APPENDIX A

Scoping Letter, NOP/NOI, and NOP Comments

THE CITY OF SAN DIEGO

THE CITY OF SAN DIEGO
DEVELOPMENT SERVICES DEPARTMENT

Date of Notice: August 4, 2016

PUBLIC NOTICE
OF THE PREPARATION OF AN ENVIRONMENTAL IMPACT REPORT AND SCOPING MEETINGS

INTERNAL ORDER No. 21003699

PUBLIC NOTICE: The City of San Diego, as the lead agency, has determined that the project described below will require the preparation of an Environmental Impact Report/Environmental Impact Statement (EIR/EIS) in compliance with the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). This Notice of Preparation of an EIR/EIS and Scoping Meetings was publicly noticed and distributed on August 4, 2016. This notice was published in the *San Diego Daily Transcript* and placed on the City of San Diego website at http://www.sandiego.gov/city-clerk/officialdocs/notices/index.shtml.

SCOPING MEETING: Two public scoping meetings will be held by the City of San Diego's Development Services Department: one on August 23, 2016 from 6:00 p.m. to 7:30 p.m. at the Scripps Miramar Ranch Public Library located at 10301 Scripps Lake Drive, San Diego, California 92131, and one on August 25, 2016 from 6:30 p.m. to 8:00 p.m. at the City of San Diego Public Utilities Department, located at 9192 Topaz Way, San Diego, California 92123. Depending on the number of attendees, the meeting could end earlier than the end times noted above. Verbal and written comments regarding the scope and alternatives of the proposed EIR/EIS will be accepted at the meetings.

Written/mail-in comments may also be sent to the following address: Mark Brunette, Senior Environmental Planner, City of San Diego Development Services Department, 1222 First Avenue, MS 501, San Diego, California 92101, or via email to DSDEAS@sandiego.gov. Include the project name and number in the subject line, and send within 30 days of the date of this Public Notice, above. Responsible agencies are requested to indicate their statutory responsibilities in connection with this project when responding. An EIR incorporating public input will then be prepared and distributed for the public to review and comment.

Project Name/No: Pure Water San Diego Program, North City Project EIR/EIS / 499621
Community Area: University, Mira Mesa, Scripps Miramar Ranch, Clairemont Mesa, Linda Vista, Kearny Mesa, Tierrasanta, Navajo
Council District: 1, 2, 5, 6, 7

Project Description: The Bureau of Reclamation and the City of San Diego will prepare a joint Environmental Impact Report/Environmental Impact Statement to evaluate the effects of the North City Project, the first phase of the Pure Water San Diego Program (Pure Water Program). The Pure Water Program is a water and wastewater facilities plan to produce potable water from recycled water. The Pure Water Program consists of the design and construction of new advanced water treatment facilities, wastewater treatment facilities, pump stations, and pipelines.

The proposed project will expand the existing North City Water Reclamation Plant and construct an adjacent North City Pure Water Facility with a purified water pipeline to Miramar Reservoir. A project alternative would install a longer pipeline to deliver product water to the larger San Vicente Reservoir.

Other project components include: a new pump station and forcemain to deliver additional wastewater to the North City Water Reclamation Plant, a brine discharge pipeline, and upgrades to the existing Metropolitan Biosolids Center to accommodate additional biosolids from the increased treatment capacity at the North City Water Reclamation Plant.

A new electrical transmission line is proposed, connecting the North City Water Reclamation Plant to the future cogeneration facility at the Metropolitan Biosolids Center to deliver power for North City Project components. The electrical transmission line would cross Marine Corps Air Station Miramar and will require approval by the United States Marine Corps.

Figure 1 shows the location of the proposed facilities and pipelines. Figure 2 shows the location of the proposed facilities and pipelines for the San Vicente Alternative.

Applicant: City of San Diego, Public Utilities Department

Recommended Finding: Pursuant to Section 15060(d) of the CEQA Guidelines, it appears that the proposed project may result in significant environmental impacts in the following areas: Land Use, Visual Effects and Neighborhood Character, Air Quality/Odor, Biological Resources, Energy, Environmental Justice, Geology/Soils, Greenhouse Gases, Health and Safety, Historical Resources/Indian Trust Assets, Hydrology and Water Quality, Noise, Paleontological Resources, Public Services, Public Utilities, Transportation/Circulation/ Parking, and Water Supply.

Availability in Alternative Format: To request this Notice of the City's letter to the applicant detailing the required scope of work (EIR Scoping Letter) in alternative format, call the Development Services Department at 619.446.5189.

Additional Information: For environmental review information, contact Mark Brunette at 619.446.5379. The Scoping Letter and supporting documents may be reviewed, or purchased for the cost of reproduction, in the Development Services Department on the 5th floor of the Development Services Center. For information regarding public meetings/hearings on the project, contact the Project Manager, Keli Balo at 858.292.6423 or via email: kbalo@sandiego.gov. This notice was published in the SAN DIEGO DAILY TRANSCRIPT and distributed on August 4, 2016.

