REVISED DRAFT ECONOMIC ANALYSIS

Proposed Basin Plan Amendment to
Revise the Water Quality Objective for
Nitrate-Nitrogen in the
Chino South Groundwater Management Zone

Lead Agency:

Santa Ana Regional Water
Quality Control Board

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Section 1
Introduction

Federal law requires states to establish water quality standards (beneficial uses, water quality criteria, and an antidegradation policy) for all surface water bodies within the state's jurisdiction and to review those standards at least once every three years. The Porter-Cologne Water Quality Control Act (Division 7, "Water Quality," of the California Water Code) establishes similar requirements in state law for both surface waters and groundwaters. For the Santa Ana Region, these standards are established in the Water Quality Control Plan for the Santa Ana River Basin (aka "Basin Plan"). In California, water quality criteria are known as "water quality objectives."

The California Regional Water Quality Control Board, Santa Ana Region (Santa Ana Water Board or Regional Board) is considering revising Table 4-1 in the Basin Plan to change the water quality objective for nitrate as nitrogen in the Chino-South Groundwater Management Zone (CS GMZ) from its current value of 4.2 mg/L to a new value of 5.0 mg/L[1]. No other changes to the Basin Plan are being proposed by the Regional Board.

The current nitrate-nitrogen objective of 4.2 mg/L was established by the Regional Board as part of a larger Basin Plan update in 2004 (adopted under Resolution No. R8-2004-0001) and is intended to represent the best water quality attained since the state antidegradation policy was established in 1968. This "antidegradation objective" was computed as the volume-weighted average nitrate-nitrogen concentration in the Chino-South GMZ using water quality sampling data collected between 1954 and 1973.

As the Lead Agency, the Regional Board is required by California law to consider potential economic impacts when considering amendments to the Basin Plan. Accordingly, this Economic Analysis has been prepared to address the potential costs associated with the proposed basin plan amendment (proposed project) in comparison with costs associated with the no-project alternatives. This economic analysis is not intended to provide definitive estimates of costs for the project versus no project alternatives; rather, the analysis provides relative, concept-level costs.

The economic analysis for the proposed amendment and the no action alternatives includes two specific elements:

- *Implementation Costs* – This element addresses the direct implementation costs specific to the alternative, including capital expenditures, long term operation and maintenance (O&M) costs, including monitoring, labor costs, and Program of Implementation costs

[1] By convention, nitrate is typically expressed in terms of nitrate as nitrogen in this technical memorandum. "Nitrate," "nitrate-N," "nitrate-nitrogen," and "NO_3-N" all refer to nitrate as nitrogen, with a maximum contaminant level (MCL) of 10 milligrams per liter (mg/L). However, in Section 4, potential cost impacts to the Chino Desalter Authority are based on concentrations of nitrate expressed as nitrate. The text will be clear in Section 4 when nitrate as nitrate is used.

(associated with amendments to the Basin Plan). For this analysis, the costs estimates were conducted at the concept level.

- *Regional Economic Effects* – A regional economic effects analysis considers the qualitative changes in regional economic activity as a result of a project or action. Effects are evaluated in factors such as employment, income, economic output, and other economic parameters. Total effects include direct, indirect, and induced effects. Indirect and induced effects are the result of "multiplier effects" and account for changes in business activity of support industries and changes in household income as a result of a direct effect. Indirect economic effects can also occur as a result of environmental impacts.

1.1 Regulatory Setting

California Law requires a consideration of economics when: (i) establishing water quality objectives (Water Code section 13241[2]); and (ii) when adopting an amendment that will require the installation of pollution control equipment or is a performance standard or treatment requirement (Public Resources Code section 21159[3]).

1.1.1 California Water Code Section 13241

California Water Code Section 13241 requires that the Regional Board consider six elements when adopting or modifying water quality objectives. The Water Code allows that the "it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses.[2]" In potentially allowing for those changes in water quality, the Regional Board must consider

1. Past, present, and probable future beneficial uses;
2. Environmental characteristics of the hydrographic unit under consideration, including the quality of water;
3. Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area;
4. Economic considerations;
5. The need for developing housing within the region;
6. The need to develop and use recycled water.

1.1.2 California Public Resources Code Section 21159

California Public Resources Code Section 21159 requires that an agency must perform "an environmental analysis of the reasonably foreseeable methods of compliance" for "…a rule or regulation that requires the installation of pollution control equipment or a performance standard or treatment requirement…The environmental analysis shall take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and specific sites."

[2] http://law.onecle.com/california/water/13241.html
[3] http://codes.findlaw.com/ca/public-resources-code/prc-sect-21159.html

Section 2

Proposed Action Description

2.1 Background

Federal law requires states to establish water quality standards (beneficial uses, water quality criteria, and an antidegradation policy for all surface water bodies within the state's jurisdiction and to review those standards at least once every three years. The State Water Resources Control Board (State Water Board) sets statewide policy, and, together with the nine Regional Boards, implements state and federal laws and regulations. Each of the Regional Boards, including the Santa Ana Regional Board, is required to adopt a Water Quality Control Plan or Basin Plan subject to approval by the SWRCB that identifies the beneficial uses of the surface and groundwaters in each region and local water quality conditions and problems. Under the Porter-Cologne Water Quality Control Act (California Water Code, Division 7, Chapter 2 §13050), establishment of water quality standards, including beneficial uses and water quality objectives, is required for all waters of the state (surface and groundwater). In California, water quality criteria are known as "water quality objectives."

The current Basin Plan for the Santa Ana region was adopted in 1995 and updated in 2004 and 2008. Minor editorial corrections were made to Chapter 4 in 2011. The Basin Plan establishes water quality standards for the surface and groundwaters of the Santa Ana region and provides the basis for the Regional Board's regulatory programs. The Basin Plan designates the beneficial uses of specific waterbodies within the Santa Ana region and establishes water quality objectives for the protection of these uses. The Basin Plan also establishes distinct groundwater management zones (GMZs) to set water quality standards for groundwater.

2.1.1 2004 Basin Plan Amendment

In 2004, Regional Board amended the Basin Plan to better control the discharge of nitrate and total dissolved solids (TDS) to local surface waterbodies and groundwater. Resolution Number R8-2004-0001 established new groundwater management zones (GMZ), revised nitrate-nitrogen and TDS objectives, revised TDS and nitrate Waste Load Allocations (WLAs) for discharges of wastewater to the Santa Ana River and its tributaries, and revised reach designations for selected waterbodies.

Figure 2-1 shows the current GMZ boundaries and water quality objectives for nitrate and TDS, as amended in 2004. GMZs are intended to be hydrologically-distinct groundwater units from a groundwater flow and water quality perspective. The Basin Plan identifies 37 separate GMZs and assigns appropriate water quality objectives for TDS and nitrogen for each. In general, the groundwater management zone boundaries are consistent with groundwater

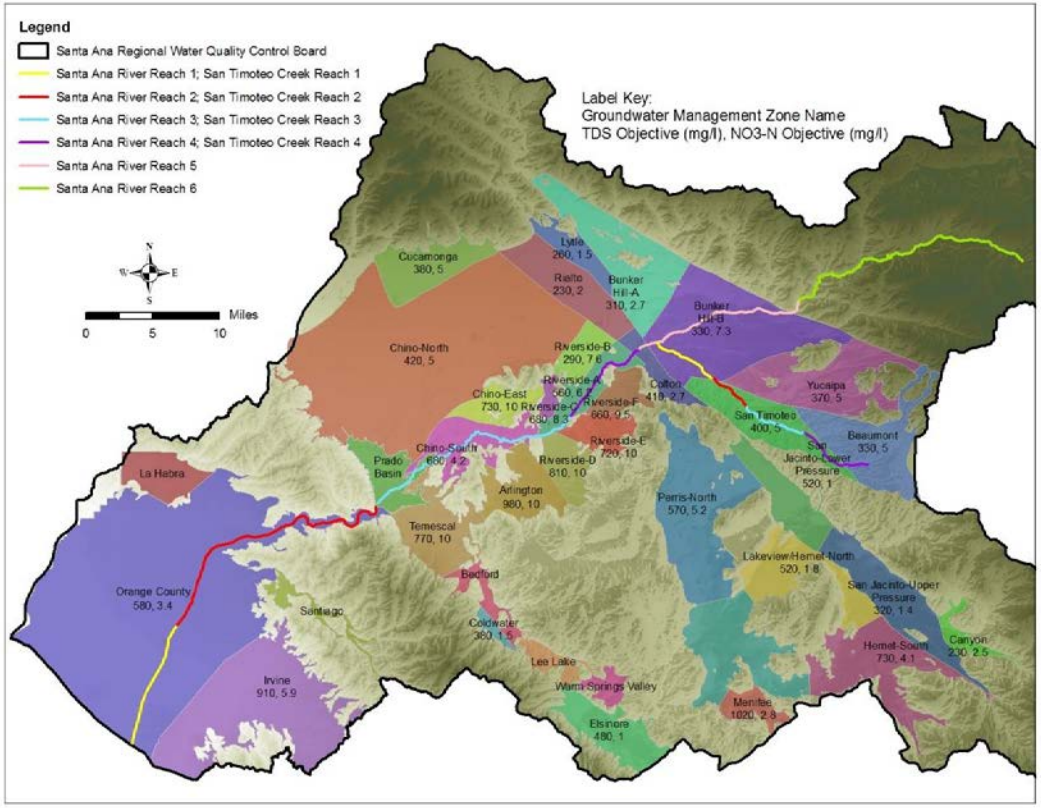

Figure 2-1 Groundwater Management Zones and Water Quality Objectives for TDS and Nitrate-Nitrogen (NO_3-N) based on Basin Plan amendment to update the Salt Management Plan (Resolution No. R8-2004-0001)

flow regimes and include well-defined areas of recharge and discharge. As shown on Figure 2-1, a water quality objective of 4.2 mg/L for nitrate was adopted in the Chino-South GMZ. The objective was computed as the volume-weighted average concentration of nitrate based on all sampling data collected beginning for in 1954 and ending in 1973 (*e.g.*, the baseline evaluation period).[4]

