

FINAL REPORT

CONJUNCTIVE USE AND WATER TRANSFERS – PHASE II (TASK 6)

Proposition 84

Department of Water Resources

Integrated Regional Water Management Planning Grant

Northern Santa Cruz County Integrated Regional Water Management

Agreement No. 4600009400

May 2015

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Submitted to:

Regional Water Management Foundation

Department of Water Resources

Table of Contents

Executive Summary.....	5
1.0 Introduction	9
2.0 Background Studies & Plans	13
2.1 Phase I - Prop 50 Conjunctive Use Report	13
2.2 Water Agency Planning Documents	13
2.2.1 City of Santa Cruz Integrated Water Plan	14
2.2.2 Soquel Creek Water District – Integrated Resources Plan.....	14
2.2.3 Scotts Valley Water District – Urban Water Management Plan	14
2.3 Santa Cruz Habitat Conservation Plan (HCP) Efforts.....	15
3.0 Existing Surface Water Sources.....	17
3.1 Tait Street Diversion.....	18
3.2 Felton Diversion	18
3.3 Graham Hill Water Treatment Plant	18
3.3.1 Production Capacity	18
3.3.2 Treatment Requirements.....	19
3.3.3 Treated Water Disinfection.....	19
3.3.4 Washwater and Solids Handling	20
3.3.5 System Operation and Maintenance	20
3.4 Existing Water Rights	20
4.0 Potential Water Transfer Scenarios.....	22
4.1 Assumptions for Potential Water Transfers.....	25
4.1.1 Priority for Water Delivery	25
4.1.2 Source and Diversion Capacity.....	26
4.1.3 Demand and GHWTP Objectives	26
4.1.4 Winter Water Quality in San Lorenzo River	27
4.1.5 System Operations and Maintenance.....	28
4.1.6 Potential Impacts of Climate Change.....	28
4.2 Use of Water for Direct Recharge	28
4.3 Fish Habitat Effects	29
4.4 Transfer of Water to Santa Cruz	31
5.0 Infrastructure Improvements	33

5.1	Tait Street Diversion Improvements.....	33
5.2	Graham Hill Water Treatment Plant.....	34
5.3	Distribution System Connection to Scotts Valley Water District.....	34
5.4	Distribution System Connection to Soquel Creek Water District.....	34
6.0	Potential Scenario Yield and Associated Costs.....	36
6.1	Capital Costs.....	36
6.2	O&M Costs.....	36
6.3	Life-Cycle Unit Water Costs.....	38
7.0	Water Rights.....	40
7.1	Short Term Options.....	40
7.1.1	Transfer of Pre-1914 Appropriative Water Right.....	40
7.1.2	Temporary Urgency Transfer.....	40
7.1.3	Temporary Transfer.....	41
7.1.4	Temporary Urgency Permit.....	41
7.1.5	Excess Municipal Water.....	41
7.2	Long-Term Options.....	41
7.2.1	Long-Term Transfer.....	41
7.2.2	Petition to Change Place of Use.....	41
7.2.3	Application for New Water Rights.....	41
7.3	Fishery and CEQA Issues.....	43
8.0	Next Steps.....	44
8.1	Consideration of Other Conjunctive Use Options.....	44
8.2	Further Technical Evaluations.....	44
8.3	Consideration of Fishery and CEQA Issues.....	45
8.4	Water Rights.....	45
8.5	Institutional Framework.....	45
8.6	Short Term Project.....	46
9.0	References.....	47
10.0	Appendices.....	48
10.1	Appendix A – Water Rights and Fish Habitat Impacts.....	48
10.2	Appendix B – Yield Modeling.....	48
10.3	Appendix C – Infrastructure and Costs.....	48

List of Figures

Figure 1 - Santa Cruz IRWM Water Districts 10

Figure 2 - Santa Cruz IRWM Groundwater Basins 11

Figure 3. Duration curve showing frequency and rate of delivery (mgd) for Scenario 2, Current Tait; and Scenario 3, Unlimited Tait..... 25

Figure 4. Effect of Transfer Diversions on Steelhead Adult Migration below Tait 31

List of Tables

Table 1. Summary of potential water transfer scenarios 7

Table 2 - Current Graham Hill Treatment Plant Capacities (in million gallons per day (mgd))..... 19

Table 3 - Summary of City of Santa Cruz Water Rights..... 21

Table 4 - Potential Water Transfer Scenarios and Yield Estimates 23

Table 5. Average November-April Tait Street Production (mg) (Increased Tait Capacity, Scenario 3) 24

Table 6. Assumed Monthly Demands (millions of gallons) 27

Table 7 – Planning Level Capital Costs 37

Table 8 – Planning Level O&M costs, GHWTP 38

Table 9 – Planning Level Annualized Life-Cycle Unit Water Cost 39

Table 10 - Summary of Water Rights Options 42

EXECUTIVE SUMMARY

This report describes the results of technical, regulatory, and legal studies carried out to further define the feasibility of water transfer options between water agencies in the Santa Cruz Integrated Regional Water Management (IRWM) planning region. This work began in 2007 with Phase I of the Conjunctive Use Feasibility Study, funded by a Proposition 50 Integrated Regional Water Management (IRWM) implementation grant. Further evaluations were conducted in 2012-14 under the current effort, funded by a Proposition 84 IRWM Planning grant. This report presents the results of those evaluations, which can be utilized in the ongoing water supply planning efforts currently underway in the region.

Unlike many regions in the state, the Santa Cruz Integrated Regional Water Management (IRWM) planning region does not receive water imported via state or federal water supply projects. Despite the many benefits of a local water supply, the region's current water demand exceeds sustainable supply resulting in overdrafted aquifers, diminished streamflow, and inadequate long-term supply. These conditions are due in part to the timing of rainfall in the region – most of the rainfall occurs during the winter when demand is lowest. Exacerbating this situation is the situation that local water districts generally utilize only one source of water for supply, which has limited opportunities to better manage resources through conjunctive use.

This report evaluates the feasibility of transferring excess available surface water from the San Lorenzo River during the winter months of November through April. Water would be transferred from the City of Santa Cruz diversions on the San Lorenzo River to the surrounding groundwater agencies (Scotts Valley Water District, southern portion of San Lorenzo Valley Water District and Soquel Creek Water District) to supply their demands, allowing them to reduce pumping from their overdrafted groundwater basins, helping those basins to recover. As basin recovery occurs, increased groundwater levels will increase stream baseflow and available fish habitat, and during dry summers water could be provided back to the City of Santa Cruz to help meet their demands while leaving more flow in the streams for fish. The City of Santa Cruz would also benefit indirectly from some increase in San Lorenzo River flow and increase in groundwater levels in the western Purisima basin, which the City shares with the Soquel District.

As originally conceived, winter water would first be provided to the Scotts Valley area (Scotts Valley and San Lorenzo Valley Water Districts), which is within the San Lorenzo Watershed, and would eventually lead to increased baseflow in Bean Creek and the lower San Lorenzo River. Any available water in excess of Scotts Valley demand would be provided to Soquel Creek Water District. The eventual priority and timing of deliveries is a matter subject to negotiation and agreement among the water agencies. Interties already exist to transfer water to Soquel, and basin recovery there is a very high priority in order to prevent a worsening of seawater intrusion.

The timing and amount of water delivered back to the City would depend on three yet to be understood issues including the condition of the groundwater basins, pumping capabilities of the groundwater agencies, and policies for basin management established by the governing boards. With current infrastructure and the addition of a pump station at 41st Avenue, Soquel could theoretically pump 1.44 mgd to the City, or 172.8 million gallons (530 acre-feet) over a 4 month period. This would be dependent on assurance that the additional withdrawal for that period would not have an adverse impact on seawater intrusion. This assurance could be provided by better knowledge of the location of the seawater interface, groundwater modeling, and/or an increase in basin storage resulting from prior deliveries and in-lieu recharge. Delivery in excess of 1.44 mgd to Santa Cruz from Soquel would require an increase in intertie and pumping capacity and additional wells. Delivery of water from Scotts Valley to

Santa Cruz would require construction of an intertie and additional wells to be able to deliver 1 mgd, (700 gpm) 120 million gallons (370 acre-feet) in a 4 month period.

The City of Santa Cruz utilizes the Confluence model to model the availability of water supplies and determine water supply shortages, taking into account the variation in demand, the availability of water from its various sources, and the capacity of its infrastructure to pump and treat the water. Confluence has been used to model the various water transfer scenarios to calculate the expected yield during the range of historical hydrologic conditions from 1937-2009. All model runs took into account the need to protect fish habitat throughout the City operations and utilized the "Tier 3" flow bypass requirements that had been under consideration in the City's Draft Habitat Conservation Strategy. Under those conditions, it should be noted that the City utilizes the Tait Street Diversion significantly more during winter months than they have historically used it, leaving less water available for transfer to neighboring agencies. The total amount potentially transferred in a day is also limited to the actual daily demand of the groundwater agencies.

Winter flow in the San Lorenzo River is frequently subject to higher sediment load, higher turbidity, and increased organic and potential pathogen load, requiring considerable treatment to meet State Drinking Water requirements. Depending on the amount of water transferred, pumping more winter water from Tait Street, with treatment at the City's Graham Hill Treatment Plant, will require upgrade of diversion and treatment facilities and increased operation costs. Kennedy/Jenks Consultants (2013) prepared an analysis of the improvements needed under the various scenarios and a planning level estimate of the capital and operational costs of those improvements.

The following transfer scenarios have been evaluated:

0. Use of current water rights, current Tait Street Diversion capacity (7.8 mgd), current Graham Hill Treatment Plant capacity (10 mgd), and existing interties between Santa Cruz and Soquel to transfer water to Soquel Service Areas 1 and 2 of the Soquel Water District. This assumes a transfer capacity of 1.48 mgd, based on hydraulic capacity of those interties.
1. Utilize current water rights and diversion/treatment infrastructure, with new interties to Scotts Valley (1-2 mgd capacity) and to Soquel (1.5-3.5 mgd capacity). This would also require some upgrades to the Tait Street intake to better handle the increased sediment load from increased winter use.
2. Increase Treatment Plant Capacity to 16 mgd. This would require replacement of the pre-treatment solids settling and filtration components and oxidation/disinfection components at the Treatment Plant.
3. Increase Treatment Plant capacity to 16 mgd as in Scenario 2 and double diversion capacity at Tait Street to 14 mgd by constructing an additional new diversion works and upgrading pumps.
4. Increase Treatment Plant capacity to 16 mgd as in Scenario 2 and upgrade treatment process to treat turbid source water up to 200 NTU, by upgrading the solids handling process. This allows more days of diversion during the winter.
5. Increase Treatment Plant Capacity to 16 mgd and turbidity treatment to 200 NTU per Scenario 4 and Tait Street diversion capacity to 14 mgd per scenario 3.

The following table presents the results of the yield and cost analysis of the various scenarios.

Table 1. Summary of potential water transfer scenarios

	Scenario	SqCWD Average Yield MG(AF)	SVWD Average Yield MG(AF)	Total Potential Yield MG(AF)	Capital Cost \$M ⁴	Annual Cost \$M ⁴	Production Cost/AF \$/AF ⁴
0	Current Tait/GHTP Infrastructure/ Water Rights/ Connections, 1.48 mgd to SqCWD SA1 and SA2 ¹	145 (445)	(no existing intertie)	145 (445)	5.8	0.1	1,020
1	Current Infrastructure/Rights ^{2,3} New interties (SV: 1-2mgd; SqCWD: 1.5-3.5 mgd)	39 (120)	106 (325)	145 (445)	26.95	1.90	4,260
2	Increase GHWTP Capacity from 10 mgd to 16 mgd ^{2,3}	95 (292)	108 (331)	204 (623)	77.53	5.24	8,420
3	Increase GHWTP Capacity and Increase Tait Capacity from 7.8 to 14 mgd ^{3,5}	333 (1,022)	154 (473)	488 (1495)	90.61	6.40	4,280
4	Increase GHWTP Capacity and Turbidity Treatment from 15 to 200 NTU (Tait at 7.8 mgd) ^{2,3}	136 (417)	124 (381)	260 (798)	85.73	5.91	7,410
5	Increase GHWTP Capacity, Increase Tait Capacity, Increase Turbidity Treatment ⁶	384 (1,178)	174 (534)	558 (1,712)	91.68	6.68	3,900

Sources/Notes

¹ Kennedy/Jenks, Draft Technical Memo No. 3 Surface Water Transfer Alternatives, July 10, 2014

² Fiske, Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision), May 22, 2013

³ Fiske, Water Transfer Phase 2 Summary, June 27, 2013

⁴ Kennedy/Jenks, Water Transfer Infrastructure Summary Report, October 25, 2013; costs are costs of production and do not include additional costs of delivery to customers.

⁵ Fiske, Phase 2 Water Transfer Project Draft Task 3 Technical Memorandum: Potential Transfers with Unlimited Tait Street Capacity, June 20, 2013

⁶ Fiske, Supplemental Analysis of Water Transfer Volumes, July 24, 2013

⁷ Fiske, Water Transfer Project: Long-Term Analysis Scenario 2 Final, June 22, 2012

Implementation of any of these scenarios will require approval of a new water right and/or transfer of water under the City's existing rights. A variety of mechanisms were identified to accomplish this task, likely to include a combination of short term transfer under existing rights while a new water right application is filed with the State Water Resources Control Board.

Any water rights approval will require environmental review under CEQA and a demonstration that the transfer of water would have no significant impact on habitat for endangered coho salmon and steelhead. The transfer scenarios were designed to maintain flows necessary for fish and provide eventual habitat benefits. An effects analysis has shown no significant reduction in available habitat.

The City of Santa Cruz and the Soquel Creek Water District are both actively engaged in identifying new supplemental supply options, including the potential use of water transfers. A number of possibilities are currently under consideration and will be evaluated in relation to the transfer options described in this report. With the approval of an emergency transfer and local agreements, the infrastructure is already in place to move up to 445 acre-feet a year from Santa Cruz to Soquel.

