357
3690 + 00	-227.0	-154.6	31.3	3775 + 97	-240.2	-174.9	28.3	8,597	42	25,937	6.01	0.002357

*** Note:** CV Alternative B-2 represents Alignment B using flows from the Existing Service Area **with** Energy Recovery facilities.

Table 26 – CV Alternative B-2* Summary of WaterCAD Results for Turbine Generators

Turbine Location (Station)	Pipe Inv. Elev. (In) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Turbine Head (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
792 + 41	1,484.3	2,204.3	311.5	25,937	700.0	1,504.3	8.6
978 + 36	1,184.2	1,411.4	98.3	25,937	200.0	1,211.4	11.7
1364 + 04	684.0	1,018.8	144.9	25,937	300.0	718.8	15.0
2038 + 20	224.1	464.7	104.1	25,937	230.0	234.7	4.5

*** Note:** CV Alternative B-2 represents Alignment B using flows from the Existing Service Area **with** Energy Recovery facilities.

Table 27 – CV Alternative B-3* Summary of SewerCAD Results for Pipe Segments (Sheet 1 of 3)

Start Station			Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (ft)	Stop Station			Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Ave. Vel-ocity (ft/s)	Capacity (Full Flow) (cfs)
0	+	00	2,586.0	2,570.0	2,639.8	36.0	26	+	88	2,620.9	2,604.9	2,619.7	36.0	2,688	-0.013	36	57.76	8.2	-76.0
26	+	88	2,620.9	2,604.9	2,619.7	36.0	70	+	72	2,600.1	2,584.1	2,586.6	29.5	4,384	0.005	36	57.76	8.2	45.9
70	+	72	2,600.1	2,584.1	2,586.6	29.5	78	+	83	2,590.0	2,574.0	2,576.0	23.9	811	0.012	36	57.76	11.6	74.4
78	+	83	2,590.0	2,574.0	2,576.5	29.5	150	+	52	2,520.8	2,504.8	2,507.6	33.5	7,169	0.010	36	57.76	10.5	65.5
150	+	52	2,520.8	2,504.8	2,507.6	33.5	156	+	40	2,526.8	2,501.0	2,503.5	29.5	588	0.006	36	57.76	8.2	53.6
156	+	40	2,526.8	2,501.0	2,503.5	29.5	272	+	99	2,399.8	2,383.8	2,386.0	25.8	11,659	0.010	36	57.76	10.7	66.9
272	+	99	2,399.8	2,383.8	2,386.3	29.5	336	+	90	2,300.2	2,284.2	2,286.0	22.1	6,391	0.016	36	57.76	12.7	83.3
336	+	90	2,300.2	2,284.2	2,286.7	29.5	398	+	49	2,199.9	2,183.9	2,185.7	21.7	6,160	0.016	36	57.76	12.9	85.1
398	+	49	2,199.9	2,183.9	2,186.4	29.5	453	+	35	2,100.1	2,084.1	2,085.9	21.0	5,486	0.018	36	57.76	13.5	90.0
453	+	35	2,100.1	2,084.1	2,086.6	29.5	515	+	82	2,000.0	1,984.0	1,985.8	21.8	6,247	0.016	36	57.76	12.9	84.4
515	+	82	2,000.0	1,984.0	1,986.5	29.5	564	+	07	1,900.9	1,884.9	1,886.6	20.2	4,825	0.021	36	57.76	14.2	95.6
564	+	07	1,900.9	1,884.9	1,887.4	29.5	623	+	37	1,800.4	1,784.4	1,786.2	21.5	5,931	0.017	36	57.76	13.1	86.8
623	+	37	1,800.4	1,784.4	1,786.9	29.5	686	+	22	1,700.0	1,684.0	1,685.8	21.8	6,285	0.016	36	57.76	12.8	84.3
686	+	22	1,700.0	1,684.0	1,686.5	29.5	740	+	24	1,599.8	1,583.8	1,585.5	20.9	5,402	0.019	36	57.76	13.6	90.8
740	+	24	1,599.8	1,583.8	1,586.3	29.5	792	+	41	1,500.3	1,484.3	1,486.0	20.6	5,218	0.019	36	57.76	13.8	92.1
792	+	41	1,500.3	1,484.3	1,486.8	29.5	861	+	61	1,399.7	1,383.7	1,385.6	22.6	6,920	0.015	36	57.76	12.4	80.4
861	+	61	1,399.7	1,383.7	1,386.2	29.5	932	+	11	1,299.7	1,283.7	1,285.6	22.8	7,049	0.014	36	57.76	12.3	79.4
932	+	11	1,299.7	1,283.7	1,286.2	29.5	978	+	36	1,200.2	1,184.2	1,200.1	36.0	4,626	0.022	36	57.76	14.4	97.8
978	+	36	1,200.2	1,184.2	1,200.1	36.0	1110	+	00	1,115.6	1,099.6	1,102.1	29.5	13,164	0.006	36	57.76	8.2	53.5
1110	+	00	1,115.6	1,099.6	1,102.1	29.5	1123	+	92	1,100.1	1,084.1	1,086.2	24.8	1,392	0.011	36	57.76	11.1	70.4
1123	+	92	1,100.1	1,084.1	1,086.5	28.6	1184	+	35	1,000.5	984.5	986.1	19.7	6,042	0.016	42	57.76	13.1	129.2