As part of the same 2004 Basin Plan amendment, the Regional Board approved an updated WLA for nitrogen (and TDS) to prevent degradation of water quality in the Chino-South GMZ (and other GMZs) that are recharged by flows in the Santa Ana River system. These WLAs are the basis for National Pollutant Discharge Elimination System (NPDES) permit effluent limitations on nitrogen (and TDS) in treated municipal effluent (wastewater) discharges to those segments of the Santa Ana River that overlie the Chino-South GMZ. All affected NPDES permits include effluent limitations that are consistent with the approved WLAs. This includes a limit for total inorganic nitrogen (TIN) of 10 mg/L.[5]

The 2004 Basin Plan Amendment also contained provisions that required implementation of a long-term watershed-wide monitoring program to determine compliance with water quality objectives and to assess the status and trends of nitrate and TDS concentrations throughout the watershed. The Basin Monitoring Program Task Force (BMPTF) formed by local stakeholders and facilitated by the Santa Ana Watershed Project Authority (SAWPA) implements the monitoring requirements. The monitoring data are used to assess whether applicable water quality standards are being attained, determine if any assimilative capacity[6] exists in each groundwater management zone, and, when needed, revise wasteload allocations.

In the Chino-South GMZ, the current ambient groundwater concentrations of nitrate for the most recent recomputation period is well above the water quality objective of 4.2 mg/L. Thus, there is no assimilative capacity for nitrate or TDS in the Chino-South GMZ. When there is no assimilative capacity, the State Water Board has stated that, "Where the constituent in a groundwater basin is already at or exceeding the water quality objective, the Regional Board must set [effluent] limitations no higher than the objectives set forth in the Basin Plan. Exceptions to this rule may be granted where it can be shown that a higher discharge limitation is appropriate due to system mixing or removal of the constituent through percolation through the ground to the aquifer.[2]"

As described below, the Regional Board is proposing to amend the Basin Plan to approve a change to the water quality objective for nitrate in the Chino-South GMZ to resolve the inconsistency.

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[4] Wildermuth Environmental, Inc. TIN/TDS Study Phase 2A of the Santa Ana Watershed, Development of Groundwater Management Zones, Estimation of Historic and Current TDS and Nitrogen Concentrations in Groundwater, Final Technical Memorandum. July 27, 2000.

[5] The concentration of TIN can be approximated (in the range of pH conditions normally observed in the Santa Ana stream system) as the sum of nitrate + ammonia + nitrite. Ammonia and nitrite may be transformed into nitrate-nitrogen by natural chemical and biological processes in the environment. The Regional Board takes this into consideration by imposing effluent limits for TIN to ensure attainment of nitrate objectives in the receiving water.

[6] Assimilative capacity refers to the ability of a water body to naturally absorb and use a substance without impairing water quality or harming aquatic life. If current pollutant concentrations are the same or greater than the water quality objective, then no assimilative capacity exists for that pollutant.

2.1.2 Nitrate Objective

California has established a Primary Maximum Contaminant Level (MCL) of 10 mg/L for nitrate in drinking water.[7] However, because water quality in the Chino-South GMZ, during the baseline evaluation period, was better than necessary to protect the designed beneficial use, the nitrate objective was set to 4.2 mg/L in order to preserve and maintain this higher quality as is required by the antidegradation policy.[8]

The Chino-South GMZ antidegradation nitrate objective was established in 2004; since then, more recent data show that groundwater quality in the Chino-South GMZ is degrading. Groundwater samples collected for the 20-year period beginning in 1978 and ending in 1997 showed that the nitrate concentration had increased by more than 100 percent to a volume-weighted average of 8.8 mg/L. Routine reassessments, performed every three years, indicate that nitrate levels continue to rise in the Chino-South GMZ (see Figure 2-2). The most recent computation, using data collected in the 20-year period from 1993 to 2012, indicates that the volume-weighted average nitrate concentration is now approximately 28 mg/L.

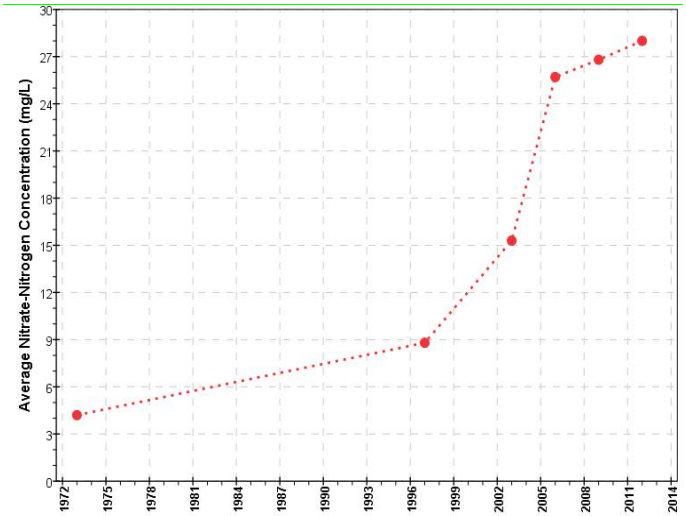

Figure 2-2 Long-Term Trend for Average Nitrate Concentrations in the Chino-South GMZ Average Nitrate Concentrations in the Chino-South GMZ[9]

[7] 22 CCR §64431(a); see Table 64431-A: Maximum Contaminant Levels for Inorganic Chemicals.

[8] Antidegradation refers to avoiding a lowering of existing water quality standards as prescribed under SWRCB Resolution 68-16, Statement of Policy with Respect to Maintaining High Quality Of Waters in California. Resolution 68-16 requires that existing water quality be maintained even if it is better than the established standards unless it can be demonstrated that a change would be consistent with providing maximum benefit to the people of California; would not unreasonably affect present and anticipated beneficial use of such water; and would not result in water quality that is less than that prescribed. State Water Resources Control Board Resolution No. 68-16: Statement of Policy with Respect to Maintaining High Quality Waters in California. (October 28, 1968).

[9] Wildermuth Environmental, Inc. Recomputation of Ambient Water Quality in the Santa Ana Watershed for the Period 1993 to 2012. Technical Memorandum prepared for the Santa Ana Watershed Project Authority Basin Monitoring Program Task Force. August, 2014. (see Table 3-2 in original).

The pattern of nitrate concentrations evident from comprehensive well monitoring data throughout the Chino-South GMZ indicates that the long-term degradation of water quality is most likely due to past land use practices in the area. Nitrates that originated from widespread use of fertilizer or the dairy operations that were once prevalent in the area have been slowly seeping into the groundwater for many years. Most of these legacy nitrate loads occurred when there was little or no regulatory control over such discharges. Today, most of these agricultural operations have been displaced by urbanization. But, the problem will continue until the excess nitrates are finally flushed from the vadose (unsaturated) zone. Prior experience in the Pomona area, where urban development displaced the once-dominant agricultural land used, suggests that it takes about 50 years to purge the vadose zone.

Because the current ambient average concentration (28 mg/L) is greater than the applicable water quality objective (4.2 mg/L), the Regional Board has determined that there is no assimilative capacity for nitrate in the Chino-South GMZ.

The Regional Board relies on a Waste Load Allocation Model (WLAM) to derive appropriate discharge limitations for wastewater discharges to the Santa Ana River system while taking into account the nitrate reductions that occur through system mixing or as a result of percolation through the streambed sediments.[10] The WLAM is a predictive tool that can assess whether projected flows percolating to groundwater from surface streams comply with the applicable water quality objectives for that area. The WLAM takes into consideration the quantity and quality of all flows projected to be present in the surface stream including both stormwater runoff and discharges of wastewater. Results from the WLAM analysis are used to establish appropriate effluent limits governing TIN and TDS concentrations in wastewater discharged to surface waters throughout the region.