Next steps for implementation of a water transfer project would include:

1. Consultation with fishery agencies and the State Water Resources Control Board,
2. Reevaluation of yields and capabilities for transfer from Santa Cruz in relation to new operating conditions and potential climate change effects,
3. Completion of additional technical work to establish the amount of water that could be returned to Santa Cruz,
4. Development of more detailed plans and cost estimates and CEQA analysis, and
5. Development of agreements and the institutional framework for moving a project forward.

1.0 INTRODUCTION

Integrated Regional Water Management (IRWM) is a statewide initiative by California's resource management agencies to promote collaborative, local solutions to water management challenges. IRWM enables self-forming regions to identify, integrate and implement water management measures appropriate for their needs. The fundamental principle of IRWM is that regional water managers are best positioned to manage regional water resources. While large, inter-regional water management systems, such as the State Water Project, Central Valley Project, and large flood management systems are important for California, the majority of the State's water resource management investments are made at the local and regional level.

The Santa Cruz region's rich natural resources provide critical habitat to numerous threatened and endangered species, drinking water for residents and visitors, and opportunities for recreational and commercial activities. The overwhelming majority of the region's water supply is locally derived from surface and groundwater sources – a unique fact in a state supported by large federal and state water projects. However, like many other areas of California, the region faces water resource challenges including impaired water quality, overdrafted groundwater basins, depleted streams, and locally degraded riparian habitat. Most of the groundwater basins are being pumped in excess of sustainable yield and the major water supply agencies do not have sufficient sustainable supplies to meet current and future projected demand. Historic salmon and steelhead populations have been greatly diminished by reductions in streamflow, increased erosion and sedimentation, barriers to migration, and removal of large woody material from streams.

The initial Santa Cruz IRWM plan was drafted in response to Chapter 8 of the voter-approved Proposition 50, which called for the development of such plans. The Santa Cruz IRWM region boundary is based upon watershed boundaries, jurisdictional boundaries, and water management issues and includes approximately 80% of the population and 85% of the geographic extent of the County (Figure 1). The 2005 IRWM plan was adopted by six partner agencies¹.

Development of the 2005 IRWM Plan helped secure a \$12.5 million grant award from the State Water Resources Control Board for the implementation of 15 high-priority projects, one of which included Phase I of an analysis of conjunctive use opportunities in the lower San Lorenzo River watershed and Santa Margarita groundwater basin (Figure 2). The main goals of the project were to conduct initial analyses of streamflow, fishery regulations, existing infrastructure and other constraints to determine the feasibility of large-scale water exchanges and aquifer recharge projects.

Eight technical analyses grouped into four general areas were conducted in Phase I, including:

- hydrogeologic analyses (regional hydrogeology, groundwater recharge potential of various locations, and groundwater modeling of potential projects),
- surface water resource analyses (water rights, stream flow, water quality, and fisheries needs),
- engineering analyses (current water sources, existing and potentially new infrastructure, planning level cost estimates),

¹ 2005 Plan Partner Agencies Include: Soquel Creek Water District; City of Santa Cruz; Scotts Valley Water District; Davenport Sanitation District; County of Santa Cruz – Environmental Health Services and Department of Public Works; Resource Conservation District of Santa Cruz County.

- and regional water demand analyses (current and future local demands, current and future supply sources).

After completion of the technical studies and analysis of over 100 project alternatives, three preferred management strategies that warrant further analysis were identified:

1. stormwater recharge in the Scotts Valley area ,
2. inter-district exchange of water for in-lieu recharge of aquifers, and
3. surface water diversion from the San Lorenzo River for groundwater recharge in the Hanson Quarry area.

Figure 1 - Santa Cruz IRWM Water Districts

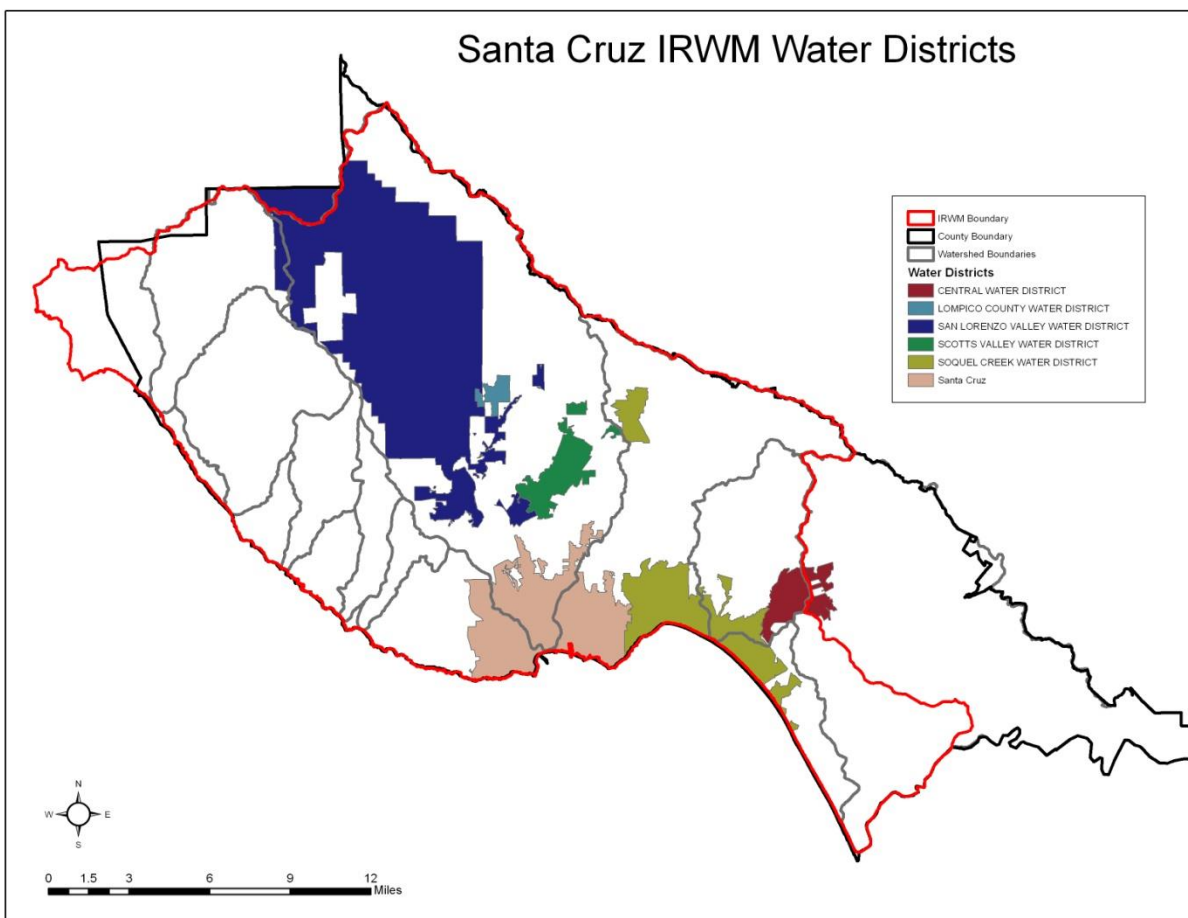
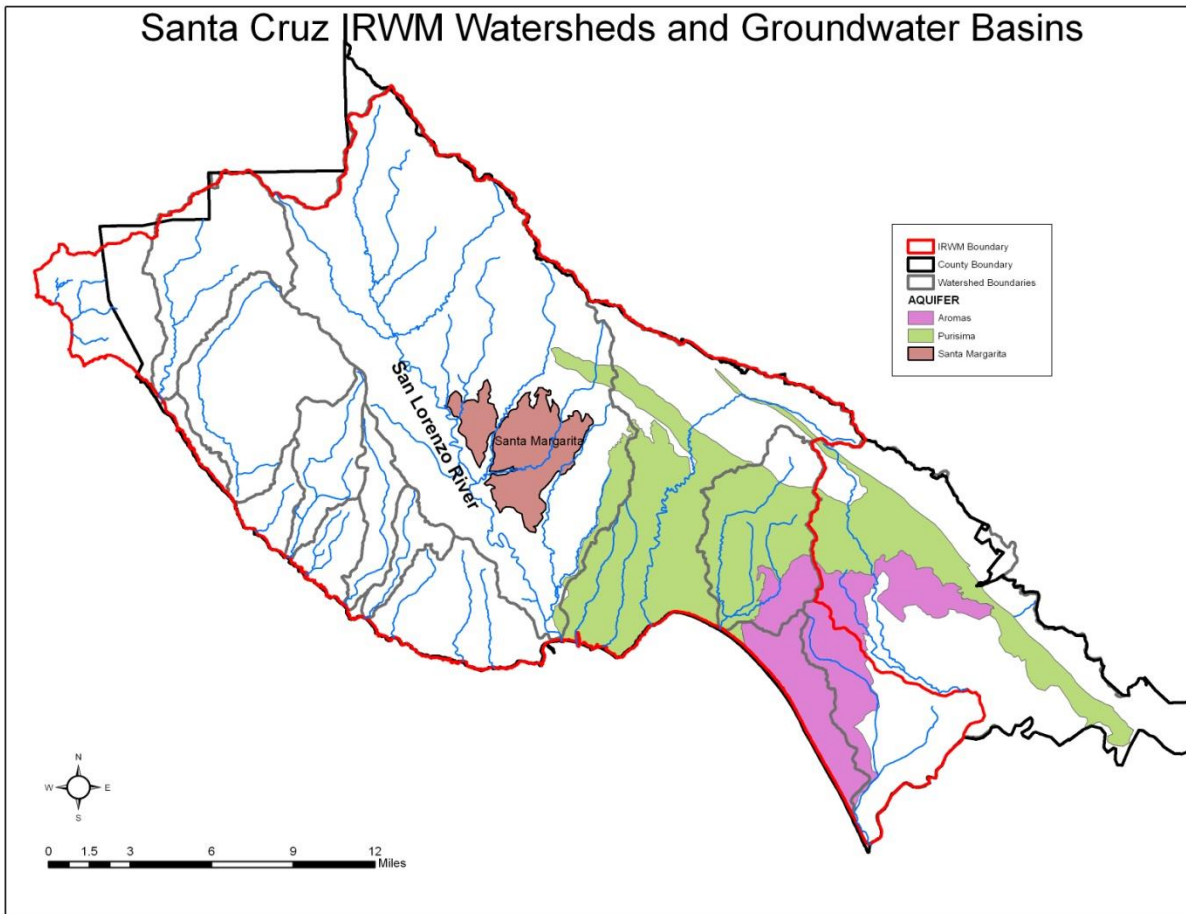


Figure 2 - Santa Cruz IRWM Groundwater Basins



A Proposition 84 Planning Grant was awarded by the Department of Water Resources to the Regional Water Management Foundation² for development of an updated Santa Cruz IRWM plan, including continued analysis of conjunctive use opportunities. Phase II builds on the technical information generated in Phase I by analyzing specific technical and regulatory aspects of a water exchange scenario between the City of Santa Cruz Water Department (City) and adjacent groundwater agencies in the Scotts Valley area (Scotts Valley Water District and the southern part of the San Lorenzo Valley Water District), and Soquel Creek Water District Soquel. The original concept for the project is that the City would use existing facilities to divert and treat surplus winter flows from the San Lorenzo River and transfer that water to Scotts Valley and/or Soquel. In drought years, the adjacent agencies could possibly send groundwater back to the City when its surface sources were inadequate to meet both City demand and fish flows.

² The Regional Water Management Foundation (RWMF) is a non-profit, 501(c)3, subsidiary of the Community Foundation Santa Cruz County. The RWMF was formed in response to the initial Proposition 50 award to act as the administrative and fiscal entity for the IRWM region for various grants.

Specific work items included modeling the City water system to estimate water yields potentially available for water exchange after the fish flow requirements and City demand was met. The modeling also computed residual flows that were used to analyze potential impacts upon fish habitat. The yield scenarios were used to develop planning-level engineering and cost estimates for potential upgrades to the water diversion and treatment infrastructure at Tait. The analysis examined seven scenarios from a simple water transfer with current infrastructure to a water transfer that included increased diversion and enhanced treatment and solids handling capacity. In addition to the engineering analysis, legal consultants completed a detailed draft memo of short term and long term options to obtain water rights approvals for water transfers.

The final work products from these analyses include (available as appendices to this report):

1) Water Yield Monitoring – Gary Fiske and Associates, INC.

a) *Task 1: Short-term transfer analysis w/ existing infrastructure*

- i) Current infrastructure and water rights.
- ii) Direct Felton diversion to GHWTP.
- iii) GHWTP improvements to treat more turbid water.

Report: Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision) (May 22, 2013)

b) *Task 2: Short-term transfer analysis w/ infrastructure improvements*

Report: Phase 2 Water Transfer Project Draft Task 2 Technical Memorandum: Utilization of Tait Street Capacity (June 11, 2012)

c) *Task 3: Long-term transfer analysis with various scenarios*

Reports:

- i) Water Transfer Project: Long-Term Analysis Scenario 1 (June 1, 2012)
- ii) Phase 2 Water Transfer Project Draft Task 3 Technical memorandum: Potential Transfers with Unlimited Tait Street Capacity (June 20, 2012)
- iii) Water Transfer Project: Long-Term Analysis Scenario 2 (Revised) (June 22, 2012)
- iv) Water Transfer Project: Long-Term Analysis Scenarios 3 and 4 (June 25, 2012)
- v) Water Transfer Project: Long-Term Analysis Scenario 5: GHWTP Improvements (July 2, 2012)
- vi) Water Transfer Project: Potential Transfers with Unlimited Tait Street Capacity, (June 20, 2013)

d) *Summary report*

Reports:

- i) Final Water Transfer Project Results Summary (July 6, 2012)
- ii) Supplemental Analysis of Water Transfer Volumes, (July 24, 2013)

2) Fishery Habitat Impacts Assessment – Jeff Hagar, Hagar Environmental Science

- a) Flow Related Effects of San Lorenzo Water Transfer on Habitat for Steelhead and Coho Salmon (Plots of various habitat parameters under different diversion and flow scenarios, June 25, 2013)

3) Infrastructure and Cost Assessment – Kennedy/Jenks Consultants

- a) Water Transfer Infrastructure Summary Report (October 25, 2013)
- b) Opinion of Probable Construction Costs. (July 25, 2013)

4) Water Rights Assessment – Best Best & Krieger, LLP

- a) Memorandum, County of Santa Cruz Water Supply and Water Rights Issues (October 28, 2013)

5) Intertie Capacity Analysis – Akel Engineering Group

- a) Analysis of hydraulic capacity to pump water from Santa Cruz to Soquel and from Soquel to Santa Cruz under various scenarios (February 19, 2014).