*** Notes:** - CV Alternative B-3 represents Alignment B with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Table 27 - CV Alternative B-3* Summary of SewerCAD Results for Pipe Segments (Sheet 2 of 3)

Start Station	Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (ft)	Stop Station	Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Ave. Vel-ocity (ft/s)	Capacity (Full Flow) (cfs)
1184 + 35	1,000.5	984.5	986.9	28.6	1235 + 88	900.1	884.1	885.7	18.7	5,153	0.019	42	57.76	13.9	140.4
1235 + 88	900.1	884.1	886.5	28.6	1241 + 21	890.0	874.0	875.6	19.0	533	0.019	42	57.76	13.7	138.5
1241 + 21	890.0	874.0	876.4	28.6	1290 + 31	799.9	783.9	785.5	19.1	4,910	0.018	42	57.76	13.6	136.3
1290 + 31	799.9	783.9	786.3	28.6	1364 + 04	700.1	684.1	685.8	20.9	7,373	0.014	42	57.76	12.1	117.1
1364 + 04	700.1	684.1	686.5	28.6	1377 + 60	686.9	670.9	672.8	23.0	1,356	0.010	42	57.76	10.7	99.3
1377 + 60	686.9	670.9	673.3	28.6	1382 + 65	702.9	666.0	667.9	23.0	505	0.010	42	57.76	10.7	99.1
1382 + 65	702.9	666.0	668.4	28.6	1403 + 39	650.0	634.0	636.6	31.3	2,074	0.015	42	57.76	12.7	125.0
1403 + 39	650.0	634.0	636.6	31.3	1428 + 28	640.0	624.0	626.4	28.6	2,488	0.004	42	57.76	7.5	63.8
1428 + 28	640.0	624.0	626.4	28.6	1494 + 33	600.2	584.2	586.4	26.9	6,605	0.006	42	57.76	8.9	78.1
1494 + 33	600.2	584.2	586.6	28.6	1592 + 01	500.0	484.0	485.9	22.7	9,768	0.010	42	57.76	10.9	101.9
1592 + 01	500.0	484.0	486.3	27.5	1725 + 33	400.2	384.2	386.1	23.0	13,332	0.007	48	57.76	9.7	124.3
1725 + 33	400.2	384.2	386.5	27.5	1905 + 65	299.2	283.2	285.3	25.1	18,032	0.006	48	57.76	8.7	107.5
1905 + 65	299.2	283.2	285.5	27.5	2038 + 20	240.1	224.1	226.5	28.8	13,256	0.004	48	57.76	8.0	95.9
2038 + 20	240.1	224.1	226.5	28.8	2107 + 90	215.0	199.0	201.3	27.5	6,970	0.004	48	57.76	7.4	86.2
2107 + 90	215.0	199.0	201.3	27.5	2125 + 66	207.0	191.0	193.2	26.8	1,776	0.005	48	57.76	8.0	96.4
2125 + 66	207.0	191.0	193.3	27.5	2169 + 11	200.3	170.0	172.4	29.3	4,345	0.005	48	57.76	8.2	99.9
2169 + 11	200.3	170.0	172.4	29.3	2179 + 64	200.0	165.0	167.4	28.6	1,053	0.005	42	57.76	8.1	69.3
2179 + 64	200.0	165.0	167.4	28.6	2189 + 16	199.9	160.0	162.4	28.2	953	0.005	42	57.76	8.4	72.9
2189 + 16	199.9	160.0	162.4	28.6	2196 + 12	199.8	156.0	158.3	27.4	696	0.006	42	57.76	8.7	76.3
2196 + 12	199.8	156.0	158.4	28.6	2202 + 80	173.8	151.0	153.1	25.0	668	0.007	42	57.76	9.7	87.1
2202 + 80	173.8	151.0	153.3	27.5	2206 + 74	165.0	149.0	153.0	47.8	394	0.005	48	57.76	8.4	102.3