The WLAM takes into account system mixing using more than 60 years of daily precipitation and streamflow data to estimate the volume and quality of stormwater runoff draining to the Santa Ana River. The WLAM also accounts for the nitrate removal that occurs as water flows downstream and percolates through the vadose zone. The Regional Board has approved a site-specific nitrogen loss coefficient of 50 percent for streambed recharge to groundwater where the Santa Ana River overlies the Chino-South GMZ.[11]

The WLAM is periodically updated and re-run to adjust for changes in land use, wastewater discharges and precipitation patterns. The most recent update, completed in early 2015, shows that the long-term (63-year) average concentration of TIN[12] in water recharging the Chino-South GMZ from Reach 3 of the Santa Ana River ranges from 4.03 mg/L to 4.14 mg/L depending on how much wastewater is discharged versus how much is used as recycled water.[13] This suggests that the current NPDES permit limits, which specify an average annual TIN concentration no greater

[10] Wildermuth Environmental, Inc. TIN/TDS Study - Phase 2B of the Santa Ana Watershed, Wasteload Allocation Investigation Technical Memorandum. October, 2002.

[11] See pg. 5-21 of the Basin Plan (Jan. 24, 1995; updated Feb., 2016).

[12] Total inorganic nitrogen = nitrite + nitrate+ ammonia nitrogen

[13] Wildermuth Environmental, Inc. Addendum to the 2008 Santa Ana River Wasteload Allocation Model Report: Scenario 8. Technical Memorandum. January 5, 2015.

than 10 mg/L, would ensure compliance with the nitrate objective for the Chino-South GMZ over the long run.[14]

Data from the most recent WLAM analysis also indicates that the highest average concentration of TIN in water recharging to the Chino-South GMZ corresponds to periods with lower than average precipitation (droughts) and, therefore, less dilution from the related runoff. Review of the results show that during the driest 10-year portion of the entire 63-year meteorological simulation period, the maximum average concentration of TIN in water recharging to the Chino-South GMZ is expected to range from 4.25 mg/L to 4.34 mg/L depending on how much treated effluent is recycled versus discharged. As shown in Table 1, at such times, the maximum average TIN concentration in water percolating from the Santa Ana River to the Chino-South GMZ will be about 3.3 percent (0.14 mg/L) higher than the nitrate objective.[15]

Table 2-1 Average TIN Concentrations in Water Recharged to the Chino-South GMZ from Reach-3 of the Santa Ana River (2020 land use conditions)

Metric	Scenario 8d: Max. Recycle	Scenario 8e: Intermediate	Scenario 8f: Max. Discharge
Long-Term Average (63 years)	4.03 mg/L	4.10 mg/L	4.14 mg/L
Single Highest 10-year Average	4.25 mg/L	4.31 mg/L	4.34 mg/L
Probability that average recharge quality will exceed 4.2 mg/L in any 10-year-period	11.1%	30.2%	44.4%
Maximum amount the Basin Plan objective would be exceeded	0.05 mg/L 1.1%	0.11 mg/L 2.6%	0.14 mg/L 3.3%

Although the exceedance of the nitrate objective is relatively small when it occurs, and the long-term average still complies with the Basin Plan objective, results from this WLAM analysis complicate the process of issuing permits for wastewater discharges flowing into Reach 3 of the Santa Ana River. Federal and state law require the Regional Board to establish effluent limits that will ensure that these discharges will not cause or contribute to an exceedance of water quality objectives. The permit limits must ensure compliance under all conditions that may reasonably occur including multiple years of lower than normal precipitation. Since there is no way to accurately predict at the time the permits are issued what the future rainfall pattern will be, more restrictive effluent limitations may be deemed necessary to ensure consistent compliance with the objective.

At present, all of the NPDES permits for wastewater discharges to Reach 3 of the Santa Ana River restrict the average TIN concentration to not more than 10 mg/L[16]. However, because the WLAM indicates that imposition of this current effluent limit does not ensure consistent short-term compliance with the water quality objective in the Chino-South GMZ during droughts, the Regional Board may be obligated to impose more stringent effluent limits unless some other adjustment is made to address the short-term compliance issue.

[14] See Basin Plan, Chapter 5 Implementation, TDS and Nitrogen Management, III. TDS/Nitrogen Management Plan, B. TDS and Nitrogen Regulation, 3 Nitrogen Loss Coefficients.

[15] Wildermuth Environmental, Inc. Addendum to the 2008 Santa Ana River Wasteload Allocation Model Report: Scenario 8. Technical Memorandum. January 5, 2015.

[16] NPDES permits specify the TIN limitation as a running 12-month flow-weighted average.

2.2 Proposed Amendment

The Proposed Action consists of an amendment to the Basin Plan to raise the nitrate objective in the Chino-South GMZ to resolve the current inconsistency. The amendment consists of amending Table 4-1 in the Basin Plan to revise the water quality objective for nitrate in the Chino-South GMZ from its current value of 4.2 mg/L to a new value of 5.0 mg/L.

As described in Section 2.1 above, the current nitrate objective of 4.2 mg/L was established by the Regional Board in 2004 based on baseline evaluation of all sampling data collected in 1954 through 1973. Over time, the average nitrate concentration in the Chino-South GMZ has been rising and the most recent estimate, based on sampling data collected between 1993 and 2012, indicates the volume-weighted average nitrate concentration now stands at about 28 mg/L. The long-term increase is caused by legacy loads of nitrogen that resulted from past agricultural / livestock practices and are moving through the vadose zone. Urbanization has since displaced most of these former agricultural operations but water quality in the Chino-South GMZ may continue to be adversely affected for many years until nitrates are flushed from the vadose zone. Prior experience in the Pomona area, where urban development displaced the once-dominant agricultural land used, suggests that it takes about 50 years to purge the vadose zone.

Until then, the discharge of large quantities of treated municipal effluent at no more than 10 mg/L TIN to Reach 3 of the Santa Ana River, which overlies and recharges the Chino-South GMZ, will help reduce the average nitrate concentration in the Chino-South GMZ. The Proposed Action would accommodate these ongoing discharges without requiring significant expenditures to provide additional treatment that might otherwise be required to ensure objective compliance during drought periods.

Raising the water quality objective for nitrate in the Chino-South GMZ from 4.2 mg/L to 5 mg/L would have no adverse impact on the beneficial uses of the GMZ. Most importantly, a 5 mg/L nitrate objective is half of the Primary MCL established to protect drinking water uses and prevent methemoglobinemia.

Applying the 50 percent nitrogen loss coefficient established in the Basin Plan, wastewater discharged at an average TIN concentration of 10 mg/L would enter the aquifer at no more than 5 mg/L. Thus, continuing to meet the current effluent limits would ensure that wastewater discharges could meet a 5 mg/L nitrate objective in groundwater without needing to rely on any stormwater dilution to make this demonstration.

Raising the nitrate objective to 5 mg/L would not result in less stringent effluent limitations for the wastewater treatment plants: effluent limitations of 10 mg/L TIN would continue to be specified in relevant NPDES permits pursuant to the established WLAs. Thus, the change in objective would not raise concerns with regard to federal anti-backsliding regulations. [17]

Raising the objective would avoid the need to impose more restrictive permit limits in order to address the short-term compliance issues that may arise because of drought conditions, as

[17] 40 CFR §122.15(i) implementing 33 U.S.C. §1342(o) [§402(o) of the Clean Water Act]

discussed above. In turn, this would avoid costs associated with meeting more restrictive effluent limits. This finding takes into account the facts that:

1) The existing and reasonably foreseeable future nitrate concentrations in the GMZ are and will be driven by legacy nitrogen loading from the vadose zone;

2) Wastewater discharges currently provide dilution and improvement of GMZ quality conditions. Comprehensive water quality data reveal that the lowest nitrate concentrations measured in the Chino-South GMZ are found in those areas of the aquifer closest to the Santa Ana River. The discharge of large volumes of wastewater effluent to Reach 3 of the River is not causing or contributing to the problem in the GMZ; rather, it is part of the long-term solution for improving groundwater quality; and

3) The beneficial uses of the GMZ would continue to be protected even if the nitrate objective is raised and no treatment beyond that already provided is necessitated.

As previously noted, significant additional treatment costs may result in the relocation of wastewater discharges to avoid those costs. Relocation of the discharges would mean that these wastewater discharges would no longer provide dilution of nitrogen (and TDS) in the Chino-South GMZ.

2.3 Identification of Reasonably Foreseeable Methods of Compliance

As discussed previously, while the Regional Board cannot specify the particular manner of compliance, with orders it adopts, the analysis conducted for this SED must address possible environmental impacts of the reasonably foreseeable methods of compliance, taking into account a range of environmental, economic, and other factors.