2.0 BACKGROUND STUDIES & PLANS

The water supply challenges and related impacts to resources in the Santa Cruz Region have been known for decades. Numerous studies have been conducted in an attempt to identify supplement sources of water and reduce demand to minimize shortages. Recent efforts from the three agencies are described below.

2.1 Phase I - Prop 50 Conjunctive Use Report

This project conducted a series of technical analyses and evaluated a wide range of water source and aquifer recharge alternatives for the Santa Margarita Groundwater Basin. The intent of the study was to identify potential alternatives to reverse groundwater decline for the benefit of domestic water supply and fisheries habitat.

Eight technical evaluations formed the basis of this study. The evaluations were broken into hydrogeologic analyses (regional hydrogeology, groundwater recharge potential of various locations, and groundwater modeling of potential projects), surface water resource analyses (water rights, stream flow, and fisheries needs), engineering analyses (current water sources, existing and potentially new infrastructure, conceptual level cost estimates), and regional water demand analyses (current and future local demands, current and future supply sources). Potential project types and project components were identified and screened to determine which would have the greatest benefit to water supply in the lower San Lorenzo River Watershed and Santa Margarita Groundwater Basin.

Three preferred alternative were identified: 1) stormwater recharge in the Scotts Valley area , 2) inter-district exchange of water for in-lieu recharge of aquifers, and 3) surface water diversion from the San Lorenzo River for groundwater recharge in the Hanson Quarry area. Conceptual-level engineering analyses, order-of-magnitude cost estimates, and implementation plans were developed for each of the three alternatives.

The following documents were prepared as part of the Conjunctive Use and Enhanced Aquifer Recharge study:

- Technical Memorandum 1A – Hydrogeology Evaluation
- Technical Memorandum 1B – Evaluation of Recharge Potential
- Technical Memorandum 1C – Groundwater Modeling Evaluation
- Technical Memorandum 2A – Water Rights Evaluation
- Technical Memorandum 2B – Source Water Assessment
- Technical Memorandum 2C – Fisheries Evaluation
- Technical Memorandum 3 – Engineered Facilities Evaluation
- Technical Memorandum 4 – Regional Water Demand
- Final Report (August 2011)

2.2 Water Agency Planning Documents

Water exchange has been evaluated as a potential source of alternative supply in Integrated Resource Plans prepared for the City, Soquel and the Urban Water Management Plan for the SVWD.

2.2.1 *City of Santa Cruz Integrated Water Plan*

For decades, the City had been considering possible new water supplies ranging from additional groundwater exploration to surface water impoundment sized to serve nearly all demand in a drought condition as severe as the 1976-1977 event. The City Council directed an approach that would look at combinations of water conservation, use curtailment in drought years, and development of a more modest water supply, hence an Integrated Water Planning (IWP) process. The purpose of the IWP was to (1) reduce the near-term drought year shortages, and (2) provide a reliable supply that meets long-term needs while ensuring protection of public health and safety. A key premise of the IWP is that, overall, it might be better for the City to accept and manage some level of peak season water shortage from time to time than to try to eliminate the possibility of any future shortage by developing enough supply capacity to overcome the drought of record. Based on studies and input from the community at that time (2001-03), the highest level of worst peak-season shortage that is tolerable for Santa Cruz water customers was 25%. Thus, strategies examined in the IWP only focus on curtailment profiles for which the worst peak-season shortage did not exceed this level (in addition to ongoing conservation efforts). Based on substantial analysis conducted as part of the IWP, desalination along with 15% worst-year curtailment were identified as the preferred alternatives. Water transfers, system interties and treatment upgrades had been identified as early as 1985 as a supply alternative, however a water exchange project was not carried forward citing , limited water supply benefit to the City, and the possibility of jeopardizing the City's existing water rights.

In the face of substantial public opposition to the proposed desalination project, in 2013, the City put the desal project on hold and initiated a further public review of demand projections, demand reduction options, and supply alternatives. The City's Water Supply Advisory Committee (WSAC) is presently reviewing a number of supply options, demand management strategies, and shortage levels, including the potential for pursuing a portfolio of multiple projects and programs similar to the concept of the IWP. The WSAC is also contemplating potential impacts of climate change on weather and hydrology. The Committee is expected to make a recommendation to the City Council in October 2015. Water exchange is one of the possibilities being considered.

2.2.2 *Soquel Creek Water District – Integrated Resources Plan*

Beginning in the mid-1990's, Soquel began to respond to indications of groundwater overdraft through the development of an Integrated Resources Plan (IRP). In 2006, the IRP was revised with updated information and further evaluation of potential water supply alternatives. The IRP was revised again in 2012 based on more recent information developed regarding groundwater conditions of the Soquel-Aptos basin and reduced demand projections. The 2012 IRP identifies key water supply planning objectives including limiting groundwater pumping to 2,900 AFY, achieving that goal within 6 – 8 years, and continuing to limit the pumping to that level for at least 20 consecutive years. These objectives would be achieved through a variety of components, including demand management, groundwater management, conjunctive use supply projects, and local supplemental supply alternatives. Soquel had been pursuing the regional desalination project along with Santa Cruz, but when the City put that project on hold in 2013, Soquel redoubled their efforts to evaluate other options, including demand management, desalination, recycled water, groundwater injection, and surface water transfer from the San Lorenzo River.

2.2.3 *Scotts Valley Water District – Urban Water Management Plan*

An Urban Water Management Plan (UWMP) is a state-mandated planning tool that generally guides the actions of water management agencies. It provides a broad perspective on a number of water supply issues, but it is not intended to be a substitute for project-specific planning. In general, an UWMP

describes the potential sources of supply and demand, given a reasonable set of assumptions about growth and water management practices, and how well those figures match up. The Scotts Valley UWMP states that, although there have been significant years of drought and declining groundwater levels, the overall storage in the basin is apparently sufficient to provide adequate resources for the district given the past, current and anticipated future demand. The long-term adequacy of the supply will rely on improving direct and in-lieu recharge, and reduction in groundwater pumping through improved water use efficiency, and recycled water production. The UWMP also states that the concept of water transfer has evolved into a viable supplemental source to improve supply reliability, stating that one of the most important aspects of any resource planning process is flexibility. A water exchange with the City of Santa Cruz is discussed in the UWMP along with potential recycled water exchange including City of Scotts Valley, Scotts Valley Water District, Santa Cruz, and the Pasatiempo Golf Course. Scotts Valley is also currently leading the effort to evaluate options to develop a groundwater recharge project at the abandoned Hanson Quarry using recycled water and/or surface water pumped from the San Lorenzo River. A recent grant has funded the construction of emergency interties between Scotts Valley Water District and the various service areas of the San Lorenzo Valley Water District, facilitating additional potential water transfer options, subject to evaluation of the potential environmental effects of such transfers.

2.3 Santa Cruz Habitat Conservation Plan (HCP) Efforts³

Recently, diversions from the Santa Cruz s surface water sources have been limited by Endangered Species Act (ESA) issues. All of the streams from which Santa Cruz diverts water, including the North Coast sources, San Lorenzo River, and Newell Creek, provide important habitat for steelhead trout, which are listed under the federal ESA as threatened. Additionally, the San Lorenzo River and Laguna Creek also provide habitat for coho salmon, listed under the federal and state ESAs as endangered.

Any activity that may have the potential to result in take of a federally listed species requires a federal Section 10(a) Permit. To take a species means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The term harm in this definition has been interpreted to include detrimental modification of a species habitat, such as the effect of streamflow reductions upon fishery habitat. Leading up to the application for the permit, the City must look critically at its operations and the potential to take any listed species and prepare an HCP. The anadromous fisheries HCP will describe measures that the City would take to minimize and mitigate take of these species to the maximum extent practicable. The City has been working with the National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS) and with the California Department of Fish and Wildlife (CDFW) on the HCP and the counterpart planning under the California ESA, as well as developing master streambed alteration agreements for all of its water diversions under the California Fish and Game Code.

Numerous studies undertaken in support of the HCP have evaluated how much water flow is needed in streams during various times of the year to protect the fisheries habitat during all freshwater life phases (migration, spawning, and rearing). These studies show that the City's operations are affecting special-status anadromous salmonid species and may result in take. Generally speaking, the impacts are greatest on the North Coast streams during the dry season and during dry water years. However, potential adverse effects can also occur during the wet season. Given this, the City is also confronted

³ Paraphrased From: URS Corporation. 2013. *SCWD² Regional Seawater Desalination Project Draft Environmental Impact Report*. City of Santa Cruz and Soquel Creek Water District. Pg. 3-13 – 3-17

with the requirement to provide adequate wet season in-stream flows to support anadromous salmonid migration, spawning, and egg incubation. Additionally, given the renewed focus on the San Lorenzo River for coho salmon recovery, the conservation strategy developed for the HCP must also address the relatively complex San Lorenzo watershed.

The HCP development process began in 2002 when the City hired a firm to develop a citywide, multi-species HCP. The City also conducted extensive technical studies of streamflow flow and available habitat under various flow conditions in the reaches downstream of the City diversions. In August 2011 the City developed the refined Draft Habitat Conservation Plan Conservation Strategy for Steelhead and Coho Salmon (Conservation Strategy) to serve as a key component of the HCP. A critical component to the Conservation Strategy is the identification of streamflow targets based on the amount of rainfall received in a given year. These targets or “tiers” reflect varying amounts of streamflow to remain in the stream, from existing diminished flows (Tier 1) up to the flow needed to maintain 80% of the fish habitat that would be available without the City diversions (Tier 3). Negotiations regarding the streamflows are ongoing with the resource agencies, and negotiations have focused on evaluating a CDFW flow proposal (DFG-5), which would leave more water in the streams in dry years, and potential water infrastructure modifications that might benefit fish flows. In the meantime, the City is already voluntarily releasing more flow downstream of its existing diversions at Tait Street and the North Coast.

The City utilizes the Confluence Water Resources Planning Model⁴ to simulate current and future water supply system operation with user-provided weather and hydrologic conditions. Extensive Confluence water modeling has been initiated to evaluate the potential for decreased future water diversions with the potential infrastructure changes. From an operational standpoint, meeting fish flow requirements will be very complex to implement regardless of the agreed-upon strategy. According to the City UWMP, the process to secure an incidental take permit involves many more steps and could potentially take several more years to complete. While the outcome remains uncertain, it is clear that compliance with endangered species regulation at the state and federal levels will result in less water being available for use by the City from the San Lorenzo River and North Coast streams in future years, compared to the past. This, in turn, will place greater reliance on water stored in Loch Lomond Reservoir and groundwater to meet the community’s annual water needs, which will exacerbate the aforementioned problem of water shortage. This will also result in an increase in City wet weather diversions from the San Lorenzo River to make up for the reduced diversions from the North Coast sources.

⁴ Gary Fiske and Associates, Inc. Confluence® Water Resources Planning Model. <http://confluence-water.com/>

3.0 EXISTING SURFACE WATER SOURCES⁵

In order to provide the context for a potential water exchange project, the following is a brief overview of the City's water supply and delivery system operations.

The Santa Cruz City Water Department serves an estimated population of nearly 91,000 people who reside in the water service area, according to the 2010 U.S. Census. Some 59,950 people, or about two thirds of the total population, live inside the City limits. Another 31,350 people, or 34 percent of the service area population, live outside the City limits.

The City water system has four main water supply sources: 1) the North Coast sources including Laguna, Regiardo and Majors Creeks and Liddell Spring; 2) the San Lorenzo River; 3) Loch Lomond Reservoir; and 4) the Beltz Wells. In general, the City's water system has been managed to take advantage of the better quality and less expensive sources as a first priority and to retain the maximum amount of water possible in Loch Lomond Reservoir to safeguard against future droughts. Maximum diversion rates and minimum bypass requirements contained in the City's water rights also govern the operation of the water system.

The City water supplies are generally prioritized to meet daily demands in the following order: North Coast, San Lorenzo River, Beltz Wells, and Loch Lomond Reservoir. Due to the excellent water quality and lowest production cost, the North Coast sources have historically been used to the greatest extent possible. Further, water from the North Coast diversions are diverted under pre-1914 appropriative water right and least affected by water rights limitations. However, the fishery agencies are seeking significant increases in downstream bypasses as part of the HCP. Additional water needed to meet daily demands is pumped from the San Lorenzo River at Tait Street. Although there are presently no established bypass requirements at Tait, the maximum diversion rate is limited to 12.2 cfs. During the summer and fall, when the City's flowing sources are inadequate to meet peak-season daily demands, additional water is taken from the Beltz Wells and from Loch Lomond Reservoir. The Felton Diversion is operated intermittently as needed in the winter months to augment storage in Loch Lomond. However in normal to wet years, Loch Lomond fills without Felton Diversion water and in dry years, the operation of the diversion is limited by several factors, including bypass flow requirements, turbidity constraints, and demand needs at Tait Street, as well as pressure limitations on pipeline infrastructure to move water to the lake.. Currently, the same pipeline is used to fill and draw down the lake. On days the lake is being drawn down, water cannot be pumped from Felton.

Over the period between 2006-2010, gross production from the North Coast sources has averaged 1,065 million gallons per year (mgy), or 30 percent of the total supply, while the San Lorenzo River supply has averaged 1,889 mgy, or about 54 percent of the total supply. Together, these flowing sources provide over 80 percent of the City's yearly water needs. Water supplied from Loch Lomond Reservoir averaged

⁵ Paraphrased From: URS Corporation. 2013. *SCWD² Regional Seawater Desalination Project Draft Environmental Impact Report*. City of Santa Cruz and Soquel Creek Water District.

And

Kennedy/Jenks Consultants. 2013. *Water Transfer Infrastructure Summary Report*. Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation.