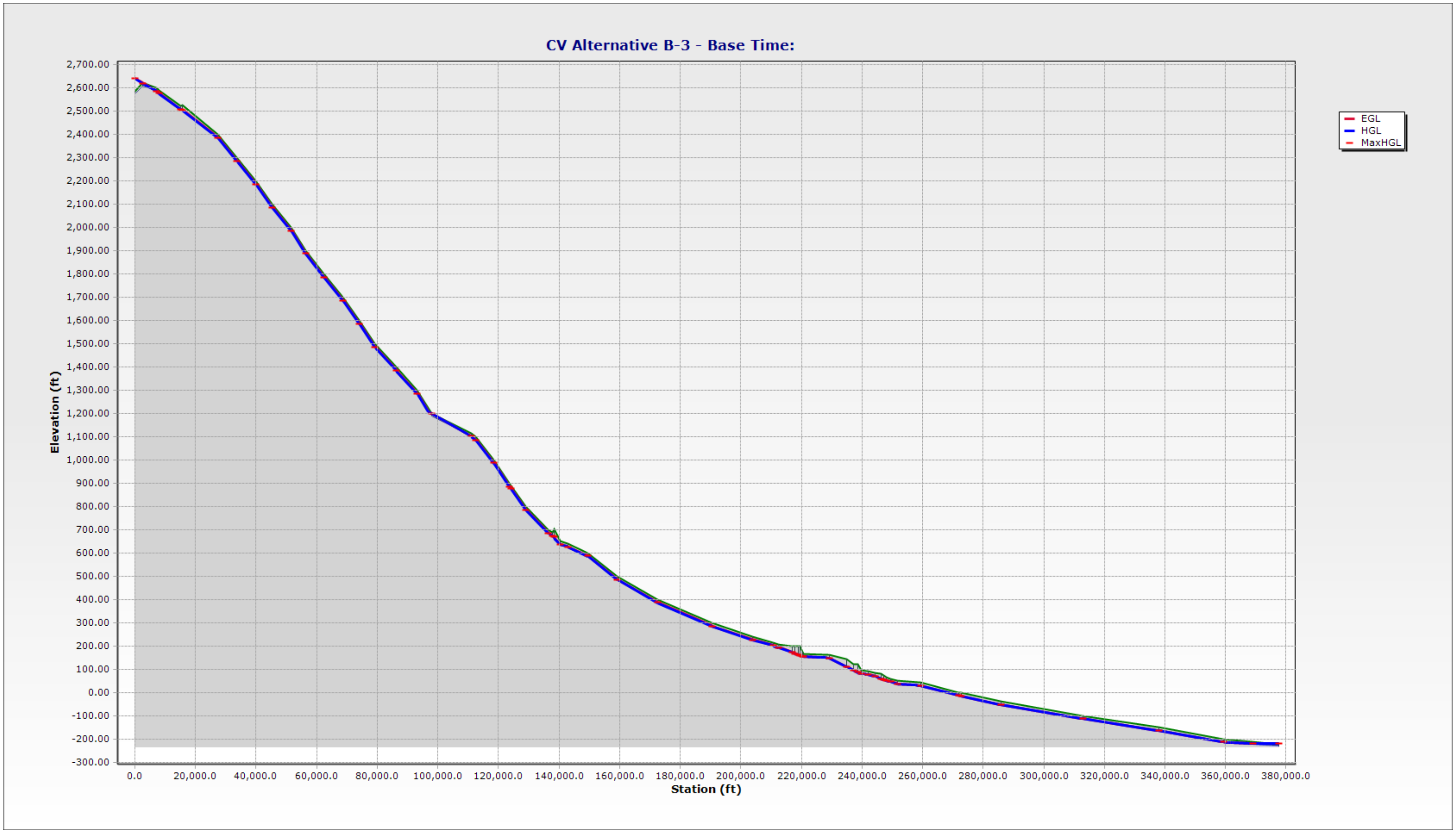
*** Notes:**
- CV Alternative B-3 represents Alignment B with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Table 27 - CV Alternative B-3* Summary of SewerCAD Results for Pipe Segments (Sheet 3 of 3)