Currently, a variety of methods are in place and being implemented in an effort to achieve compliance with the Basin Plan objectives, including source control programs, advanced treatment of effluent, reuse of effluent, and programs aimed at reducing urban runoff and stormwater pollution through implementation of structural and non-structural Best Management Practices (BMPs). The wastewater treatment plants in the Santa Ana River watershed are implementing Best Practicable Treatment or Control (BPTC) for TIN and operate advanced nitrification and denitrification systems.

The proposed amendment involves adoption of a revised nitrate objective, which would not trigger the need for upgrading technologies to reduce nitrate concentrations or other compliance mechanisms that would not otherwise occur should the proposed amendment not be adopted. In other words, BPTCs would continue to be implemented and maintained whether or not the proposed amendment is adopted. In addition, the amendment is not anticipated to substantially change the manner or type of BPTC or other compliance methods that may be implemented in the future.

As the water quality of receiving waters would be maintained and would not be allowed to deteriorate, no adverse changes to the water quality of the receiving water are anticipated. Thus,

the proposed revision to the nitrate objective would not result in the need for BPTC or implementation of other compliance methods that would not otherwise occur should the amendment not be approved. Should new BPTC or other compliance methods associated with the Proposed Action be implemented, a project-specific economic review would be conducted by the lead agency and any potential economic impacts would be addressed during that process.

Section 3

Environmental Setting

3.1 Surrounding Land Uses and Setting

The Santa Ana River watershed is located in southern California, south and east of the City of Los Angeles. In very broad terms, the Santa Ana Region is a group of connected inland basins and open coastal basins drained by surface streams flowing generally southwestward to the Pacific Ocean. It is the smallest of the State's nine regions at approximately 2,800 square miles. It includes the upper and lower Santa Ana River watersheds, the San Jacinto River watershed, and several other small drainage areas. It includes the northern portion of Orange County, the northwestern corner of Riverside County, and the southwestern corner of San Bernardino County.

The Santa Ana Basin is one of the most densely populated of the nine Regions, with approximately 5 million people living in the region. Land use ranges from pristine forests to highly developed urban areas. The area is subject to a variety of pollution sources from industrial, agricultural and urban activities. Approximately 32 percent of the land use is developed as residential, commercial, or industrial uses. The nature of surface waters in the Basin varies considerably in relation to land use. Surface streams in mountainous/undeveloped areas are generally unmodified while surface waters in developed areas are generally modified/armored to varying degrees to ensure protection from flooding.

River drainages generally flow from the northeast to southwest. The highest elevations of the watershed occur in the San Bernardino, San Gabriel and San Jacinto Mountains. In the central part of the watershed, the Santa Ana Mountains and the Chino Hills form a topographic high before the River flows onto the Coastal Plain and into the Pacific Ocean.

The climate of the Santa Ana Region is classified as Mediterranean: generally dry in the summer with mild, wet winters. The average annual rainfall in the region is about 15 inches, most of it occurring between November and March. Most streams within the basin carry minimal flow throughout most of the year except in response to rainfall events, or as a result of man-made discharges such as wastewater treatment effluent discharges or imported water releases. During the winter season, storms can bring significant rainfall resulting in high flow rates within the River and tributary streams and channels.

3.1.1 Chino-South Groundwater Management Zone (GMZ)

The Chino-South GMZ is located in the extreme northwest corner of Riverside County directly under Reach 3 of the Santa Ana River (see Figure 3-1), primarily underlying the areas of Eastvale, Jurupa Valley, Norco, and Riverside. Land uses overlying GMZ generally consist of mixed urban development and open space.

The Chino-South GMZ was established by the Regional Board when groundwater boundaries were realigned and the Basin Plan was updated in 2004.[18] The Chino-South GMZ is designated MUN to acknowledge the fact that the aquifer serves as a source of domestic or municipal drinking water supply. Other designated beneficial uses include agricultural supply (AGR) industrial service supply (IND), and industrial process supply (PROC).

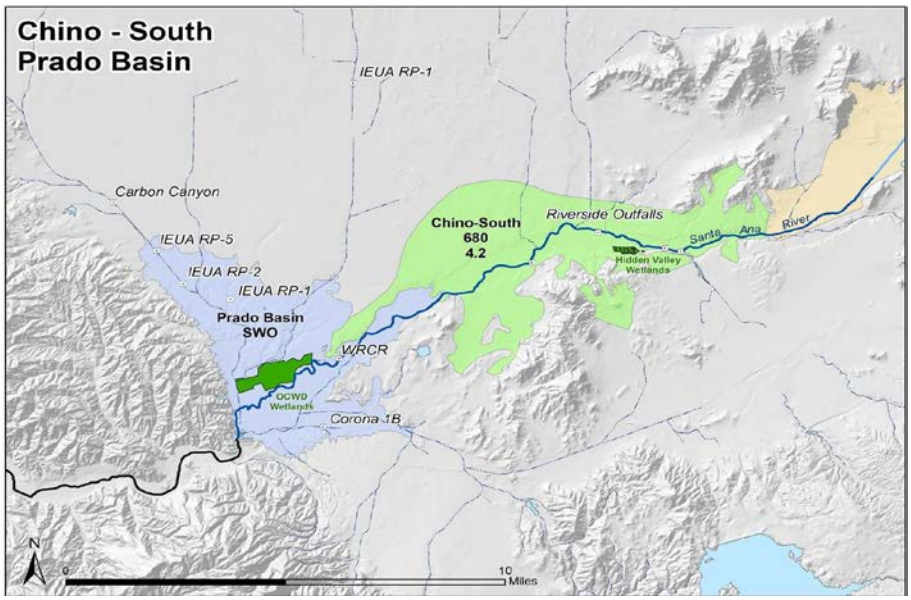

Figure 3-1 Chino-South Groundwater Management Zone[19]

[18] Res. No. 2004-0001 (January 22, 2004).

[19] Map provided courtesy of Wildermuth Environmental, Inc.

Section 4

Economic Analysis

This section presents the Economic Analysis for the proposed basin plan amendment that would change the WQO for nitrate in the CS GMZ from its current value of 4.2 mg/L to a new value of 5.0 mg/L. This increase in the nitrate water quality objective is the proposed action and this analysis will determine the additional cost required for the Chino Desalter Authority (CDA) to pump a blend of native groundwater (current ambient nitrate in the CS GMZ is 28 mg/L) and effluent (at 5 mg/L versus 4.2 mg/L). Potential no-action alternative methods of compliance are the following:

- Additional nitrate reductions at wastewater treatment plants (WWTPs) by upgrading the plants
- Physically moving the WWTP discharge locations downstream of CS GMZ (into the Prado Basin Management Zone).
- Purchase and blend State Project Water (SPW) in the Santa Ana River overlying the CS GMZ.

4.1 Proposed Action and the Economic Impact Analysis on CDA

The CDA owns and operates the Chino I and Chino II Desalter facilities (Chino I and Chino II). Chino I and Chino II purify brackish groundwater extracted from the lower Chino Basin prior to distribution to CDA's member agencies. The Analysis of CDA's annual operating costs was completed in the following steps:

1. Establish the potential impact on groundwater quality should groundwater TDS and nitrate concentrations increase as a result of the proposed change to the water quality objectives. Current NPDES permits restrict the average TIN concentration of the WWTP effluent to be less than or equal to 10 mg/L; applying the nitrogen loss coefficient would result in concentration of 5 mg/L when the effluent reaches groundwater (not including dilution). The WWTP discharge limits are not anticipated to change due to anti- federal antibacksliding regulations.
2. Review process flow diagrams for Chino I and Chino II to identify process units that would be impacted by the potential increase in groundwater TDS and nitrate concentrations.
3. Develop TDS and nitrate mass balances for Chino I and Chino II to evaluate the economic impact of increasing groundwater TDS and nitrate concentrations on facility operations.
4. Estimate the economic impact of the potential increase in groundwater TDS and nitrate concentrations on the Chino I and Chino II annual operating costs.
5. Summarize the results of the Economic Analysis.

The assumptions applied and the analysis performed to complete each of these steps is summarized in the sections that follow.

4.1.1 Establish Potential Impact on Groundwater Quality

To determine the impact on the Chino I and Chino II operating costs, the following assumptions were applied to establish the potential change in water quality for the portion of the Chino Basin groundwater that can be attributed to the Santa Ana River.

- The Santa Ana River nitrate concentration is equal to the anticipated future wastewater treatment plant (WWTP) regulatory discharge limit for total inorganic nitrogen (TIN) (TIN = 10 mg/L).
- All of the TIN in the Santa Ana River is measured as nitrate. This is a conservative assumption since the actual nitrate concentrations in the Santa Ana River would be less than 10 mg/L-N.
- Half of the nitrate from the Santa Ana River is removed during soil aquifer treatment (SAT) prior to mixing with Chino Basin groundwater; resulting in a nitrate concentration of 5.0 mg/L in the portion of the groundwater attributed to the Santa Ana River.
- Half of the raw groundwater purified at Chino I and Chino II can be attributed to the Santa Ana River. The remaining half is attributed to 'other' groundwater sources in the Chino Basin. WEI (2016) states that, "Based on Chino Basin groundwater modeling results, approximately 50% of CDA production originates from Santa Ana River (SAR) recharge."[20]
- The nitrate and TDS concentrations in groundwater contributions to the Chino Basin from 'other' sources are not impacted by the hypothetical increase of nitrate in the Basin Plan objectives.
- For every incremental increase in groundwater nitrate concentration, there is an equal incremental increase in groundwater TDS concentration.
- The nitrate concentration of the native groundwater attributed to the Santa Ana River prior to the hypothetical increase in the Basin Plan objective for nitrate is 4.2 mg/L-N.
- The TDS concentration of the native groundwater attributed to the Santa Ana River is 500 mg/L.