419 mgly, or 12 percent. Groundwater from the Beltz Wells provided an average of 156 mgly, or about 4 percent of the City's total supply. However, going forward, the ESA issues will likely affect the priority of source selection and the relative contribution of each source to overall production.

3.1 Tait Street Diversion

The Tait Street Diversion delivers San Lorenzo River surface water directly to the Graham Hill Water Treatment Plant (GHWTP). The diversion is located on the San Lorenzo River near Tait Street in Santa Cruz, and has a design capacity of up to approximately 12.2 cubic feet per second (cfs) (approximately 7.8 mgd). The Tait Street Diversion includes a diversion structure in the river, a diversion inlet structure with narrow-slot screens for fish protection, an intake sump with three multi-stage vertical turbine pumps, pump station building, a standby power generator, and associated piping, valves, instrumentation and controls. Water is pumped via a 24-inch pipeline from the diversion to the inlet of the GHWTP. Because the additional surface water for transfer would come from the San Lorenzo River, the capacity of the Tait Street Diversion may need to be increased to accommodate additional diversion needed for winter-time water transfers.

3.2 Felton Diversion

The Felton Diversion is used by the City to transfer water from the San Lorenzo River into the Loch Lomond Reservoir for storage. Water can then be brought down from the reservoir to the GHWTP. The Felton Diversion augments storage in the reservoir) and is not presently permitted to divert surface water directly to the GHWTP. Therefore, direct diversion from the Felton Diversion is not presently considered as an intake source for the additional winter-time surface water transfer. A water rights amendment and further evaluation of bypass flows for downstream fish habitat would be required to use Felton Diversion for water exchange, groundwater recharge, or other conjunctive use projects.

3.3 Graham Hill Water Treatment Plant

The City's Graham Hill Water Treatment Plant (GHWTP) was commissioned in 1960 and has a current target capacity of approximately 18 million gallons per day (mgd). The GHWTP is a conventional surface water treatment plant with pre-oxidation, periodic powdered activated carbon addition, rapid mix coagulation, flocculation, sedimentation, granular media filtration, and free chlorine disinfection. The current treatment process at the GHWTP is limited to treating source water with turbidity levels less than approximately 15 NTU. During wintertime storms the turbidity levels increase significantly above the 15 NTU limit for the GHWTP, and the GHWTP must limit or stop production from the river sources completely until the turbidity levels drop. The wintertime capacity of the GHWTP is also limited by operational maintenance requirements. In the wintertime, each of the three flocculation and sedimentation basins are sequentially taken out of service for cleaning and maintenance, limiting total winter time production capacity to 10 mgd.

In addition to improvements to the GHWTP for treating higher turbidity source water and meeting increased wintertime production requirements, improvements to the source water pumping stations and treated water delivery system would also be required to transfer significant quantities of water.

3.3.1 *Production Capacity*

As stated, the GHWTP has a current summer-time target peak production capacity of approximately 18 mgd and a winter-time production capacity of approximately 10 mgd. The nominal hydraulic capacity of the GHWTP is approximately 24 mgd however, the plant is unable to be operated at the rate due to equipment or process limitations, maintenance requirements, and the need to meet certain water

quality objectives.. The current City daily winter-time demands at the GHWTP can range from approximately 6 mgd to 9 mgd. The winter-time water transfers would be in addition to the current City water demands served by the GHWTP.

Table 2 - Current Graham Hill Treatment Plant Capacities (in million gallons per day (mgd))

Design Parameter	Current Summer	Current Winter
Maximum Plant Production	18	~10
Average Plant Production	12	8
Nominal Plant Hydraulic Capacity	24	24

3.3.2 Treatment Requirements

The GHWTP produces water that complies with both federal and State rules, regulations, and guidelines established under the Federal and State Safe Drinking Water Acts, including the requirements in the Surface Water Treatment Rule (SWTR), Interim Enhanced SWTR (IESWTR), and Long Term 2 Enhanced SWTR (LT2ESWTR) for systems serving more than 100,000 people.

Turbidity: To meet the requirements of the California SWTR, the GHWTP must maintain filtered water turbidity less than or equal to 0.3 NTU in at least 95 percent of the filtered water samples collected during each month. In addition, both the settled water turbidity and recycled water turbidity objective is to be less than 2 NTU in accordance with the California Cryptosporidium Action Plan (CAP). The current treatment process at the GHWTP is limited to treating source water with turbidity levels less than approximately 10 to 15 NTU. During winter-time storms and high flows in the San Lorenzo River and the North Coast sources, the turbidity levels increase significantly above the 10 NTU limit for the GHWTP, and the GHWTP must limit or stop water withdrawal from the San Lorenzo River until the turbidity levels drop.

Microbial Removal and Disinfection: A typical surface water treatment plant is required to provide filtration removal and disinfection to achieve a 3-log Giardia and 4-log virus removal/inactivation performance standard. Since 1998, CDPH has required an increased level of 4-log (99.99%) Giardia cyst and 5-log (99.999%) virus removal/inactivation through the filtration and disinfection processes at the GHWTP to be in compliance with the SWTR. The basis for the increased removal-inactivation requirements was elevated levels of total coliform in the San Lorenzo River source waters to the GHWTP. This additional removal/inactivation requirement places constraints on the GHWTP production capacity. To accomplish the winter-time water transfers, an additional and more robust disinfection process such as ozone or ultraviolet light could be required.

3.3.3 Treated Water Disinfection

Many modern WTPs include a treated water tank (or clearwell) that is used for chlorine disinfection of the treated water after the water has been settled and filtered. Modern treated water disinfection clearwells have an efficient flow-through design to achieve the disinfection contact time before the water leaves the WTP. The existing GHWTP treated water tank (the “filtered water tank”) has a single inlet-and-outlet pipeline and is not designed for disinfection. The tank serves as a distribution system storage tank at the WTP site. Disinfection at the GHWTP is currently accomplished in the sedimentation basins, a process that would need to be modified in order to accommodate transfers. The City is in the

process of evaluating potential use of all the concrete tanks to provide enhanced chlorination opportunities.

3.3.4 Washwater and Solids Handling

The GHWTP solids residual handling facilities capture and treat the waste flow streams containing solids that settle out in the flocculation and sedimentation treatment basins and that are removed by the filters. If source water with an increased sediment load were treated at the plant, the solids handling process would need to be modified to handle the increased load that would come from treating additional winter flow.

3.3.5 System Operation and Maintenance

City staff perform annual maintenance of the GHWTP treatment process equipment and infrastructure during the winter, when water demands are lower and treatment processes can be taken off-line. During the winter-time maintenance period, each of the flocculation-sedimentation basins and each of the filters are taken out of service sequentially for cleaning and maintenance. The basin maintenance period typically lasts from 2 to 4 weeks. As a result, over the winter maintenance period, only two flocculation-sedimentation basins would be available for operation. Filters are also taken out of service for maintenance that could last several days to weeks. During this period, only 5 filters would be available for operation.

3.4 Existing Water Rights

Surface water in California is a Public Trust Resource, and the State Water Resources Control Board is the agency responsible for allowing use of this resource through the water rights process. Simply stated, a water right is legal permission to use a reasonable amount of water for a beneficial purpose such as domestic supply, farming, or other uses. Water rights generally stipulate the amount and timing of water that can be diverted from a stream and the locations where that water can be put to beneficial use. Appropriative water rights in California are based on a priority system that generally adheres to the doctrine of, first in time, first in right, meaning that water rights established first are senior to those subsequently established. Senior water rights holders are generally entitled to their full allotment of water before more junior rights can be exercised. In California there are three main categories of water rights :

- Pre-1914 Appropriative Rights are rights established by an appropriation of water that was established before 1914. Pre-1914 water rights do not require a permit from the state, and thus generally do not have explicit restrictions on amount, timing or place of use. Despite not having these restrictions in a permit, water cannot be taken under these rights in a manner that would harm senior users or beneficial uses. The City diversions on the North Coast streams are all covered by pre-1914 water rights.
- Riparian rights are senior to appropriative rights and entitle streamside landowners to use a correlative share of the water flowing past their property for use on that property only. Riparian rights do not require permits, licenses, or government approval, but they apply only to the water which would naturally flow in the stream. Riparian rights do not entitle a water user to divert water to storage in a reservoir for use in the dry season or to use water on land outside of the watershed. Riparian rights remain with the property when it changes hands, although parcels severed from the adjacent water source generally lose their right to the water. None of the City's water rights are riparian rights.
- Appropriative rights: appropriative rights are for the use of water on non-riparian land. The SWRCB issues permits for appropriative rights that stipulate the timing, amount and place of

use of the appropriated water. The City’s Felton and Tait Street diversions are both appropriative rights.

The State has a very different approach to groundwater regulation. In most areas of California, overlying land owners and municipal appropriators may extract percolating ground water and put it to beneficial use without approval from the State Board or a court. In several basins that have been adjudicated, however, groundwater use is subject to regulation in accordance with court decrees adjudicating the ground water rights within the basins. The recently adopted Sustainable Groundwater Management Act of 2014 requires management of groundwater extraction to prevent adverse affects on groundwater and surface water flow, but does not limit groundwater rights.

Current water rights for the Felton Diversion authorize diversion to storage in Loch Lomond Reservoir but do not allow for water to be diverted directly from Felton to the GHWTP. The City is seeking approval of change petitions that would add direct diversion as a method of diversion from the San Lorenzo River at Felton Diversion and from the Loch Lomond Reservoir to improve the operational flexibility of the system. The City is also requesting an extension of time allowed to put the full yield from the Felton Diversion to beneficial use. Resource agencies have protested the City’s current applications, pending successful completion of HCP negotiations.

Table 3 - Summary of City of Santa Cruz Water Rights

Source	Period	Maximum Diversion Rate (cfs)	Bypass Requirement (cfs)	Annual Diversion Limit
North Coast (Pre-1914 Appro.) Liddell Spring Laguna / Reggiardo Creeks Majors Creek	Year-round	No limit	None	None
San Lorenzo River Tait Street	Year-round	12.2	None	None
San Lorenzo River Felton Diversion	September	7.8	10	977 mg/yr (3000 af/yr)
	October	20	25	
	Nov. – May	20	20	
	June – Aug.	0	--	
Newell Creek Collection	Sept. – Jun.	No Limit	1	1,825 mg/yr (5600 af/yr)
Newell Creek Withdrawal	Year-Round	--	1	1,042 mg/yr (3200 af/yr)

4.0 POTENTIAL WATER TRANSFER SCENARIOS

The Phase II Conjunctive Use project evaluated the potential yield of transferring winter flow from the San Lorenzo River under a variety of scenarios involving various levels of infrastructure improvement. The City's Confluence model takes into account the variation in demand, the availability of water from different City sources under different hydrologic conditions, requirements for fish flow bypasses, and the capacity of raw water infrastructure to pump and treat the water. The model simulates the operation of the City system on a daily time step using 73 years of historic hydrologic record. The model ensures that City demands and fish flows are first met and then calculates how much additional water would be available for inter-district water transfer. The fish flow requirements used in this study are the Tier 3 requirements, which are intended to maintain fish habitat at least 80% of what would be available if there were no City diversions.

In the scenarios below, the City would continue to meet City drinking water demands with the following current priority of water supply:

1. North Coast Sources – highest quality water source, but reduced availability due to increased bypass for fish habitat.
2. Tait Street Diversion (San Lorenzo River) – lower quality water source, and subject to interruption due to high turbidity during winter storms.
3. Loch Lomond (Newell Creek) – lower water quality and minimize use to reserve water for stream releases and drought supply. Loch Lomond is generally only used during the winter during storm periods when the other sources are too turbid.
4. Felton Diversion (San Lorenzo River) – used to pump water to Loch Lomond during the winter when there is available capacity in Loch Lomond and San Lorenzo River flows are adequate.

Only when there was additional water in the San Lorenzo River, that was not needed to meet City demands or downstream fish habitat needs would that water be available for transfer. Furthermore, it is assumed that the City would not withdraw extra water from the North Coast or Loch Lomond to facilitate water transfers. All potential water transfer supply would come from the San Lorenzo River. Note also that the production capacity values for the GHWTP are maximum possible daily production values, not necessarily continuous production values. Since the water available for water transfer would come from Tait Street Diversion, this water source could be operating at the maximum production whenever there is sufficient water in the San Lorenzo River. The amount of water transferred in any given day was also limited by the amount of demand. If the amount of district demand that day was less than the amount of transfer capacity that day, the actual amount of transfer was the demand. For the purposes of most of the scenarios, it was assumed that Scotts Valley demand would be satisfied first, and then additional yield would go to Soquel. The reasons for this are discussed below.

For each water year, the Confluence model calculates the amount of water transfer for each day and then sums it for the year (November to April). Average annual yields were calculated for the whole 73 year period of record and averages were calculated for each type of water year: wet, normal, dry and critically dry. The model output was also used to prepare duration curves to show the frequency that a given flow or given yield might occur. This information could be used to optimize the capacity of infrastructure improvements. Examples of this additional information are shown in Table 5 and presented in the Appendices.

Table 4 summarizes the different scenarios, the conditions associated with each scenario, and the average annual yields averaged over the 73 year hydrologic record. The potential annual yield varies significantly by type of water year, depending on how wet it is (Table 5). Various infrastructure upgrades are required to accomplish the projected yields, as indicated.

Table 4 - Potential Water Transfer Scenarios and Yield Estimates

No.	Name	Source Water Turbidity (ntu)	Max. Tait Capacity (mgd)	Max. GHWTP Capacity (mgd)	Potential Transfer to Scotts Valley (mgy/afy)	Potential Transfer to Soquel Creek WD (mgy/afy)	Potential Total Annual Transfer (mg/af)
0	Current Tait & GHWTP Capacity, Existing intertie to Soquel only	<15	7.8	Up to 10	--	145 / 445	145 / 445
1	Current Tait & GHWTP Capacity	<15	7.8	Up to 10	106 / 325	39 / 120	145 / 445
2	Increase GHWTP Capacity	<15	7.8	Up to 16	108 / 331	95 / 292	204 / 623
3	Increase Tait & GHWTP Capacity	<15	14	Up to 16	154 / 473	333 / 1,022	488 / 1,495
4	Increase GHWTP Capacity & Treatment	Up to ~ 200	7.8	Up to 16	124 / 381	136 / 417	260 / 798
5	Increase Tait & GHWTP Capacity and Treatment	Up to ~200	14	Up to 16	174 / 534	384 / 1,178	558 / 1,712

GHWTP = Graham Hill Water Treatment Plant
 Tait = Tait Street Diversion
 ntu = nephelometric turbidity units
 mgd = million gallons / day
 mgy = million gallons / year

Scenario No. 0 utilized the 73-year flow record on the San Lorenzo River to examine the potential volume of water available for transfer between the City and Soquel at current levels of demand and infrastructure. Some additional water could be available for transfer by operating the current Tait Street Diversion and GHWTP up to the approximate 10-mgd winter-time capacity limitation when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 2 mgd from Tait Street could be treated for transfer.