Start Station	Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (ft)	Stop Station	Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Ave. Vel-ocity (ft/s)	Capacity (Full Flow) (cfs)
2206 + 74	165.0	149.0	153.0	47.8	2292 + 48	161.7	145.7	148.1	28.6	8,574	0.000	66	57.76	3.1	65.9
2292 + 48	161.7	145.7	148.1	28.6	2349 + 87	145.0	108.0	110.2	26.0	5,739	0.007	42	57.76	9.2	81.5
2349 + 87	145.0	108.0	110.4	28.6	2371 + 75	122.0	93.0	95.1	25.7	2,188	0.007	42	57.76	9.4	83.3
2371 + 75	122.0	93.0	95.4	28.6	2386 + 81	120.0	84.0	86.3	27.0	1,506	0.006	42	57.76	8.9	77.8
2386 + 81	120.0	84.0	86.4	28.6	2396 + 46	94.6	78.6	81.6	35.4	965	0.006	42	57.76	8.6	75.3
2396 + 46	94.6	78.6	81.6	35.4	2419 + 16	90.0	74.0	76.7	31.8	2,271	0.002	48	57.76	5.8	64.7
2419 + 16	90.0	74.0	76.7	31.8	2443 + 86	83.4	67.4	69.7	27.5	2,469	0.003	48	57.76	6.5	74.3
2443 + 86	83.4	67.4	69.7	27.5	2463 + 74	80.0	57.0	59.1	25.6	1,988	0.005	48	57.76	8.5	103.9
2463 + 74	80.0	57.0	59.3	27.5	2473 + 08	75.0	53.0	55.3	27.2	935	0.004	48	57.76	7.9	94.0
2473 + 08	75.0	53.0	55.3	27.5	2480 + 29	65.0	49.0	51.4	28.7	721	0.006	48	57.76	8.7	107.0
2480 + 29	65.0	49.0	51.4	28.7	2493 + 58	60.2	44.2	46.5	27.6	1,329	0.004	48	57.76	7.4	86.3
2493 + 58	60.2	44.2	46.5	27.6	2518 + 59	50.0	34.0	37.0	36.0	2,502	0.004	48	57.76	7.7	91.7
2518 + 59	50.0	34.0	37.0	36.0	2593 + 28	41.9	25.9	28.2	27.4	7,469	0.001	60	57.76	4.7	85.8
2593 + 28	41.9	25.9	28.2	27.4	2719 + 87	0.0	-16.0	-13.7	27.5	12,660	0.003	54	57.76	7.2	113.1
2719 + 87	0.0	-16.0	-13.7	27.5	2729 + 09	0.0	-19.0	-16.6	28.9	922	0.003	54	57.76	7.1	112.2
2729 + 09	0.0	-19.0	-16.6	28.9	2860 + 00	-38.9	-54.9	-52.4	30.6	13,091	0.003	54	57.76	6.7	103.0
2860 + 00	-38.9	-54.9	-52.4	30.6	3128 + 82	-100.1	-116.1	-113.6	29.9	26,882	0.002	54	57.76	6.2	93.8
3128 + 82	-100.1	-116.1	-113.6	29.9	3380 + 50	-150.2	-166.2	-163.8	28.6	25,168	0.002	60	57.76	5.9	116.2
3380 + 50	-150.2	-166.2	-163.8	28.6	3593 + 78	-200.0	-216.0	-213.1	34.6	21,328	0.002	60	57.76	6.3	125.8
3593 + 78	-200.0	-216.0	-213.1	34.6	3690 + 00	-212.5	-228.5	-218.4	60.0	9,622	0.001	60	57.76	5.0	93.8
3690 + 00	-212.5	-228.5	-218.4	72.0	3775 + 97	-224.2	-234.2	-220.0	72.0	8,597	0.001	72	57.76	2.0	109.1

*** Notes:**
- CV Alternative B-3 represents Alignment B with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Exhibit 17 - CV Alternative B-3 Profile



APPENDIX C – SALT REMOVAL (EVAPORATION PONDS)

Background

Treatment processes used to reduce TSS and BOD concentrations in water are not effective at removing TDS (salt) and the Treatment Facility proposed in this TM3 cannot be expected to significantly reduce the salt loads in the IEI flows. Therefore, a separate process would be necessary if removal of salt associated with the proposed IEI flows were deemed necessary.