Based on the assumptions above, it can be concluded that changing the Basin Plan objective for nitrate from 8.4 mg/L to 10 mg/L would result in a 0.8 mg/L increase in nitrate and a 0.8 mg/L increase in TDS in the portion of the raw groundwater that can be attributed to the Santa Ana River.

[20] WEI. 2016. Table entitled, "Potential Increase in Nitrate Mass in CDA Production Resulting from the Proposed Increase in Nitrate-N Objective for the Chino-South Groundwater Management Zone."

4.1.2 Review Process Flow Diagrams

The process flow diagrams used in the economic analysis are provided in Figure 4.1 for Chino I and Figure 4.2 for Chino II. The concentrate reduction facility (CRF) shown in Figure 4.2 is a new facility that is not yet in service. The CRF will provide additional treatment to recover additional product water from the reverse osmosis (RO) brine.

The economic analysis on CDA's annual operating cost is based on the assumption that any potential increase in groundwater TDS and nitrate concentration will impact only the feed water quality and operation of the RO and ion exchange (IX) systems. As such, the treated water quality from the RO and IX systems would match the treated water quality prior to any potential increase in groundwater TDS and nitrate concentrations because the RO and IX system operations would be adjusted to provide the same treated water quality. Specially, the increase in TDS concentration would increase the discharge pressure that the RO feed pumps must overcome and the increase in nitrate concentration would increase the salt consumption and regeneration frequency of the IX systems.

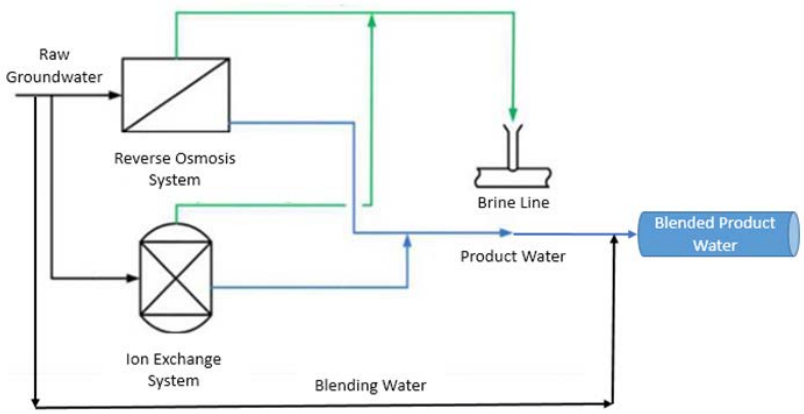

Figure 4-1 Chino I Process Flow Diagram

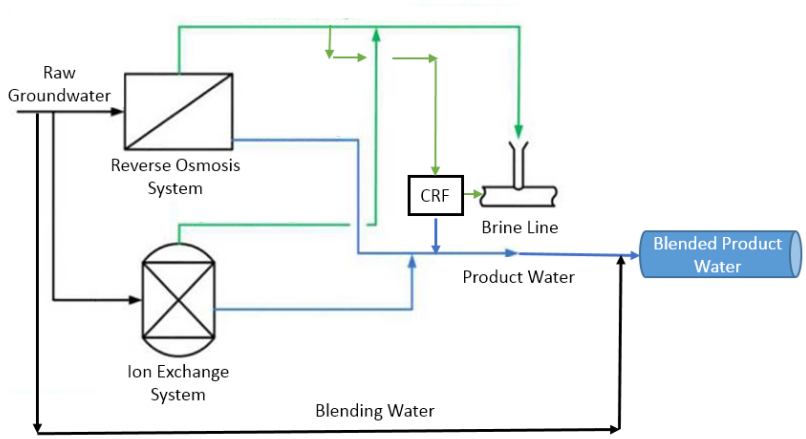

Figure 4-2 Chino II Process Flow Diagram

4.1.3 Develop TDS and Nitrate Mass Balances

Based on the assumptions previously outlined in this TM, mass balances were developed using data obtained from CDA for Chino I and Chino II. The mass balances were used to determine the potential change in RO and IX feed TDS and nitrate concentrations that would result from increasing the Basin Plan objective for nitrate.

The mass balance was developed for two conditions: Nitrate1 and Nitrate2 (Figures 4-3 and 4-4). The Nitrate1 condition corresponds with a nitrate concentration of 4.2 mg/L -Nitrate-N (18.56 mg/L Nitrate-NO_3) in the raw groundwater attributed to the Santa Ana River. The Nitrate-2 condition corresponds with a nitrate concentration of 5.0 mg/L Nitrate-N (22.10 mg/L Nitrate-NO_3) in the raw groundwater attributed to the Santa Ana River. The difference between the two conditions represents an increase in groundwater nitrate concentration of 0.8 mg/L Nitrate-N (3.54 mg/L Nitrate-NO_3) as a result of the potential change in the Basin Plan objective for nitrate.

As shown in Figure ~~3-1~~4-3 for Chino I and Figure ~~3-4~~4-4 for Chino II, the TDS in the raw groundwater that can be attributed to the Santa Ana River under the Nitrate1 condition is 496.46~~9.20~~ mg/L and 500.00 mg/L under the Nitrate-2 condition. The change (*i.e.*, delta) in TDS concentration between the two conditions is 3.54~~0.8~~ mg/L. The delta in RO and IX feed concentrations between the two conditions are 1.77~~0.4~~ mg/L Nitrate-NO_3 for nitrate and ~~0.4~~1.77 mg/L for TDS. The calculated delta values for RO and IX feed TDS and nitrate concentrations are the same for both Chino I and Chino II.

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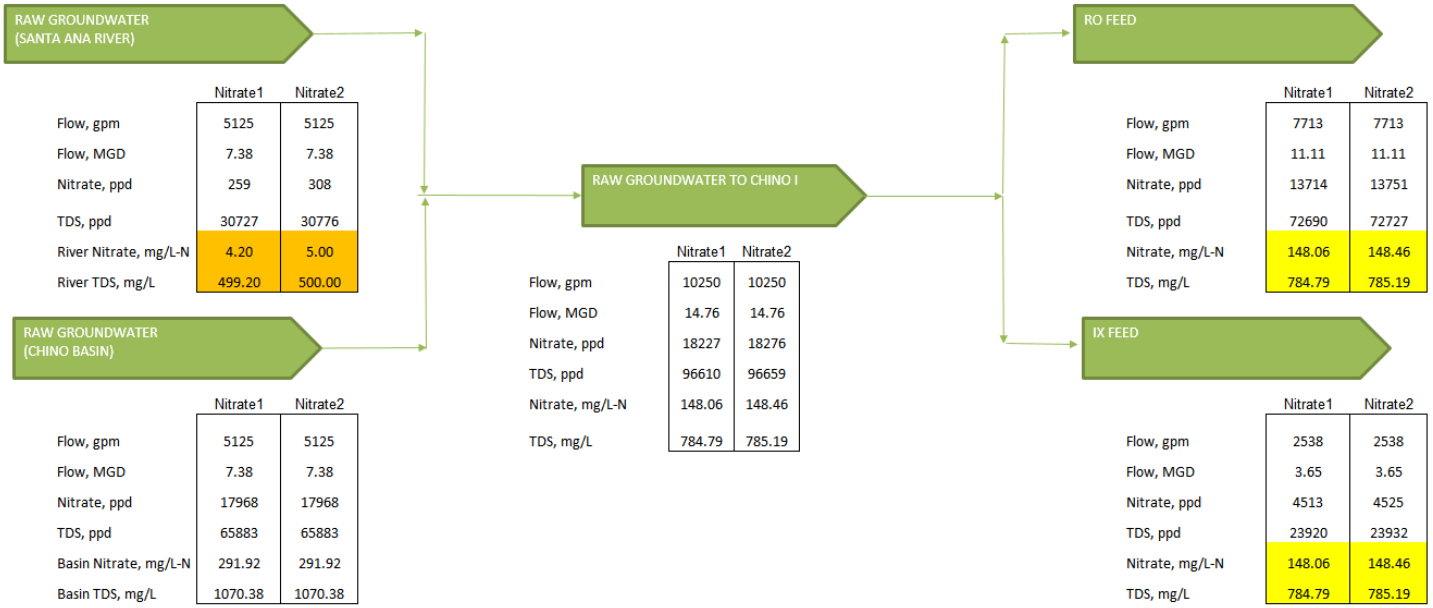