Scenario No. 1 utilized the same assumptions as Scenario 0, with the addition of a new intertie to Scotts Valley, which allowed transfer to Scotts Valley as a priority over Soquel. The overall transfer volumes are the same, but divided among the two recipients.

Scenario No. 2 modeled the effects improvements to increase the capacity of the GHWTP up to 16 mgd, but still operating when turbidity levels are appropriate for the current facility processes (less than approximately 15 NTU). An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 3.5 mgd from Tait Street could be treated for transfer.

Scenario No. 3 examined the water that could be available for transfer by improvements to increase the capacity of the Tait Street Diversion up to approximately 14 mgd and the GHWTP up to 16 mgd. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 8 mgd from Tait Street could be treated for transfer. This scenario still assumes no modification to treat water at higher turbidity levels.

Scenario No.4 examined the additional water that could be available for transfer by improvements to the GHWTP up to 16 mgd, and improvements to permit operating when turbidity levels are up to approximately 200 NTU, such as immediately following storm events. In this scenario, Tait Street capacity is not increased. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 3.5 mgd from Tait Street could be treated for transfer.

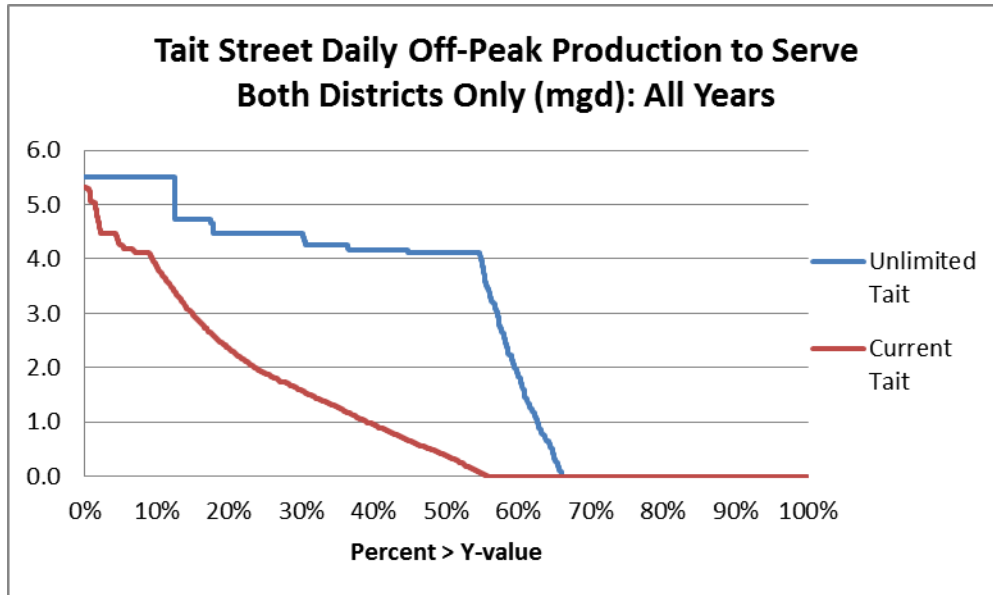
Scenario No.5 examined the additional water that could be available for transfer by improvements to increase the capacity of the Tait Street Diversion up to approximately 14 mgd and the GHWTP up to 16 MGD, and improvements to permit operating when turbidity levels are approximately 200 NTU, such as immediately following storm events. An example of this scenario could be when the City demands are 8 mgd, and they are taking 4 mgd from the North Coast sources and 4 mgd from Tait Street. An additional 8 mgd from Tait Street could be treated for transfer.

Following are examples of the more detailed breakdown of information provided in Confluence and presented in more detail in the Appendices. This information is available for each of the scenarios.

Table 5. Average November-April Tait Street Production (mg) (Increased Tait Capacity, Scenario 3)

DEMAND SERVED	HYDROLOGIC YEAR TYPE				
	Critically Dry	Dry	Normal	Wet	All
Santa Cruz Only	823	879	812	663	778
Santa Cruz & Both Districts	1102	1345	1378	1179	1262
Both Districts Only	278	464	566	517	488
Scotts Valley	105	151	174	158	154
Soquel Creek	173	313	392	358	333

Figure 3. Duration curve showing frequency and rate of delivery (mgd) for Scenario 2, Current Tait; and Scenario 3, Unlimited Tait



Source: Gary Fiske and Associates, Inc. May 22, 2013. Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision)

4.1 Assumptions for Potential Water Transfers

The volume of potentially transferable water would be constrained by the duration of the diversion period in the months of November through April, the availability of surface flows that are in excess of anadromous fish needs, suitable water quality, available water rights, the amount of winter water demand, and capacity of available infrastructure. Because the City has existing diversion works and water treatment facility, the Graham Hill Treatment Plant (GHTP), the production characteristics of the plant, sources and volumes of surface water supply, and system infrastructure capacities were evaluated to determine how they could best be utilized.

4.1.1 *Priority for Water Delivery*

For the majority of the model runs, it was assumed that water would be transferred to Scotts Valley first, and any additional capacity beyond the Scotts Valley demand would be used to transfer water to Soquel. Therefore, with the lower yielding scenarios, Scotts Valley would receive more water than Soquel, even though the total Scotts Valley demand is lower. Scotts Valley was initially assigned a higher priority for the following reasons:

- The initial analysis in Phase I focused on restoring groundwater levels in the Scotts Valley portion of the Santa Margarita Groundwater Basin.
- Transferring water to Scotts Valley keeps the water in the San Lorenzo River Watershed, and with reduced use of the groundwater basin would ultimately contribute to additional baseflow in Bean Creek and the San Lorenzo River, with benefits to fish habitat and the downstream City of Santa Cruz diversion.

This priority and distribution of delivery is subject to future discussion and negotiation to determine what makes the most sense for long term regional water needs. The Soquel groundwater basin is

currently threatened by seawater intrusion and water could be more immediately transferred there using already existing interties. Groundwater pumping in Scotts Valley has declined in recent years and groundwater levels have stabilized and recovered slightly, albeit at reduced levels, further supporting consideration of sending water to Soquel as a higher priority.

4.1.2 Source and Diversion Capacity

Water for transfer would be drawn from the San Lorenzo River at the City Tait Street Diversion. The existing winter-time capacity of the Tait Street diversion is 7.8 mgd, the capacity could be increased to 14 mgd to better meet the needs of the City and neighboring water agencies.⁶ Diversion at Tait Street was chosen for this analysis over other points of diversion based on several considerations:

- Tait Street is lower in the watershed and has more options for working within the existing water rights.
- There are currently two pending water rights modification applications at the Felton Diversion, which could greatly complicate efforts for expanded diversion. Currently, Felton Diversion water is only able to be diverted to storage (Loch Lomond).
- Loch Lomond is the City's drought reserve and winter use is minimized to protect the reserve. Also, only Scotts Valley and the San Lorenzo Valley Water District are within the water rights place of use for Loch Lomond water. Any use outside of those areas would require an amendment of the existing water rights.
- While the North Coast sources have pre-1914 water rights, additional diversion from those streams was not considered likely due to resource concerns, in particular fish flows that are likely to be required under the HCP. However, current diversion amounts could potentially be used for transfer, as there are less water rights limitations with this water.

4.1.3 Demand and GHWTP Objectives

Demand projections for both the City demand and the districts' demand are based on the demand projection for the year 2030. For the City, this was the demand projected in the Water Supply Assessment for General Plan 2030, of 4,046 million gallons per year. (Current demand projections are significantly lower.) Monthly demand for the modeling period was allocated based on the historical pattern of water use. Future demand for the districts was assumed to be the same as their five-year average of 2005-2011 production. The Scotts Valley demand includes both the Scotts Valley Water District and the southern portion of the San Lorenzo Valley Water District. The potential daily demand used was the average daily demand for that month. The monthly district demands used are shown in Table 6.

⁶ Gary Fiske and Associates, Inc. June 20, 2013. Phase 2 Water Transfer Project Task 3 Technical Memorandum: Potential Transfers with Unlimited Tait Street Capacity.

Table 6. Assumed Monthly Demands (millions of gallons)

Month	Scotts Valley	Soquel Creek
November	42.8	99.2
December	38.7	93.4
January	37.2	92.2
February	33.8	81.5
March	40.3	98.6
April	48.3	116.9
TOTAL	241.1	581.8

The additional maximum likely demands from the districts to provide for winter-time water transfers could reach approximately 5.5 mgd (Figure 3). If this occurred at the same time as typical maximum winter demands from the City customers, the GHWTP would need to produce approximately 15.5 mgd. Therefore, the design maximum winter-time production for the GHWTP, for this study, is 16 mgd. The average winter-time production with both water transfer demands and City demands is estimated at 11 mgd.

4.1.4 Winter Water Quality in San Lorenzo River

The quality of diverted water will have an effect on the usability of the water in the conjunctive use framework. The US EPA, as well as California Drinking Water Branch (CDWB), has developed Maximum Contaminant Limits (MCLs) for over 100 organic and inorganic compounds, some occurring naturally in water supplies but many occurring as a result of human activities in the watershed. Key constituents of concern in the San Lorenzo River that could potentially limit the yield available for transfer include turbidity, organic carbon, and fecal indicator bacteria. The winter-time storm water also contains elevated levels of natural organic matter as compared to typical summer and winter non-storm source water quality.

Typical coastal California watershed streams experience rapid increases in turbidity during and shortly after storm events. The turbidity level can spike up to several hundred NTU in a matter of hours, but will often drop back to levels of 40 to 50 NTU or lower relatively quickly. The organics level in the water will also rise during storm runoff periods. The turbidity and organics levels will then slowly drop over a period of days back to normal levels, unless another storm event occurs in the watershed. Operating experience indicates that the GHWTP sources can take several days for the turbidity to drop to 10 to 15 NTU and up to a week for the turbidity to return to average low levels after a storm event. During storm events, stream water turbidity rises rapidly and is followed by a smaller rapid drop and then a more gradual exponential-shaped decrease in turbidity as the stream flow decreases after a storm. Stream-borne debris can also contribute to the turbidity by scouring the stream bottom.

Currently the GHWTP can only treat water with turbidity up to 15 NTU. During storm events, the Tait Street diversion is not operated and North Coast sources or Loch Lomond are utilized. Water would not be available for transfer to other districts during such times. Improvements to the GHWTP could be made for winter-time water transfers that would enable the plant to handle turbidity events over several hundred NTU. The Water Transfer Analysis used a source water value of 200 NTU in the analysis of potential water transfers (Scenarios 4 and 5).

Based on source water coliform data for the San Lorenzo River, the CDWB requires that the GHWTP provide a higher level of treatment to provide 4-log Giardia and 5-log virus reduction (removal and inactivation). The CDWB credits the GHWTP conventional filtration treatment process with 2.5-log Giardia removal credit as long as the filtered water turbidity is less than 0.3 NTU in at least 95 percent of the combined filter effluent samples analyzed at 15 minute intervals during each month. Therefore, 1.5-log disinfection inactivation is required to meet the overall requirements. The treatment processes at the GHWTP and the improvements to permit winter-time water transfers will need to address both the higher pathogen levels, turbidity levels and organics levels in the source water to meet the 4-log Giardia and 5-log virus removal/inactivation requirements.

4.1.5 System Operations and Maintenance

The City performs annual maintenance of the GHWTP treatment process equipment and infrastructure during the winter when water demands are lower and treatment processes can be taken off-line. During that time various elements of the treatment process are sequentially taken off-line for cleaning and maintenance over a period of 2 to 4 weeks. Any new treatment processes at the GHWTP will need to have the ability to accommodate the facility annual maintenance requirements, while meeting the system production objectives during the maintenance period.

4.1.6 Potential Impacts of Climate Change

The evaluation of the potential transfer scenarios was based on the past 73 years of hydrologic record (1937-2010) and current water demand of the agencies. Climate change would be expected to reduce the potential yields of all scenarios as a result of increased winter off-peak irrigation demand in the City service area, reduced groundwater recharge and lower winter baseflows, and potential increased winter turbidity from peak storm events. Generally the average yields might trend more to the dry and critically dry year estimates, which are 5-40% less than average yields across all year types. The City is currently preparing climate change scenarios to use in Confluence and these should be used in the future to better estimate the effect of climate change on potential transfer yields.

4.2 Use of Water for Direct Recharge

All of the above scenarios are based on the assumption that water would be treated and transferred to Scotts Valley and Soquel water districts to satisfy their normal winter demand and allow them to pump less groundwater, thereby helping their underlying groundwater basins recover. This is known as in lieu recharge. An additional approach was suggested in the Phase I Conjunctive use study, which would provide for excess winter surface water to be pumped and used for direct groundwater recharge either through percolation at an abandoned quarry or use of injection wells. The total amount of water able to be transferred under most scenarios was limited by the demand of the receiving districts. An analysis was done to assess the amount of additional raw water that might be available for direct recharge, after the winter demand of the districts was met. This analysis looked at using the City's existing pumping station at the Felton Diversion dam, while maintaining the current downstream bypass requirements. In the calculation, the total amount diverted water was not constrained by the current annual limit of 3000 af, but the maximum diversion rate was limited to 20 cfs, as specified in the City's current right. Under these conditions it was estimated that an average of 2900 af/yr (945 mgy) of raw water could be pumped from Felton Diversion for use in direct recharge.⁷ The estimated available water is much greater than the scenarios presented on Table 4 because 1) the water is raw, and therefore not subject

⁷ Fiske, Water Transfer Project: Long-Term Analysis Scenario 2 Final, June 22, 2012

to the treatment limitations of the Graham Hill WTP, and 2) because the supply analysis assumed there was a end place of unlimited capacity to receive the water. This scenario is now being further evaluated, along with the potential for blending surface water with recycled water for recharge at the old Hanson Quarry.