Distribution: See Attached

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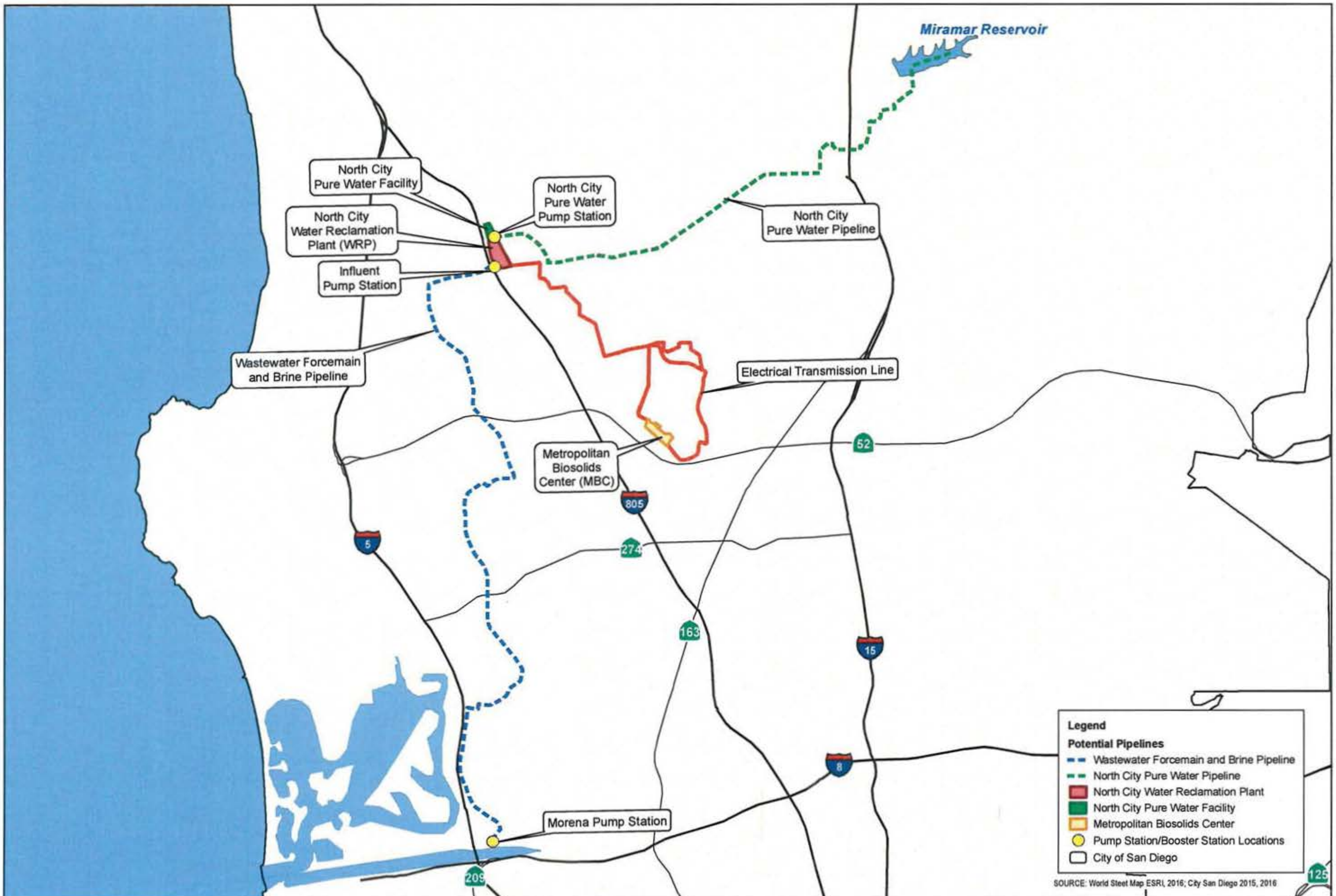