The Salton Sea restoration plans discussed previously in this TM3 include several alternative designs, most of which include a Brine Pool located at the deeper portion of the Sea. Salts would accumulate in the proposed brine pool and precipitate from super-saturated concentrations. The brine pool represents a reasonable solution to the salt mass imbalance in the Sea. The brine pool could also be used to manage the salt from the proposed IEI.

However, if the brine pool does not become available for management of the salt from the IEI, then an alternative approach may be necessary. A conceptual design for a Salt Evaporation Pond Facility (EPF) is presented in this Appendix C as an alternative approach for removal from the Salton Sea of salts attributable to the IEI flows.

Effluent Standards

The projected TDS mass load from the IEI was discussed in Technical Memorandum No. 2 of this Appraisal Analysis. The projected average rate of discharge from the IEI in Year 2060 is 75.1 MGD, of which 43.0 MGD was projected to originate from Coachella Valley. The average TDS concentration in the IEI flows was projected to increase from approximately 5,200 mg/L (currently) to a maximum of approximately 6,800 mg/L (by approximately Year 2020). This projected TDS concentration exceeds the limits established in the Basin Plan [11] for waters flowing into the Salton Sea from Coachella Valley, which are 2,000 mg/L, average and 2,500 mg/L, peak.

The total projected TDS mass in the IEI flows in Year 2060 would be approximately 2,131 tons/day. The Basin Plan TDS limit (2,000 mg/L) would allow approximately 359 tons/day in the portion of the projected IEI flows originating from Coachella Valley.

If the Basin Plan (as amended) would not allow TDS in IEI flows originating from outside of the Coachella Valley to be released to the Salton Sea, then the maximum TDS mass in the IEI flows that could be released to the Salton Sea in Year 2060 would be 359 tons/day. In that case, some form of management or removal of salt would be required for the 1,772 tons/day of TDS in the IEI flows in Year 2060 that would exceed that limit. These results are summarized in **Table 28** below.

Table 28 – TDS Removal Rate (2060)

	Average Flow	TDS Mass		IEI TDS Removal Rate
		IEI Mass (6,800 mg/L)	Basin Plan Limit (2,000 mg/L)	
	(MGD)	(tons/day)	(tons/day)	(tons/day)
Existing SAWPA Service Area	32.1	910	0	910
Potential Coachella Valley Service Area Expansion	43.0	1,221	359	862
Total (Expanded Service Area)	**75.1**	**2,131**	**359**	**1,772**

Evaporation Ponds Description

Salt evaporation ponds are a low technology approach to salt management. Large land areas are used for shallow ponds designed to hold brine from which the water is evaporated, leaving the salt for collection and disposal. The volume of water that would be lost to evaporation would be minimized by using brine with the highest possible TDS concentration available. This would also help to minimize the area of the evaporation ponds.

If an Evaporation Pond Facility (EPF) was used for management of the salt in the proposed IEI flows, then the Salton Sea itself would be the best available source of brine. The ***Salton Sea Ecosystem Restoration Program Draft PEIR*** [8] reported that the average TDS concentration of the Salton Sea is currently approximately 48,000 mg/L.

If 1,772 tons of TDS must be removed per day from the Salton Sea in Year 2060 as presented in **Table 28**, then the volume of brine (TDS concentration 48,000 mg/L) to be transported to the EPF would be approximately 9,915 acre-feet per year (AFY) or 8.8 MGD. This represents approximately 12% of the total projected IEI flows. Therefore, the net increase of inflows to the Salton Sea from the proposed IEI would be the balance (approximately 88%) of the projected flows, or approximately 66.3 MGD (74,265 AFY). The results of these calculations, based on these data, are summarized in **Table 29** below.