Based on the Santa Margarita Groundwater Model, recharge of 1000 af/yr would result in increasing groundwater levels with an eventual increase of 0.5 cfs in Bean Creek baseflow ⁸ (0.32 mgd). For the first ten years of recharge, most of the added water goes to increasing basin storage, which would be available for pumping and delivery to Santa Cruz. Injecting more than 1000 af/yr would be expected to accelerate the increased storage and the increased baseflow.

4.3 Fish Habitat Effects

Any water resource projects proposing additional stream diversion will not only have to demonstrate no significant impact to local fisheries, but should also seek to mitigate impacts created by past or current water management. The water transfer proposals were developed bearing both these objectives in mind. It is critical to demonstrate no adverse impacts on salmonid species and aquatic habitat as a part of the environmental review process and water rights permit process. There a number of factors included in the potential d projects to prevent adverse impacts to protected anadromous species:

- The diversion location is located low in the watershed and has no impact on the extensive upstream habitat.
- The period of diversion is limited to historically high-flow winter months of November to April, when there is generally more than adequate flow to support the salmonid life cycle.
- Only flows in excess of 25.2 cfs would be available for diversion for water transfer. This is the minimum winter flow agreed to by the fishery agencies to support migration across downstream critical riffles. ⁹
- The maximum amount of total diversion at Tait would be 21.7 cfs (14 mgd),) which is substantially less than the mean flow in the River of 263 cfs. from December through April.
- High flows that are too turbid to effectively treat, would not be diverted at all for periods of several days. These high flows are important for fish migration and “flushing-out” fine sediments from the streams.
- The yield calculations using the Confluence model calculated the flows available for transfer at Tait after the City’s 2030 demand was fully met while also meeting the stringent Tier 3 fish flow requirements at all the City diversions during the winter diversion season.
- The use of diverted winter flow to offset groundwater pumping and recharge the groundwater basin will result in increased dry season baseflow in the streams, and will eventually help the City reduce its dry season diversions, all of which will benefit summer rearing habitat, which is generally the most limiting factor for salmonid productivity. As described above, an increase of

⁸ Kennedy/Jenks, 2015, Draft Santa Margarita Groundwater Modeling Technical Study, for Scotts Valley Water District

⁹ California Department of Fish and Game, September 18, 2012, Letter from Scott Wilson to Bill Kocher regarding City of Santa Cruz Instream Water Diversions

1000 af/yr recharge in the Scotts Valley groundwater basin is expected to result in an increase of 0.5 cfs in summer baseflow in Bean Creek.

The effects on fish habitat of the proposed diversions for water transfer were evaluated by the City's fishery consultant, Hagar Environmental Sciences, using the same methodology that is being used in the HCP process to evaluate the effects of the City diversions. The fisheries consultants utilized data on channel conditions, habitat models, and the results of the yield analysis, specifically the residual flows with and without diversions, to estimate the effects on downstream habitat. The methods used in developing this data are fully described in HES 2011 (Assessment of Streamflow Effects on Migration, Spawning, and Rearing Habitat for Anadromous Salmonids in Streams Influenced by City of Santa Cruz Water Diversions including Newell Creek). The objective of the habitat assessment is to quantitatively determine the relationship between streamflow and potential migration, spawning, and rearing habitat for steelhead and coho salmon in the affected reach of the San Lorenzo River.

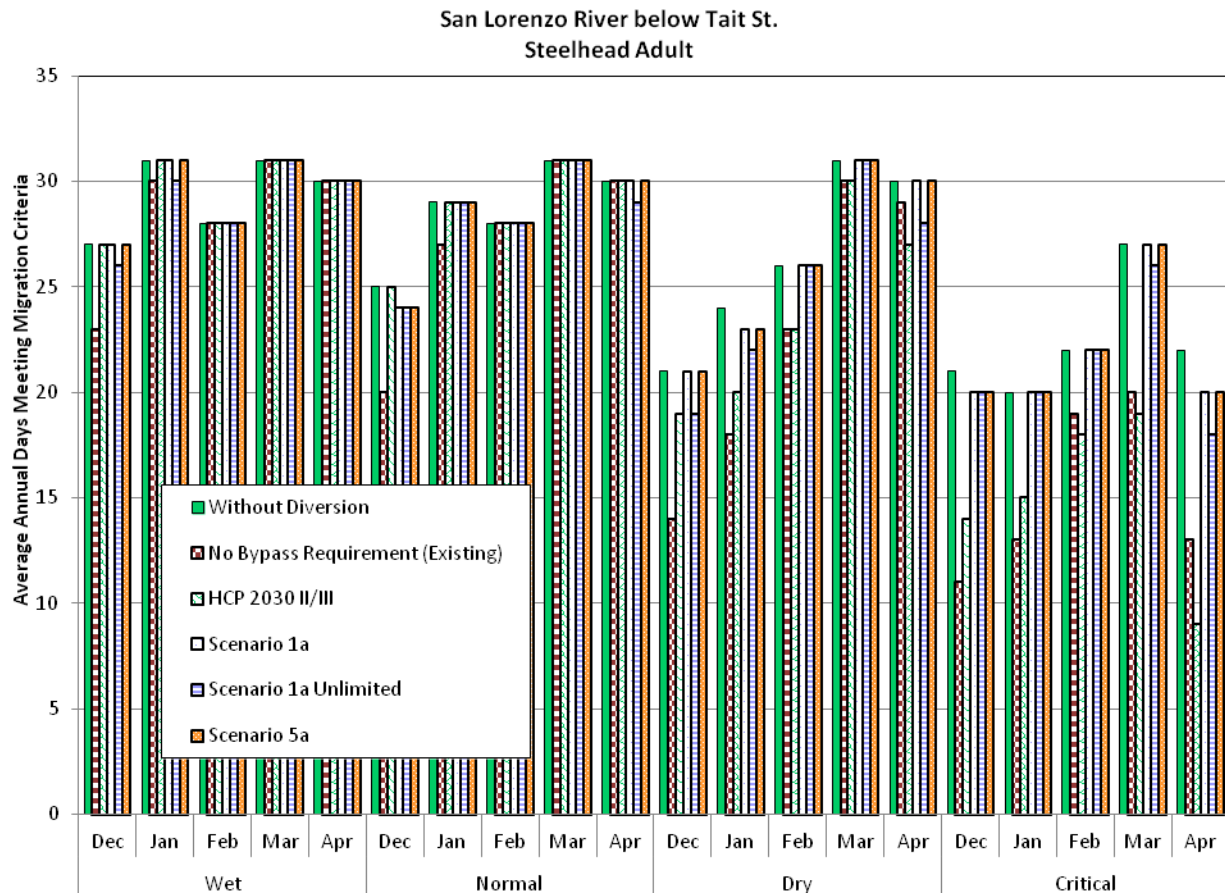
The critical life stages downstream of Tait Street November to April are steelhead adult migration (December to April), coho salmon adult migration (December to January) and smolt out migration (both species, January to May). HES (2013) calculated the average number of days each month that met migration criteria under six different flow scenarios:

- No City diversions
- Existing diversions with no bypass requirements
- HCP 2030 demand, Tier 2/3 flows (City Proposal)
- Water Transfer Scenario 1: Existing Diversion and Treatment Capacity (shown in Figure 4 as Scenario 1a)
- Water Transfer Scenario 3: unlimited Tait capacity (shown in Figure 4 as Scenario 1a Unlimited)
- Water Transfer Scenario 4: Treatment Plant upgraded to treat 200 NTU turbidity (shown in Figure 4 as Scenario 5a)

For smolts, the transfer scenarios have no effect on the number of days meeting migration criteria as compared to the no diversion scenario. For coho adults, the number of days of migration is reduced by 1-2 days in wet and dry years but is unaffected in normal and critically dry years. There is only slight additional effect for steelhead adult migration as indicated in Figure 4.

In this study there was no evaluation of the potential fishery impacts of diverting additional water at Felton Diversion. The Felton Diversion is located approximately 6 miles upstream from Tait Street. The City's water right that it obtained in 1975 requires a minimum bypass of 20 cfs with a maximum diversion rate of 20 cfs.

Figure 4. Effect of Transfer Diversions on Steelhead Adult Migration below Tait



Source: Hagar Environmental Science, 2013, Flow Related Effects of San Lorenzo Water Transfer on Habitat for Steelhead and Coho Salmon. See narrative above for explanation of scenarios.

4.4 Transfer of Water to Santa Cruz

The initial beneficiaries of the water transfer scenarios would be the Soquel Creek, Scotts Valley and San Lorenzo Valley Water Districts. However, the City of Santa Cruz could ultimately benefit by receiving deliveries of water from groundwater storage during summer months and dry years. The amount of water returned to Santa Cruz will be a function of Santa Cruz projected need, delivery capacity, groundwater pumping capacity and the condition of the groundwater basins. With a projected annual demand of 3500 mg and Tier 3 fish flows, it is projected that Santa Cruz will experience peak season shortfalls in supply 35% of the years.¹⁰ The peak season shortfall would be at least 880 mg at least 10% of the time. After 10-20% use curtailment, the shortage has been estimated at 2.5 -3.5 mgd, or 450-630 mg (1300-2000 af) requiring a 2.5-3.5 mgd supplemental supply for the peak season. More recent

¹⁰ Fiske, February 12, 2014, Volumetric Shortage Analysis for Water Transfer Project

analyses are suggesting a peak demand shortage of as much as 13 mgd during a critically an extreme dry year.¹¹

Delivery of water to the City from the Scotts Valley area would require construction of an intertie sized for 1-1.5 mgd. This could be the same intertie used to deliver water to Scotts Valley during winter months. This would also require construction of at least three additional wells in the Scotts Valley area to support a high enough rate of groundwater pumping. It is estimated that the groundwater basin has lost 28,000 af of storage since 1985, with localized groundwater level declines of 200ft. However, pumping amounts have declined and current annual pumping of about 2800 af/yr is not expected to result in further long term declines. Proposed water exchange and /or direct recharge would lead to more rapid recovery of groundwater storage and further facilitate direct transfer of water back to Santa Cruz and increased stream baseflow available for downstream diversion at Tait Street. The Santa Margarita Groundwater Model has recently been updated and could be used to simulate the effects of both the increased recharge as well as increased pumping and deliveries to Santa Cruz during dry periods.

Water could be transferred from Soquel to Santa Cruz at a rate of 1.44 mgd using the existing interties, with the addition of a 1,000 gpm pump station at Soquel Drive and 41st Avenue¹². All of the Soquel wells in Service Area 1 and 2 would need to be running to sustain that flow as well as meet current Soquel demand during the peak season. 2014 peak day demand for Soquel Service areas 1 and 2 was 4mgd, compared to a production capacity of 5.5 mgd.¹³

The expected rate of recovery and ability to deliver water from the Soquel groundwater basin remains an open question. It has been estimated that over pumping has occurred since 1979 resulting in a total deficit of 21,600 af and groundwater levels lower than the level needed to prevent seawater intrusion¹⁴. The beginnings of seawater intrusion have already been observed in the western and eastern parts of the basin. In order to achieve recovery of the basin to levels that will safeguard against seawater intrusion, Soquel has established a goal of reducing pumping by 1500 af/yr for the next 20 years. This includes a reduction of 300-500 af/yr of pumping from the Purisima area. A peer review of these targets has suggested that the pumping reductions only need to be 500 af/yr, but this is still under review. Observation of the groundwater levels in response to the current 4 year drought may also provide some insight as to the extent the basin could be pumped more heavily in dry years. A groundwater model will be developed in the next two years to provide a better tool for managing the basin, projecting the recovery that might result from water transfers, and projecting the ability of the basin to sustain transfer of water back to Santa Cruz without increasing the threat of seawater intrusion.

¹¹ Fiske, 2015

¹² Akel, 2014

¹³ Soquel Creek Water District, 2015

¹⁴ Hydrometrics WRI, 2012, Revised Protective Groundwater Elevations and Outflows for Aromas Area and Updated Water Balance for Soquel-Aptos Groundwater Basin, for Soquel Creek Water District

5.0 INFRASTRUCTURE IMPROVEMENTS

Infrastructure improvements would be required to facilitate the diversion and treatment of higher turbidity San Lorenzo River source water and transferring the excess water to the neighboring water agencies. The following sections describe conceptual level improvements to the Tait Street Diversion and the GHWTP to accomplish the winter-time water transfer concept.¹⁵

5.1 Tait Street Diversion Improvements

The Tait Street Diversion would need to be upgraded to handle the additional winter-time water capacity and increased grit loading and debris that accompany winter-time flows and storm events. The general elements of the Tait Street Diversion that would need to be improved include:

- Intake Structure, Bar Screens and Debris Removal and Haul-Away System
- Fish Screen System
- Grit Settling and Removal System
- Surface Water Pump Station
- Facility Support Systems

The improvements recommended for the Tait Street Diversion are based on a study conducted for the City in 2009 titled “Tait Street Diversion Sanding Study, Alternative Evaluation Report” (Wood Rodgers, 2009). The Tait Street Diversion Sanding Study evaluated a number of alternatives including improvements to the existing 7.5-mgd intake systems as well as replacing the existing system with a new 7.5-mgd intake system.

Depending on the different potential water transfer scenarios, different levels of improvements would be required for the Tait Street Diversion. Regardless of which scenario is employed, use of lower-quality winter-time San Lorenzo River water will necessitate additional sand and silt removal, haul away and disposal as well as increased maintenance of the facility. Also, improvements would need to be constructed in a manner that keeps the Tait Street Diversion in operation during construction. At a minimum, where water is withdrawn to the current capacity, upgrades would include improvements to the grit settling and removal system to handle the additional sand loads. In scenarios where increased withdrawals are considered, the current 7.5 mgd diversion would need to be expanded to approximately 14mgd. Where there are high flows and turbidities, upgrades include improvements to the screens and debris removal as well as grit settling and removal system to handle the additional debris and sand loads from winter-time storm flow type operations would be required.