North City Project - Proposed Project - Miramar Reservoir

Pure Water San Diego Program North City Project EIR/EIS Notice of Preparation

CITY OF SAN DIEGO

FIGURE 1

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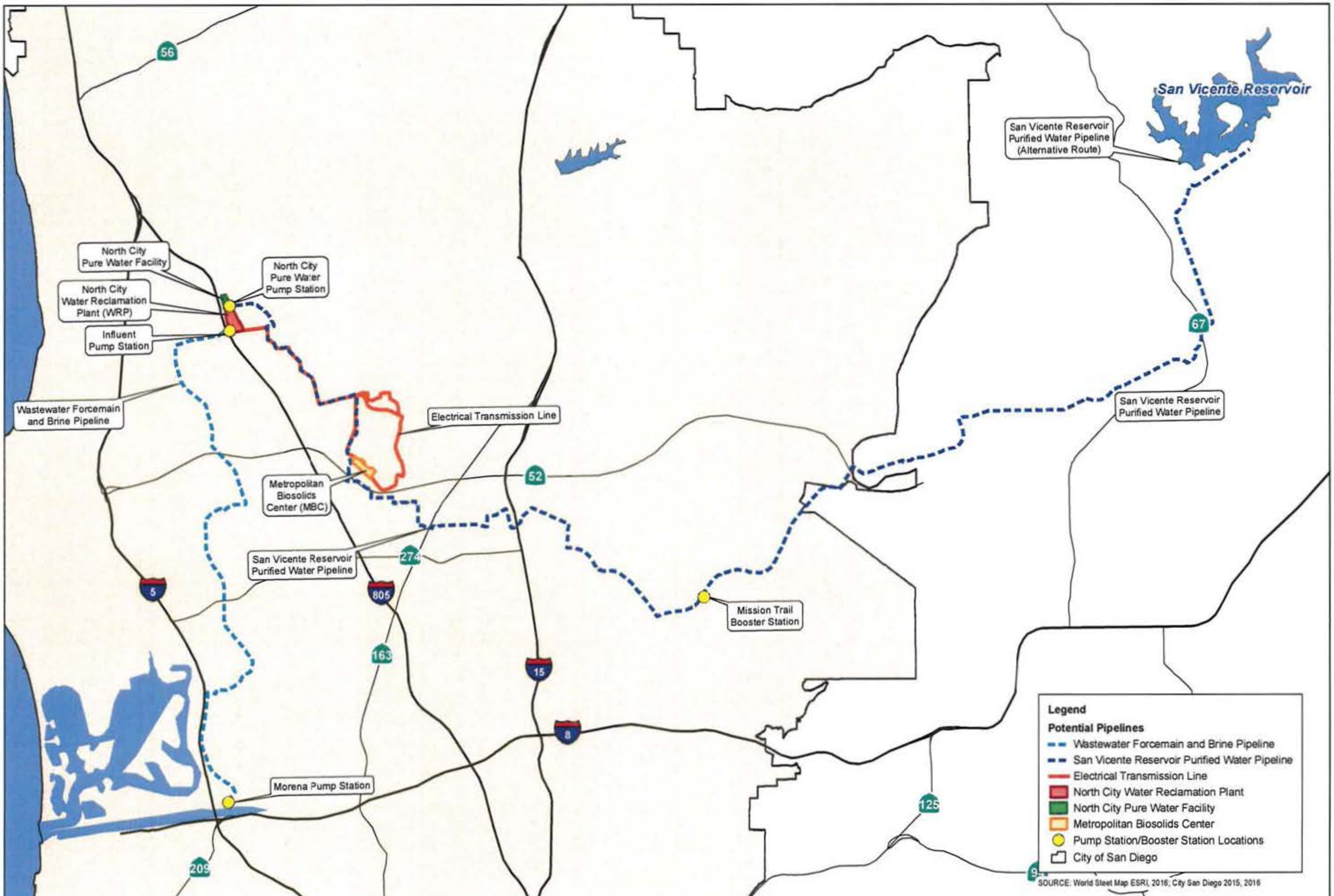

North City Project - Alternative A - San Vicente Reservoir

Pure Water San Diego Program North City Project EIR/EIS Notice of Preparation

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FIGURE 2

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August 4, 2016

Subject: Scope of Work for Draft Environmental Impact Report/Environmental Impact Statement for the Pure Water San Diego Program North City Project (project). Project No. 499621/SCH No. Pending

Based on review of the project application and pursuant to Section 15060(d) of CEQA, the Environmental Analysis Section of the City of San Diego Development Services Department determined that the above-referenced project may have a significant effect on the environment, and preparation of an EIR/EIS is required.

The purpose of this Scoping Letter is to identify specific issues to be addressed in the EIR/EIS, which will be prepared in accordance with the *City of San Diego Environmental Impact Report Guidelines* (updated December 2005) and *California Environmental Quality Act - Significance Determination Thresholds* prepared by the Development Services Department (January 2011). A Notice of Preparation (NOP) will be distributed to Trustee and Responsible Agencies and others who may have an interest in the project in accordance with CEQA Section 21083.9(a)(2) for projects with statewide, regional, or area-wide environmental impacts. Scoping Meetings are scheduled for August 23 and August 25, 2016. Changes or additions to the scope of work may be required as a result of input received in response to the Scoping Meetings and NOP. Should the project scope be modified during the scoping stage, EIR/EIS review process, and/or by the applicant, these changes will be disclosed in the EIR/EIS under the section "History of Project Changes," and be accounted for in the EIR/EIS impacts analysis to the extent required by CEQA and NEPA.