~~Figure 4-3 Chino I Mass Balance (Raw Groundwater through RO and IX Feed)~~

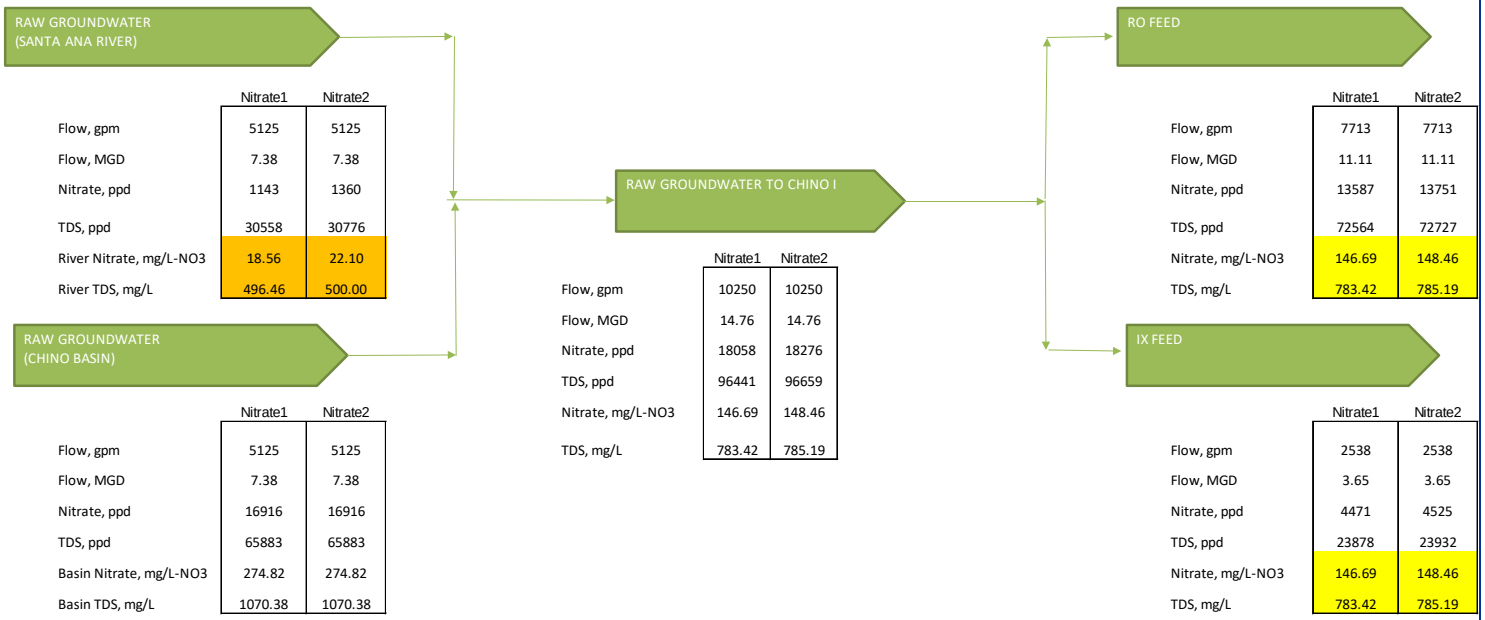

Figure 4-3 Chino I Mass Balance (Raw Groundwater through RO and IX Feed)

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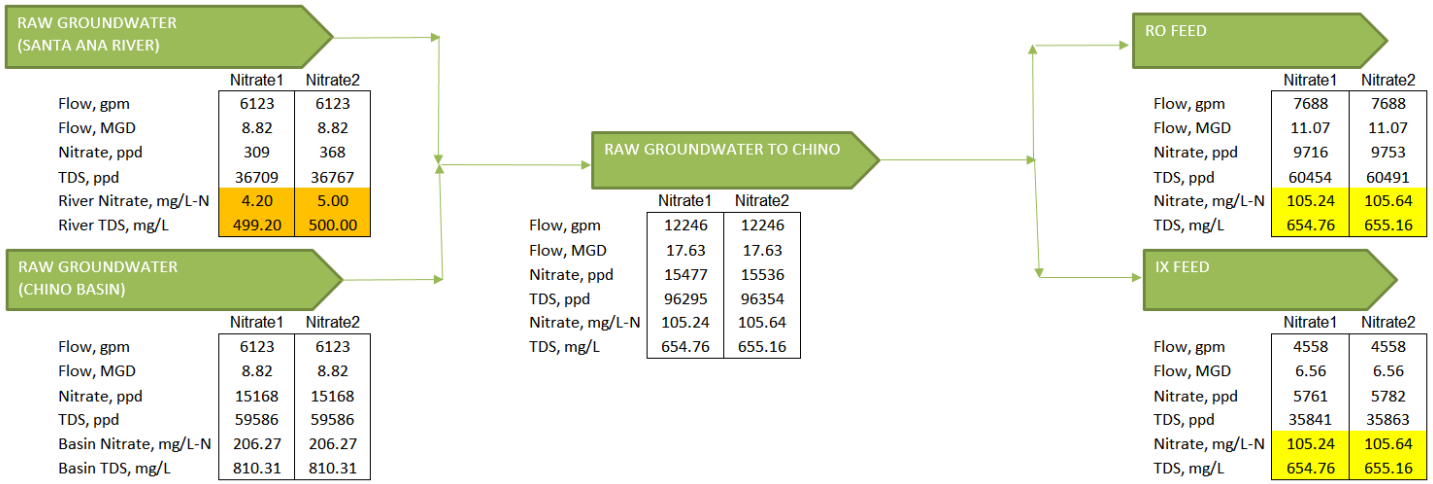

~~Figure 4-4 Chino II Mass Balance (Raw Groundwater through RO and IX Feed)~~

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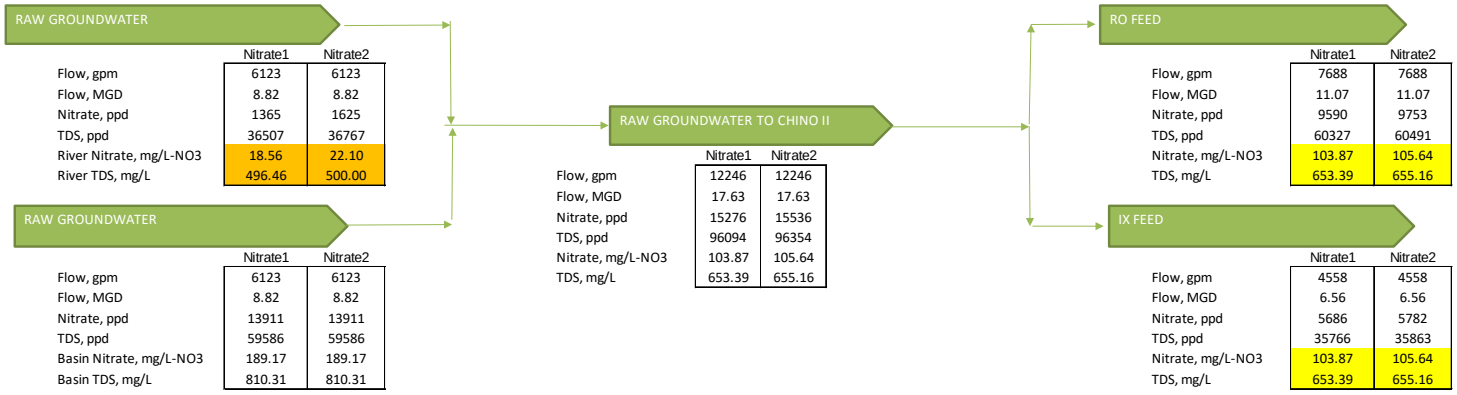

Figure 4-4 Chino II Mass Balance (Raw Groundwater through RO and IX Feed)

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4.1.4 Impact on Annual Operating Cost

The information shown in Figures 4-3 and 4-4 for the RO and IX feed systems was used to estimate the impact of the potential increase in nitrate and TDS concentration on the annual operating costs for Chino I and Chino II. Below is a summary of the key assumptions and the estimated impact on annual operating costs for the RO and IX systems.

The impact on the annual operating cost for the RO system at Chino I and Chino II was evaluated by applying the following assumptions:

- The increase in power draw required to operate the feed pumps is proportional to the increase in RO feed TDS.
- The RO feed pumps operate continuously at 24 hours/day, 7 days/week, 365 days/year.
- Power cost is $0.114/kW-hr.
- Feed pump head is 150 psi.
- Feed pump efficiency is 80%.
- $BHP = \frac{Q\ x\ H}{3960\ x\ n}\ x\ s.g.$

  Where:
  Q = pump flow
  H = pump head
  n = pump efficiency
  s.g. = specific gravity of the liquid being pumped

Additional assumptions and the results of the operating cost evaluation for the RO system are summarized in Table 4-1 for Chino I and Chino II. The impact on annual operating cost of increasing TDS by ~~0.4~~1.77 mg/L in the RO feed is estimated at $1,414~~320~~ for Chino I and $1,690~~382~~ for Chino II.