The existing pipeline between the Tait Street Diversion and the GHWTP is 24-inch diameter. Despite increased velocities in the pipe considered for some of the scenarios, it can accommodate those flows. However, larger pumps would be required to transport that water.

¹⁵ Paraphrased From: Kennedy/Jenks. 2013. *Water Transfer Infrastructure Summary Report*. Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation. P. 20 -31

5.2 Graham Hill Water Treatment Plant

Most of the scenarios considered would require upgrade of the GHWTP to handle more challenging San Lorenzo River winter-time water quality. Also, depending on the scenario, additional winter-time water capacity would also be required. The treatment processes upgrades would include:

- **New pre-treatment flocculation and sedimentation basins:** To facilitate operating the GHWTP at winter-time flow rates up to 16 mgd, when the source water turbidity is as high as 200 NTU, the existing flocculation and gravity sedimentation pre-treatment process should be replaced. A robust pretreatment process, such as ballasted flocculation and clarification process can consistently produce clarified water with turbidity less than 2 NTU with source waters in excess of 200 NTU. This is necessary to ensure that the granular media filters can consistently and reliably produce filtered water with turbidities less than or equal to 0.3 NTU to meet the Surface Water Treatment Rule (SWTR), and potentially less than or equal to 0.15 NTU so that the additional 1.0-log Giardia removal credit could be achieved.
- **Chemical feed system improvements:** the current chemical feed systems would need to be improved along with the new pre-treatment system and to permit enhanced coagulation.
- **New ozone oxidation and disinfection process:** the GHWTP treated water disinfection contact time is currently accomplished in the large gravity sedimentation basins. The replacement of the existing sedimentation basins with a new pretreatment process requires that the disinfection contact time be provided elsewhere in the treatment process. The proposed overall improved disinfection process at the GHWTP would include both ozone and free chlorine disinfection.
- **Treated water tank improvements:** The existing GHWTP treated water tank should also be modified for improved performance and disinfection.
- **Wastewater and solids handling systems:** The solids production and waste water stream from the pre-treatment process will increase. Based on the GHWTP's current operations and the limits on solids discharged from the GHWTP to the sanitary wastewater collection system, improvements would be required to the solids handling system.

5.3 Distribution System Connection to Scotts Valley Water District

A distribution system connection between the City and Scotts Valley would consist of approximately 8,200 feet of 12-inch pipe, running from the City distribution pipeline at the intersection of Sims Road and Brook Knoll Drive to the SVWD distribution connection along La Madrona Drive north of Silverwood Drive. The distribution system intertie would have an average capacity of 1-mgd but could have a maximum capacity of approximately 2-mgd to meet maximum SVWD water transfer demands. The SVWD distribution system connection would also require a pump station located near the SVWD connection along La Madrona Drive. The pump station would lift the water from the City distribution system into the water storage tanks in the SVWD system. This pipeline would also be used to transfer water back to Sana Cruz during dry periods.

5.4 Distribution System Connection to Soquel Creek Water District

Initial cost estimates for water transfer included significant upgrades to transfer capabilities between Soquel and the City and within the Soquel system. This included replacement of portions of both the City's and Soquel's existing water distribution pipelines with larger pipelines or installation of new pipelines. Upgrades to the City's distribution system would consist of approximately 5,200 feet of pipe between Morrissey Boulevard and the DeLaveaga Tanks and approximately 10,200 feet from the DeLaveaga Tanks to the Soquel Drive Intertie on Soquel Drive and 41st Avenue. In addition, the existing Morrissey pump station would be upgraded to provide a firm capacity of 5-mgd. Proposed upgrades to

Soquel's distribution system included replacement of approximately 3,600 feet of pipe partly along Soquel Drive between the Soquel Drive Intertie and East Walnut Street and installation of approximately 2,300 feet of new pipe on Soquel Drive and Park Avenue between East Walnut Street and McGregor Drive.

Many of the above improvements have either been completed or are would not be necessary if City to Soquel Creek transfers are restricted to off-peak winter months. The recent installation of an 8 inch intertie at Soquel Drive and 41st Avenue will allow water transfer from the City to meet the total Soquel Service Area 1 and 2 winter demand at 1,028 gpm (1.48 mgd) with head loss increase to 4-5 ft/1000ft.¹⁶ This demand represents a total of 820-1100 acre-feet from November to April.

¹⁶ Akel, 2014

6.0 POTENTIAL SCENARIO YIELD AND ASSOCIATED COSTS¹⁷

The following sections present planning level estimates of capital expenditures, annual operations and maintenance (O&M) costs and annualized costs for the improvements to the surface water supply systems, the GHWTP, and treated water delivery system that would be required to accomplish the wintertime water transfers.

The planning level costs of the project elements presented are based on information and costs developed by Kennedy/Jenks for this and other technical studies, and supplemented with budgetary cost estimates from equipment manufacturers, and from similar projects and professional experience. The association for the Advancement of Cost Engineering (AACE) provides information regarding the standard cost estimating level descriptions, accuracy and recommended contingencies based on the development level of the project. The proposed concepts and improvements to accomplish the winter-time water transfers have been developed to a planning level, with conceptual design criteria, site locations and a basic understanding of project elements and limitations. These include a planning level contingency of 40%.

6.1 Capital Costs

Estimated capital costs for the project components are shown and summed for each scenario in Table 7. For a full discussion of the components and their costs, see the Kennedy/Jenks, *Water Transfer Infrastructure Summary*, 2013. The capital expenditure estimates also include planning level markups for taxes, contractor overhead and profit, mobilization and bonding, engineering and construction management, and legal, permitting, and administrative costs.

6.2 O&M Costs

The planning level operating and maintenance (O&M) costs for the winter time water transfers were developed on a unit-of-water cost basis to determine the additional cost of treating and transferring water above what is currently done at the GHWTP. The unit-cost in dollars per acre foot (\$/af) is then applied to the expected average volume of water for each scenario, to determine the O&M cost to treatment and transfer the winter-time water for that scenario.

The energy and O&M costs for the Tait Street Diversion are estimated at approximately \$103 per acre-foot for the current 7.8-mgd capacity and increased production from the diversion. At 14-mgd capacity and increased winter-time production, the cost would increase to approximately \$122 per acre-foot due to increase friction losses in the pipeline and increased solids and debris removal.

The energy cost for pumping from the City's distribution system pressures to the Scotts Valley and Soquel Creek Water District systems is estimated at a combined average of approximately \$50 per acre-foot. The energy cost for pumping to Scotts Valley would likely be higher than for pumping to Soquel Creek Water District.

Table 8 summarizes the engineer's opinion of probable operations and maintenance costs for the GHWTP when operating with increased San Lorenzo River water for winter-time water transfers at

¹⁷ Paraphrased From: Kenned/Jenks. 2013. *Water Transfer Infrastructure Summary Report*. Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation. P. 32-38, with some updated information added.

average production in current (< 15 NTU) turbidity conditions and the potential higher turbidity (~200 NTU) water conditions that would occur during some of the winter-time water transfer scenarios. The O&M costs are presented for the winter-time (November to April) time period when additional water could be produced.

Table 7 – Planning Level Capital Costs

Project Component	Scenario 0: Existing Infrastructure, Transfer to Soquel Only	Scenario 1: Current Tait & GHWTP Capacity	Scenario 2: Increase GHWTP Capacity	Scenario 3: Increase Tait & GHWTP Capacity	Scenario 4: Increase GHWTP Capacity & Treatment	Scenario 5: Increase Tait & GHWTP Capacity and Treatment
Tait Diversion Improvements						
Improvements for existing 7.8mgd systems	\$2,770,000	\$2,770,000	\$2,770,000	\$2,770,000	\$3,840,000	\$3,840,000
Expansion to 14MGD capacity	n/a	n/a	n/a	\$5,950,000	n/a	\$5,950,000
GHWTP Improvements						
Pre-treatment	n/a	n/a	\$24,800,000	\$24,800,000	\$24,800,000	\$24,800,000
Oxidation and Disinfection	n/a	n/a	\$20,240,000	\$20,240,000	\$20,240,000	\$20,240,000
Solids Handling	n/a	n/a	\$5,538,400	\$12,670,000	\$12,670,000	\$12,670,000
Distribution System Improvements						
Connection to SVWD	n/a	\$5,770,000	\$5,770,000	\$5,770,000	\$5,770,000	\$5,770,000
Connection to Soquel	n/a	\$18,410,000	\$18,410,000	\$18,410,000	\$18,410,000	\$18,410,000
Total Scenario Project Cost	\$2,770,000	\$26,950,000	\$77,528,400	\$90,610,000	\$85,730,000	\$91,680,000

Table 8 – Planning Level O&M costs, GHWTP

Component	GHWTP Winter-Water Transfer (15 NTU Turbidity) Operations	GHWTP Winter-Water Transfer (High Turbidity) Operations
Power	\$145,000	\$216,000
Chemicals	\$209,000	\$327,000
Sand for Pretreatment	\$2,000	\$4,000
Solids Handling	\$50,000	\$198,000
Solids Disposal	\$31,000	\$122,925
Maintenance Materials	\$228,000	\$418,000
Labor	\$250,000	\$350,000
Total Estimate	\$915,000	\$1,636,000
\$/af	165	245

6.3 Life-Cycle Unit Water Costs

The life-cycle unit water cost in \$/af is the sum of the annualized capital costs for the improvements, plus the operating costs to treat and transfer the water, divided by the total potential additional production from winter-time water transfers. The annualized capital cost is calculated based on a project life of 30 years and an interest rate of five percent.

The life-cycle unit water costs do not include all of the routine and administrative costs of operating a water systems. Although the calculated life-cycle cost of transferring water with limited infrastructure improvement under Scenario 0 is \$1,020/af, the current City of Santa Cruz charge for bulk water is about \$2,700/af and is proposed to increase to \$3,500/af. Water districts currently typically charge other districts the bulk water rate when water is transferred through interties for emergency or other purposes.

Table 9 – Planning Level Annualized Life-Cycle Unit Water Cost

Project Cost Component	Scenario 0 Transfer to Soquel Only	Scenario 1: Current Tait & GHWTP Capacity	Scenario 2: Increase GHWTP Capacity	Scenario 3: Increase Tait & GHWTP Capacity	Scenario 4: Increase GHWTP Capacity & Treatment	Scenario 5: Increase Tait & GHWTP Capacity and Treatment
Annualized Water Transfer Capital Cost	\$313,400	\$1,754,400	\$5,047,100	\$5,898,700	\$5,581,000	\$5,968,400
Additional Tait Street O&M Cost (\$/yr)	\$45,000	\$45,000	\$63,100	\$182,700	\$97,500	\$209,200
Additional GHWTP O&M Cost (\$/yr)	\$73,300	\$73,300	\$102,600	\$246,300	\$195,800	\$420,000
Additional Pumping Cost (\$/yr)	\$22,300	\$22,300	\$31,200	\$74,800	\$39,900	\$85,600
Total Life-Cycle Cost (\$/yr)	\$454,000	\$1,895,100	\$5,224,000	\$6,402,500	\$5,914,200	\$6,683,200
Total Estimated Yield (af/yr)	445	445	623	1,495	798	1,712
Unit Cost (\$/af)	\$1,020	\$4,260	\$8,420	\$4,280	\$7,410	\$3,900

7.0 WATER RIGHTS

The legal firm of Best Best & Krieger (BB&K) was contracted to provide an assessment of water rights constraints and opportunities for the water exchange project.¹⁸ In general there are two potential pathways to address water rights in order to implement a water transfer project: (1) work within the City's existing water rights at Tait Street to seek approval for a short term or long term transfer, or (2) apply for new water rights on the San Lorenzo River. As discussed in Section 3.4, the City has water rights to the San Lorenzo River at Tait Street for which it appears that there is generally available water and diversion capacity to transfer a moderate amount of water during high flow winter months. Transfer of the full amount of water analyzed in some of the scenarios would require an additional water right. Whichever path is chosen to proceed, it is imperative that the existing City's rights are not jeopardized, and any rights petition would need to demonstrate that other lawful users are not injured, that fish and wildlife would not be unreasonably harmed, and that the transfer is in the public interest. The various options are described below and summarized in Table 10.

7.1 Short Term Options

7.1.1 *Transfer of Pre-1914 Appropriative Water Right*

California Water Code section 1706 provides for the transfer of water that is governed by a pre-1914 appropriative water right provided that the transfer causes no injury to other legal users of the water, regardless of their priority of right.¹⁹ Transfer of pre-1914 water does not require approval of the State Water Resources Control Board (SWRCB), but is subject to challenge in the courts if another user believes they are injured by the transfer.

7.1.2 *Temporary Urgency Transfer*

California Water Code section 1435 authorizes a temporary change to an existing permit to allow for a different point of diversion, place of use, and/or purpose of use where an urgent need exists for the temporary change. These temporary change orders automatically expire after 180 days, but can be renewed for good cause. A temporary urgency transfer could be used to transfer water outside of the City's existing place of use, for example, to Soquel. Several findings must be made by the SWRCB prior to issuing a change order, including:

- The permittee has an urgent need to make the proposed change;
- The proposed change may be made without injury to any other lawful user of water;
- The proposed change may be made without unreasonable effect upon fish, wildlife, or other in-stream beneficial uses; and
- The proposed change is in the public interest.

A petition for a temporary urgency transfer would likely be accompanied by a parallel non-urgent petition for a permanent right. Among other considerations, the advantages of this approach are that it could potentially be implemented quickly, but the transfer would have to be renewed after 180 days

¹⁸ Paraphrased From Best Best & Krieger. 2013. Memorandum: County of Santa Cruz Water Supply and Water Rights Issues.

¹⁹ SWRCB, 1999, Guide to Water Transfers

and it is not statutorily exempt from the California Environmental Quality Act (CEQA). If an individual CEQA exemption does not apply it may cause significant delay.