Table 29 – Process Water Rate (2060)

	Average Flow (6,800 mg/L)	IEI TDS Removal Rate	Process Water (48,000 mg/L)	
	(MGD)	(tons/day)	(MGD)	(AFY)
Existing SAWPA Service Area	32.1	910	4.5	5,091
Expanded Service Area	**75.1**	**1,772**	**8.8**	**9,915**

Pumping would be necessary to transport the brine from the Salton Sea to the EPF. Locating the EPF as near the shore as possible would help to minimize the cost of the pumping.

Evaporation Ponds Design Methodology

The Idaho National Engineering and Environmental Laboratory developed a methodology for design of evaporation ponds for use in the mining industry, which is presented in the report entitled ***Evaporation Pond Sizing with Water Balance and Make-up Water Calculations*** [12] (EP Manual). This methodology was used for conceptual design of the EPF for this Appraisal Analysis.

The EP Manual methodology uses the principle of conservation of the mass (Mass Balance Equation) to calculate the size of evaporation ponds using the volumes of the sources of mass entering (***Input***) and exiting (***Output***):

$$\boldsymbol{Evaporation\ Pond\ Storage\ \Delta} = (\boldsymbol{Input}) - (\boldsymbol{Output})$$
$$= \boldsymbol{Process\ Water} + \boldsymbol{Direct\ Precipitation\ on\ Ponds} + \boldsymbol{Leachate} - \boldsymbol{Evaporation}$$

Process Water represents the projected rate of brine withdrawal from the Salton Sea discussed above and ***Leachate*** represents percolation into the ground and through pond containment berms. ***Direct Precipitation on Ponds*** is calculated as the average ***Precipitation Rate*** over the ***Pond Surface Area*** and ***Evaporation*** is calculated as the ***Evaporation Rate*** over the ***Pond Surface Area***.

For evaporation ponds that are correctly sized for the specific conditions, the total volume of water in the ponds would remain constant and ***Input*** should be equal to ***Output***. Therefore, the Mass Balance Equation can be represented as follows:

$$\boldsymbol{Process\ Water + (Precipitation\ Rate * Pond\ Surface\ Area) + Leachate = (Evaporation\ Rate * Pond\ Surface\ Area)}$$

Therefore, the surface area of evaporation ponds necessary to remove the TDS mass (***Pond Surface Area***) was calculated as follows:

$$\boldsymbol{Pond\ Surface\ Area = \frac{Process\ Water + Leachate}{Evaporation\ Rate\ - Precipitation\ Rate}}$$

Evaporation Ponds Design Criteria

The Water Balance Equation was solved using the following criteria:

- Planning for the evaporation ponds in this Appraisal Analysis includes impervious liners below the ponds and in the containment berms to prevent percolation into the ground and leaching through the containment berms. Therefore, ***Leachate = 0***.
- ***The Hydrologic Regimen of Salton Sea, California, 1966*** [13] reported for the Salton Sea that the average ***Precipitation Rate = 3.0 inches/year***.
- ***The Hydrologic Regimen of Salton Sea, California, 1966*** [1] reported that the 3-Pan Average Evaporation Rate at the Salton Sea is 100.6 inches/year. This 3-Pan Average Evaporation Rate ($\boldsymbol{E_P}$) is a standardized measure that must be adjusted to represent the actual rate of evaporation from a surface water body (e.g. evaporation pond). The pan coefficient for the Salton Sea area is 0.69. Therefore, ***Evaporation Rate = 0.69 * E_p = 69.4 inches/year***.
- To account for necessary buffers, containment berms, access roads, etc., a ***Pond Surface Area Multiplier = 1.30*** was applied to the calculated ***Pond Surface Area*** (like the multipliers used for the Facultative Treatment Ponds and Constructed Wetlands in this TM3). This multiplier was not

developed to include extra ponds that could provide EPF capacity greater than the design flows, which may be desired for operational purposes.

Evaporation Ponds Conceptual Design

The EP Manual [12] methodology and the design criteria described above were used to develop the conceptual design for the EPF summarized in **Table 30** below.

Table 30 – Evaporation Pond Facility Area

	Process Water (48,000 mg/L)		Evaporation Pond Area		
			Surface	Total	
	(MGD)	(AFY)	(Acres)	(Acres)	(Sq. Mi.)
Existing SAWPA Service Area	4.5	5,091	920	1,196	1.9
Expanded Service Area	**8.8**	**9,915**	**1,792**	**2,330**	**3.6**