Table 4-1 Chino I and Chino II RO Feed System Estimated Impact on Annual Operating Cost

Parameter	Unit	Chino I RO Feed	Chino II RO Feed
TDS1 at Nitrate1	mg/L	~~784.79~~783.42	~~654.76~~653.39
TDS2 at Nitrate2	mg/L	785.19	655.16
Change in TDS	%	0.23~~05~~	0.27~~06~~
RO Feed Flow	mgd	11.11	11.07
Feed Pump Power Draw @ TDS1	BHP	843.55	840.88
Feed Pump Power Draw @ TDS2	BHP	841.66~~3.12~~	838.61~~40.36~~
Change in Feed Pump Power Draw	BHP	~~0.43~~1.90	~~0.51~~2.27
Power Cost	$/kW-hr	$0.114	$0.114
Annual Power Cost at TDS1	$/year	$628,183	$626,188
Annual Power Cost at TDS2	$/year	$~~627,863~~626,769	$~~625,805~~624,498

Total Annual Operating Cost Delta		$~~320~~1,414	$~~382~~1,690

The impact on the annual operating cost for the IX system at Chino I and Chino II was evaluated by applying the following assumptions: ~~:~~

- The number of regen cycles/day is proportional to the IX nitrate feed load.
- The brine pumps operate for 80 minutes/regen cycle.
- The IX currently regenerates once every 24 hours for 0.8 MG of water treated.
- The IX system operates continuously at24 hours/day, 7 days/week, 365 days/year.
- Salt cost is $106.08/ton.
- Power cost is $0.114/kW-hr

Additional assumptions used in the estimation of impact on IX annual operating costs are summarized in Table 4-2. The results of the operating cost evaluation for the IX system are summarized in Table 4-3 for Chino I and Table 4-4 for Chino II. The impact on annual operating cost of increasing nitrate by ~~0.4~~1.77 mg/L Nitrogen-NO_3 in the IX feed is estimated at $1,207 for Chino I and $3,050 for Chino II.

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Table 4-2 Chino I and Chino II IX System Assumptions for Estimating Operating Costs

Parameter	Unit	Chino I IX Feed	Chino II IX Feed
Nitrate1	mg-NO_3/L	~~148.06~~146.69	~~105.24~~103.87
Nitrate2	mg-NO_3/L	148.46	105.64
Change in Nitrate	%	~~0.27~~1.21%	~~0.38~~1.70%
Influent IX Flow	mgd	3.65	6.56
Regen Cycles per Day at Nitrate1	--	4.57	8.20
Regen Cycles per Day at Nitrate2	--	4.62~~58~~	8.34~~24~~

Table 4-3 Chino I IX System Estimated Impact on Annual Operating Cost

Parameter		Unit	Value
Nitrate Removal System at Nitrate1			
IX Vessels Regen Cycles/Day		--	4.57
Regenerable Resin per Vessel		cf	668
Total Resin Volume		cf	3052
Regeneration System			
Regen Cycle		hrs	24.00
Salt Volumetric Weight		lb/cf	7.50
Daily Salt Usage		lb/day	22,887
Annual Salt Usage		lb/yr	8,353,658
Brine Pumping (2 pumps/train each @ 2 HP)		HP/regen	4
Pump Run Time		mins/regen	80
Daily Power Draw		KW-hr/day	18.17
Annual Power Draw		KW-hr/yr	6,631
Cost Calculations	**Amount**	**Unit Price**	**Total**
Nitrate Resin Regeneration - Salt	8,353,658	$0.05	$446,000
Brine Pumping	6,631	$0.114	$756
Total Annual Operating Cost @ Nitrate1			**$446,756**
Total Annual Operating Cost @ Nitrate2			**$452,140~~47,963~~**
Chino I Total Annual Operating Cost Delta			**$5,384~~1,207~~**

Table 4-4 Chino II IX System Estimated Impact on Annual Operating Cost

Parameter		Unit	Value
Nitrate Removal System at Nitrate1			
IX Vessels Regen Cycles/Day		--	8.20
Regenerable Resin per Vessel		cf	668
Total Resin Volume		cf	5481
Regeneration System			
Regen Cycle		hrs	24.00
Salt Volumetric Weight		lb/cf	7.50
Daily Salt Usage		lb/day	41,104
Annual Salt Usage		lb/yr	15,002,976
Brine Pumping (2 pumps/train each @ 2 HP)		HP/regen	4
Pump Run Time		mins/regen	80
Daily Power Draw		KW-hr/day	32.63
Annual Power Draw		KW-hr/yr	11,910
Cost Calculations	**Amount**	**Unit Price**	**Total**
Nitrate Resin Regeneration - Salt	15,002,976	$0.05	$801,000
Brine Pumping	11,910	$0.114	$1,358
Total Annual Operating Cost @ Nitrate1			**$802,358**
Total Annual Operating Cost @ Nitrate2			**$816,015~~05,407~~**
Chino I Total Annual Operating Cost Delta			**$13,657~~3,050~~**

A summary of the analysis results are provided in Table 4-5. The economic impact to CDA of increasing the nitrate contribution by 0.8 mg/L Nitrogen-N (3.54 mg/L Nitrate-NO_3) in the native groundwater from the Santa Ana River after SAT is approximately $22,150~~5,000~~ per year.

Table 4-5 Summary of Economic Impact Analysis Results for the Chino Desalter Authority

Operating Costs	Chino I	Chino II
Increase in RO Annual Operating Cost	$1,414~~320~~	$1,690~~382~~
Increase in IX Annual Operating Cost	$~~1,207~~5,384	$~~3,050~~13,657
Total Increase in RO and IX Annual Operating Cost	**$~~1,52~~6,799~~8~~**	**$~~3,433~~15,347**

4.1.5 Regional Economic Effects for the Proposed Action

As discussed in Section 4.1.4, the implementation costs include additional power costs and additional O&M costs and supplies for the IX treatment system. The increase in O&M costs would not warrant hiring of any additional operators. There are no multiplier effects and regional economic effects would be imperceptible.

4.2 Potential No-Action Alternative Methods of Compliance

4.2.1 Wastewater Treatment Plants Upgrades

As discussed in Section 2.1.1, the WLAs are the basis for NPDES permit effluent limitations on nitrogen (and TDS) in treated municipal effluent discharges to those segments of the Santa Ana River that overlie the Chino-South GMZ. All affected NPDES permits include effluent limitations that are consistent with the approved WLAs. This includes a limit for total inorganic nitrogen (TIN) of 10 mg/L. The Regional Board has approved a site-specific nitrogen loss coefficient of 50 percent for streambed recharge to groundwater where the Santa Ana River overlies the Chino-South GMZ. Thus, a nitrate concentration in municipal effluent discharges of 10 mg/L is assumed to result in a nitrate concentration in groundwater of 5 mg/L for groundwater whose origin is municipal effluent.

The concept-level costs to reduce nitrate in the municipal effluent discharges were developed as part of this economic analysis. For the cost estimate, the nitrate discharge concentrations were reduced from 10 mg/L to 8 mg/L (instead of 8.4 mg/L) in order to provide a safety factor. The City of Riverside WQCP Plant 1, with a 26 MGD design capacity was used as an example to determine order of magnitude costs. Two common TIN reductions methods were considered: (i) RO for a s~~S~~idestream of the effluent; and (ii) the introduction of additional carbon to the secondary treatment anoxic zone to provide additional nitrogen reduction.

Figure 4-3 is a schematic that shows the additional RO treatment of a sidestream of effluent that would be necessary to achieve a blended nitrate concentration of 8 mg/L.