7.1.3 Temporary Transfer

California Water Code section 1725 authorizes a temporary change to the point of diversion, place of use, or purpose of use for up to one year. A temporary transfer would need to only involve the amount of water that would otherwise be used by the existing right's holder. The advantages of this approach are that it is an expedited process and specifically exempt from CEQA. The disadvantages include that it is short-term and could impact the City's ability to transfer previously unused surplus water.

7.1.4 Temporary Urgency Permit

California Water Code section 1425 allows for temporary diversions of water, for up to 180 days, when the SWRCB finds that an urgent need exists. The key distinction between a temporary urgency permit and a temporary urgency change is that the petition does not need to be filed by the existing water rights holder – i.e. it would be a new permit. The advantage of this approach is that it is an expedited process and could be achieved by an entity other than the City. However, this approach is not statutorily exempt from CEQA.

7.1.5 Excess Municipal Water

California Water Code section 1462 provides a specific option for third parties to obtain a temporary permit to appropriate water that a municipality is entitled to use, but is in excess of its current needs. The option would require a showing that the City is not using its full appropriative right, and the process for making such an application is not clear. This approach is likely not in the best interest of the City.

7.2 Long-Term Options

7.2.1 Long-Term Transfer

California Water Code section 1735 allows for petitions for long-term transfers of water or water rights. In contrast to a temporary transfer, a long-term transfer requires public notice and opportunity to review. This is significant as it provides resource agencies with the ability to protest the action. Currently, resource agencies have protested the City's petitions on the Felton Diversion, and any additional actions could also be protested until the resolution of the City's HCP process. Also, long-term transfers are not specifically exempt from CEQA. The benefit of this approach is that a successful petition would be effective for many years, and that there is no requirement to demonstrate that the water would have otherwise been consumptively used, as would need to be demonstrated under a temporary transfer.

7.2.2 Petition to Change Place of Use

California Water Code section 1701 allows for petitions to change the place of use of its water rights. A change petition would likely involve a rigorous environmental review process, and it is not specifically exempt from CEQA. However, these types of petitions are generally processed more quickly than a new water rights application. A disadvantage to this approach is that it does not entitle the use of water beyond the City's existing 12.2 cfs diversion right.

7.2.3 Application for New Water Rights

An application for a new, appropriative right would likely be a component of a larger, long-term water transfer strategy. This would be a long and rigorous process. The SWRCB's current estimate to process new water rights applications is two to five years, but it can take considerably longer depending on the

complexity of the petition, CEQA review, and fishery agency approval. Under such a petition the SWRCB would conduct an extensive analysis of a variety of different factors in deciding whether or not water is available to grant a new appropriative right. Such an analysis would include potential impacts to the environment, existing users and the protection of the overall public interest.

Table 10 - Summary of Water Rights Options

Description	Water Code Section	Applicant	Duration of Permit	Amount of Water	Timing to Process Application	Other Requirements
Transfer Pre-1914 Appropriative Water	1706			Within current right	No SWRCB approval required	No injury to other legal users, as determined by courts
Temporary Urgency Transfer	1435	City	180 days, renewable	Within current right	<90 days	Demonstrate urgency. File for longer term change also
Temporary Transfer	1725	City	1 year, may be extended	Within current right	<60 days No CEQA	Water would have been consumptively used
Temporary Urgency Permit	1425	Other Party	180 days, renewable	Excess Unappropriated water	Expedited	Demonstrate Urgency. File for longer term change also
Excess Municipal Water	1462/ 1203	Other +City cooperation	Temporary	Within current right	Process Unclear	Not often used
Long-Term Transfer	1735	City	Many years	Within current right	1-3 yrs	
Petition to Change Place of Use	1701	City	Permanent	Within current right, amends right	More than 1 yr	
Application for New Water Right	1202,1205-1207, 1250 et seq.	Any party	Permanent	New available water	2-5 yr + 10-20 yr	

Notes: All options require demonstration of no injury to other legal users of water and no unreasonable effect on fish and wildlife (except a Section 1706 transfer). All options require CEQA review, except a Section 1725, Temporary Transfer and a Section 1706 Pre-1914 transfer.

Sources: Best Best & Krieger. 2013. Memorandum: County of Santa Cruz Water Supply and Water Rights Issues; SWRCB, 1999, Guide to Water Transfers

7.3 Fishery and CEQA Issues

Most of the water rights approaches require review and evaluation under the California Environmental Quality Act (CEQA), and the approval of the state and federal fishery regulatory agencies. The most significant potential impact under CEQA would be potential impacts on fish and aquatic habitat. During development of the various exchange scenarios, an effort has been made to ensure that they would be operated with no significant effect on fish or the environment. Substantial information has already been developed through the City's HCP process to support those findings. Additional discussions with the agencies will be needed, but it is anticipated that the CEQA review process for the water rights could proceed relatively quickly and could perhaps be supported by a mitigated negative declaration. The scenarios that will require significant modification of the Tait Street diversion will require more extensive environmental review to evaluate the construction related impacts and any impacts on the stream channel and riparian areas.

8.0 NEXT STEPS

This report defines the benefits and costs, technical, and legal considerations for possible water transfer projects between the City and adjacent groundwater agencies. Work remains to evaluate the benefits for the City in relation to other potential supply projects, evaluate the potential effects of climate change, identify a critical path towards addressing water rights, and develop the institutional framework and agreements for proceeding with a project.

8.1 Consideration of Other Conjunctive Use Options

This effort to evaluate water transfer options was initiated in 2011 and largely completed by the end of 2013. During and after that time a number of other potential supplemental water supply projects have been identified and are currently being evaluated, many of which are related to the components of the scenarios evaluated in this project. Both the City of Santa Cruz and the Soquel Creek Water District are actively engaged in efforts to quantify their water supply shortfalls and to quickly identify projects to remedy long-standing supply deficits. Following are some of the projects currently under consideration:

1. Divert 1000-1500 af/yr from Felton Diversion with a pipeline to the abandoned Hanson Quarry for storage, treatment and recharge into the Santa Margarita Groundwater Basin, with groundwater supply available to Santa Cruz in dry periods.
2. Use subsurface radial collection well(s), such as a Ranney® collector, at Felton and/or Tait Street, which would allow diversion of higher quality winter flow during high turbidity events with reduced need for treatment upgrade at the GHWTP. This could also facilitate direct diversion of water from Felton to the GHWTP, with amendments to existing water rights.
3. Construct an entirely new treatment plant to replace the GHWTP and provide a higher volume and level of treatment for winter flow.
4. Utilize advanced treated recycled water from Scotts Valley for groundwater recharge, potentially blended with winter flow diverted from the San Lorenzo River.
5. Utilize advanced treated recycled water from the City or County Sanitation District to recharge the Soquel-Aptos Groundwater basin.
6. Utilize low impact development and managed recharge to recharge stormwater into the Santa Margarita and Soquel-Aptos Groundwater Basins.

8.2 Further Technical Evaluations

Following are the additional technical evaluations that need to be completed:

1. Evaluate the potential effects of climate change on project yield by running the transfer scenarios in Confluence with hydrology and demand scenarios based on projected climate change possibilities.
2. Use the updated Santa Margarita Groundwater model to evaluate the effects of dry year pumping and delivery of groundwater to Santa Cruz, in conjunction with the various water exchange options for recharge of the Santa Margarita Groundwater Basin.
3. Evaluate the potential for increased groundwater delivery to Santa Cruz from the Soquel-Aptos groundwater basin in conjunction with the various options to increase groundwater storage. This will be facilitated by completion of the new Soquel-Aptos groundwater model in the next two years.

4. Evaluate the yield, cost, and reliability of the water transfer options identified in this report in relation to other potential supplemental supply projects. This work is underway through several related efforts.

8.3 Consideration of Fishery and CEQA Issues

Fishery and CEQA issues will have a strong impact on the feasibility, cost and timing of any project. These issues need to be further evaluated:

1. Consult with state and federal fishery agencies regarding the provisions incorporated in the water exchange scenarios to ensure that the agencies are satisfied that fishery resources are adequately protected. Consider and evaluate additional measures as needed.
2. Consult with CEQA experts on the appropriate course of action for competing CEQA requirements first for water rights approval and second to proceed with project implementation.

8.4 Water Rights

A critical path for securing water rights will likely include both short and long-term actions. The approach to water rights should involve all of the affected agencies and ideally would be accomplished in consultation with fisheries agencies.

1. Reach preliminary agreement among local agencies on the best way to approach water rights in terms of regional collaboration, lead agency, and approach for application(s).
2. Consult with State Board staff on various short and long term water rights options and the most effective way to proceed.
3. In the short term, the agencies could petition the State for a temporary urgency transfer or a temporary transfer of water under the City's existing Tait Street water right to the San Lorenzo River. Key determinations would need to be made as to whether or not the existing water supply situation constitutes urgency – impending sea water intrusion could likely make a fairly strong argument for that assessment. A temporary transfer under section 1725 is also a possibility, given the City's recent water savings through conservation. This process is made attractive given that it is specifically exempt from CEQA, which could streamline the process.
4. A short term (temporary) application should be accompanied by a long-term approach that would involve an application for a new water right on the San Lorenzo River. The entity applying for the permit would need to be defined through the institutional framework that is developed, as would the details regarding amount and place of use.

8.5 Institutional Framework

A memorandum of agreement, joint powers authority or some other institutional framework would need to be developed between the participating agencies. Depending on the approach taken, such an agreement would define roles and responsibilities among the agencies. The agreement might also contain specific operational agreements regarding the amount, timing, and process for transferring water. Cost sharing and funding would also likely be a critical component of any such agreement. An important next step in the discussion is a determination of the amount of water that could be returned to the City in drought years. In part, this amount would depend on the amount of water transferred to Soquel and the progress of basin recovery. However, ultimately, the amount of water returned to the City would be defined by the institutional agreements developed under a water transfer scenario. Next steps include:

1. Complete a proposed agreement regarding protection of the City's existing water rights
2. Develop a memorandum of agreement among the local participating water agencies regarding proceeding with a joint water rights applications that would include provisions for allocation of priority and amount through future local agreement and negotiations.
3. Develop agreements regarding the amounts and terms under which water could be pumped and sent to Santa Cruz.
4. Develop agreements regarding responsibilities and financing for proceeding next steps.

8.6 Short Term Project

Transfer of water to Soquel is a project that could potentially be implemented on a short term basis with limited if any additional infrastructure required. This could provide up to 445 af/yr, and even in dry and critically years, Soquel could receive 360 af and 290 af, respectively.²⁰ Implementation of this with water from Tait would include:

- Updated Confluence analysis of this scenario under current parameters of demand and delivery capacity and City operations to confirm yields and frequency of yields.
- CEQA review.
- Approval from the fishery agencies and the State Water Resources Control Board for a short term transfer.
- Approval of an agreement between the City and Soquel for transfer of winter water, including terms, costs, and potential for transfer of water back to Santa Cruz given that certain conditions in the basin were met.
- Development of a simple operations plan to increase winter diversions and treatment
- Opening the valve in the 8 inch intertie at Soquel and 41st Avenue when the operational conditions and fish flows were met.
- During dry periods, water could potentially be sent to Santa Cruz from the new O'Neil well, or through a new pump station.

²⁰ Fiske, April 26, 2012, Water Transfer Project Task 1: Short-term Analysis

9.0 REFERENCES.

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- Fiske, Phase 2 Water Transfer Project Draft Task 2 Technical Memorandum: Utilization of Tait Street Capacity (June 11, 2012)
- Fiske, Phase 2 Water Transfer Project Draft Task 3 Technical memorandum: Potential Transfers with Unlimited Tait Street Capacity (June 20, 2012)
- Fiske, Water Transfer Project: Long-Term Analysis Scenario 2 (Revised) (June 22, 2012)
- Fiske, Water Transfer Project: Long-Term Analysis Scenarios 3 and 4 (June 25, 2012)
- Fiske, Water Transfer Project: Long-Term Analysis Scenario 5: GHWTP Improvements (July 2, 2012)
- Fiske, Final Water Transfer Project Results Summary (July 6, 2012)
- Fiske, Phase 2 Water Transfer Analysis: Task 1 Results (Second Revision) (May 22, 2013)
- Fiske, February 12, 2014, Volumetric Shortage Analysis for Water Transfer Project
- Fiske, April 19, 2015, Modeling Results: Harvesting Winter Flows
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- Hagar Environmental Science, June 2013, Flow Related Effects of San Lorenzo Water Transfer on Habitat for Steelhead and Coho Salmon.
- Kennedy/Jenks. 2013. *Water Transfer Infrastructure Summary Report*. Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation.
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- Soquel Creek Water District, Feb 17, 2014, Soquel Creek Water District System Water Production Status Report , 2014

State Water Resources Control Board, July 1999, A Guide to Water rights Transfers

URS Corporation. 2013. *SCWD² Regional Seawater Desalination Project Draft Environmental Impact Report*. City of Santa Cruz and Soquel Creek Water District.

10.0 APPENDICES

Available Separately

10.1 Appendix A – Water Rights and Fish Habitat Impacts

- Best Best & Krieger. 2013. Memorandum: County of Santa Cruz Water Supply and Water Rights Issues.
- Hagar Environmental Science, June 2013, Flow Related Effects of San Lorenzo Water Transfer on Habitat for Steelhead and Coho Salmon.

10.2 Appendix B – Yield Modeling

- Fiske, Water Transfer Project: Long-Term Analysis Scenario 1 (June 1, 2012)
- Fiske, Phase 2 Water Transfer Project Draft Task 2 Technical Memorandum: Utilization of Tait Street Capacity (June 11, 2012)
- Fiske, Phase 2 Water Transfer Project Draft Task 3 Technical memorandum: Potential Transfers with Unlimited Tait Street Capacity (June 20, 2013)
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- Fiske, February 12, 2014, Volumetric Shortage Analysis for Water Transfer Project
- Akel Engineering Group, February 19, 2014, City of Santa Cruz Water Department and Soquel creek Water District Intertie Capacity Analysis

10.3 Appendix C – Infrastructure and Costs

- Kennedy/Jenks. 2013. *Water Transfer Infrastructure Summary Report*. Santa Cruz Water Department, County of Santa Cruz Environmental Health Services and Regional Water Management Foundation.