> Q_t is the influent for additional treatment of 26 mgd at 10 mg/L (current discharge)
>
> Q_{ri} is the discharge of the ~~S~~sidestream to be treated with further RO (7.5 mgd at 10 mg/L)

Q_{ro} is the product water from the additional RO treatment (6 mgd at 2 mg/L)

Q_t-Q_{ri} is the WWTP effluent that is not undergoing additional treatment (18.5 mgd at 10 mg/L)

$Q_{Blended}$ is the final combined effluent from the WWTP (24.5 mgd at 8 mg/L)

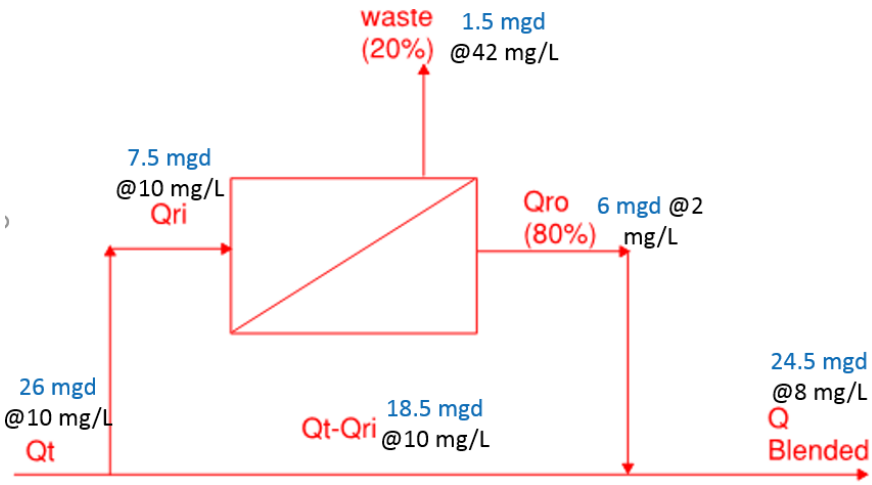

Figure 4-5 Schematic Depicting RO Treatment of a Sidestream of Effluent

Note that, in additional treatment costs, there is additional brine that would need to be managed. Using a rule of thumb cost estimate of $10 per gallon per day, the capital costs for this additional treatment is about $75M.

Nitrate in municipal effluent discharges can also be reduced through the introduction of additional carbon (methanol) to the secondary treatment anoxic zone to provide additional nitrogen reduction. 50 pounds of MeOH would be required per mgd of effluent in the secondary system to reduce nitrate from 10 mg/L to 8 mg/L at a cost of $911 per day, or $332K per year. The capital costs for this 8000-gallon system is assumed to be about $400K.

4.2.2 Modifying WWTP Discharge Locations Downstream of CS GMZ

Another alternative method of compliance is to move the location of the municipal effluent discharge to a location downstream of the CS GMZ. In order to determine the order of magnitude costs, Riverside's WQCP Plant 1 was used as an example. The maximum effluent volume – 33.9 mgd – was used and the discharge point was assumed to be moved 39,854 linear feet (about 7.5 miles).

In order to estimate the pipe size, the effluent flow converted from mgd to cubic feet per second (cfs).

$$Flow\ Rate\left(\frac{ft^3}{s}\right) = \frac{33.9\ million\ gallons}{day} \times \frac{1\ day}{24\ hours} \times \frac{1\ hour}{60\ minutes} \times$$

$$\frac{1\ minute}{60\ seconds} \times \frac{1{,}000{,}000\ gallons}{1\ million\ gallon} \times \frac{0.133681\ ft^3}{1\ gallon}$$

$$Flow\ Rate\left(\frac{ft^3}{s}\right) = 52.5\ \frac{ft^3}{s}$$

The pipeline diameter estimated to be 56 inches to target a flow velocity between 2 and 5 ft/s. The cross-sectional area of a 56-inch diameter pipeline is:

$$Cross\ Sectional\ Area\ (ft^2) = \pi * \left(\frac{56\ inches}{2} \times \frac{1\ foot}{12\ inches}\right)^2 = 17.1\ (ft^2)$$

Calculating flow velocities:

$$Flow\ Velocity\left(\frac{ft}{s}\right) = \frac{flow\ rate\left(\frac{ft^3}{s}\right)}{cross - sectional\ area\ (ft^2)} = \frac{52.5\ \frac{ft^3}{s}}{17.1\ ft^2} = 3.1\frac{ft}{s}$$

A rule of thumb range of cost estimates for pipeline construction ranges from $6 to $12 per linear foot per inch diameter, depending on conditions (urban vs. rural, permitting, etc.) Hence, the range of costs would be:

$$Low\ Cost\ Estimate$$
$$= 39{,}854\ linear\ feet\ \times\ 56\ inch\ diameter\ \times \frac{\$6}{linear\ foot - inch\ diameter}\ = \$13.4\ million$$

$$High\ Cost\ Estimate$$
$$= 39{,}854\ linear\ feet\ \times\ 56\ inch\ diameter\ \times \frac{\$12}{linear\ foot - inch\ diameter}\ = \$26.8\ million$$

In this alternative compliance method, highly-treated municipal effluent would not be available for recharge in the Chino Basin.

4.2.3 Purchase and Blend State Project Water (SPW) in the Santa Ana River Overlying the CS GMZ

Another alternative method of compliance would be to blend the municipal effluent with imported diluent water, *e.g.*, state water project (SWP) water. For this calculation, the following assumptions were made:

C_{ww} = 10 mg/L

Q_{ww} = 33.9 mgd

C_{SWP} = 0.75 to 1 mg/L

Where C_{ww} is the nitrate concentration in the WWTP effluent

Q_{ww} is the wastewater discharge

C_{swp} is the nitrate concentration in SWP water

The objective in this calculation is to determine the volume of SWP water necessary to achieve a blend of WWTP effluent and SWP where the nitrate concentration is 8 mg/L or less.

$$C_{blend} = \frac{(Q_{WW} * C_{WW} + Q_{SWP} * C_{SWP})}{(Q_{WW} + Q_{SWP})}$$

Rearranging

$$Q_{SWP} = \frac{Q_{WW} * (C_{blend} - C_{WW})}{(C_{SWP} + C_{blend})}$$

Solving for Q_{SWP} = 9.35 to 9.69 mgd or 12,600 to 13,100 AFY at a cost of $6.3M to $6.5M per year.

4.2.4 Regional Economic Impacts for Alternative Compliance Methods

Cities would need to pass the cost of WWTP upgrades, pipeline construction and maintenance or the purchase of imported diluent water to their rate payers. Ratepayers would see some reduction in discretionary income and potentially affecting their spending habits within the region. Decreased spending within the regional economy would have an adverse effect in the region, affect total sales of local businesses.

Construction activities associated with WWTP upgrades and/or pipeline construction would increase economic activity in the region due to increases in equipment rentals, purchase of supplies, and employment of engineers and construction workers. These effects would be temporary and only occur during the construction period. It is assumed that annual operations would be completed by existing employees and would not result in an increase in employment in the region.

Section 5

Summary of Economic Analysis

The Proposed Action consists of an amendment to the Basin Plan to raise the nitrate objective in the Chino-South GMZ to resolve the current inconsistency. The amendment consists of amending Table 4-1 in the Basin Plan to revise the water quality objective for nitrate in the Chino-South GMZ from its current value of 4.2 mg/L to a new value of 5.0 mg/L.

As described in Section 2.1 above, the current nitrate objective of 4.2 mg/L was established by the Regional Board in 2004 based on baseline evaluation of all sampling data collected in 1954 through 1973. Over time, the average nitrate concentration in the Chino-South GMZ has been rising and the most recent estimate, based on sampling data collected between 1993 and 2012, indicates the volume-weighted average nitrate concentration now stands at about 28 mg/L. The long-term increase is caused by legacy loads of nitrogen that resulted from past agricultural / livestock practices and are moving through the vadose zone. Urbanization has since displaced most of these former agricultural operations but water quality in the Chino-South GMZ may continue to be adversely affected for many years until nitrates are flushed from the vadose zone. Prior experience in the Pomona area, where urban development displaced the once-dominant agricultural land used, suggests that it takes about 50 years to purge the vadose zone.

Until then, the discharge of large quantities of treated municipal effluent at no more than 10 mg/L TIN to Reach 3 of the Santa Ana River, which overlies and recharges the Chino-South GMZ, will help reduce the average nitrate concentration in the Chino-South GMZ. The Proposed Action would accommodate these ongoing discharges without requiring significant expenditures to provide additional treatment that might otherwise be required to ensure objective compliance during drought periods.

Section 4 presents the Economic Analysis for the proposed basin plan amendment that would change the WQO for nitrate in the CS GMZ from its current value of 4.2 mg/L to a new value of 5.0 mg/L. This increase in the nitrate water quality objective is the Proposed Action and this analysis estimated the additional cost required for the CDA to pump a blend of native groundwater (current ambient nitrate in the CS GMZ is 28 mg/L) and effluent (at 5 mg/L versus 4.2 mg/L). Section 4 also reviewed potential no-action alternative methods of compliance:

- Additional nitrate reductions at wastewater treatment plants (WWTPs) by upgrading the plants.
- Physically moving the WWTP discharge locations downstream of CS GMZ (into the Prado Basin Management Zone).
- Purchase and blend State Project Water (SPW) in the Santa Ana River overlying the CS GMZ.

These costs are summarized in Table 5-1.

Table 5-1 Summary of Concept-Level Costs for the Proposed Action and Alternative Methods of Compliance

Action/Alternate Compliance Method	Method	Capital		O&M	
Cost Impacts to the CDA	Analysis of additional annual O&M			$22.15K	
Nitrate Reduction at WWTP	1. RO Sidestream of Effluent	$75M			
	2. Introduction of Methanol	$400K		$332K	
Move Discharge Locations		$13.4M	$26.8M		
Blend Effluent with SWP				$6.3M	$6.5M