Each section and issue area of the EIR/EIS will provide a descriptive analysis of the project followed by a comprehensive evaluation. The EIR/EIS will also include sufficient graphics and tables, which, in conjunction with the relevant narrative discussions, will provide a complete and meaningful description of all major project features, the environmental impacts of the project, cumulative impacts, mitigation of significant impacts, and alternatives to the project.

Project Description

The Pure Water San Diego Program (Pure Water Program) is the City of San Diego's Public Utilities Department proposed program to provide a safe, secure, and sustainable local drinking water supply for San Diego. Advanced water purification technology would be used to produce potable water from recycled water. The Pure Water Program would consist of the design and construction of new advanced water treatment facilities, wastewater treatment facilities, pump stations, transmission lines, and pipelines.

The City of San Diego is proposing to move forward with the first phase of the Pure Water Program with the North City Project. Components included in the first phase are summarized below. The City is initiating the processing of a joint EIR/EIS, with the United States Bureau of Reclamation (Reclamation) as federal lead agency, to cover the Pure Water Program activities. The joint North City Project EIR/EIS is envisioned to be a project-specific summary and analysis that includes all components associated with the North City Project, Phase 1 of the Pure Water Program. The document must include all environmental impacts and a comprehensive mitigation strategy.

North City Project – Miramar Reservoir (Preferred Alternative)

The North City Project includes expansion of the existing North City Water Reclamation Plant, and construction of a new full-scale advanced water purification facility adjacent to the reclamation plant, pipelines, and support facilities such as pump stations. The purified water produced at the new purification facility would be piped to the Miramar Reservoir.

North City Water Reclamation Plant Expansion

The North City Water Reclamation Plant would be expanded from its current treatment capacity of 30 million gallons a day to 52 million gallons a day. To increase capacity, a number of new process units and tankage would be required. Process units requiring expansion would consist of influent screening, primary sedimentation, flow equalization, aeration basins, secondary clarification, and tertiary filtration. A new influent pump station would be located at the reclamation plant site and would pump tertiary effluent via a pipeline across Eastgate Mall Road connecting the reclamation plant to the purification facility. Additional wastewater flows to the expanded plant would be delivered from the new Morena Pump Station and wastewater force main.

North City Pure Water Facility

The new North City Pure Water Facility would be located on the vacant lot owned by the City of San Diego, across Eastgate Mall Road to the north of the existing water reclamation plant and would be designed to produce 30 million gallons a day of purified water. The water purification facility would use multiple treatment processes including an ozone system, biological activated carbon filtration, membrane filtration, reverse osmosis and ultraviolet/advanced oxidation process, before it is stabilized and chlorinated prior to being pumped out to the Miramar Reservoir.

North City Pure Water Pump Station and Pipeline

A new pump station and a purified water pipeline would be needed to convey the purified water produced at the North City Pure Water Facility to the Miramar Reservoir.

Morena Pump Station, Wastewater Force Main, and Brine Conveyance

To use the proposed expanded capacity of the water reclamation plant, additional wastewater flows that would normally be conveyed to the Point Loma Wastewater Treatment Plant would be diverted to the North City Water Reclamation Plant to be recycled. The Morena Pump Station is proposed to be located near the intersection of Friars Road and Interstate 5 to collect wastewater flows from a combination of trunk sewers and sewer interceptors to pump the diverted flows to the reclamation plant through a new wastewater force main. Additional brine from the reverse osmosis process at the water purification facility would be conveyed via a gravity flow line back to the proposed Morena Pump Station in the same corridor as the wastewater force main. The brine line would discharge downstream of the diversion structures back to into the sewer system.

Electrical Transmission

A new electrical transmission line is proposed to connect the North City Water Reclamation Plant to the future cogeneration facility at the Metropolitan Biosolids Center to deliver power to North City Project components. The electrical transmission line would cross Marine Corps Air Station (MCAS) Miramar property and require approval by the United States Marine Corps.

Metropolitan Biosolids Center Improvements

Process improvements would be required for handling future flows from the expanded North City Water Reclamation Plant. These improvements would upsize existing equipment and provide additional units to handle the increased flows. Improvements may include replacement of raw solids feed pumps, expansion of the grit removal facility, installation of one new grit separator, and installation of one new clarifier, snail, and screw conveyor.

Project Location

The Project would include a variety of facilities located throughout the central coastal areas of San Diego County in the North City geographic area. Figure 1 shows the location of proposed facilities. The new advanced water purification facility, proposed pipelines and three pump stations would be located within the corporate boundaries of the City. Potential electrical transmission facilities would traverse federal lands within MCAS Miramar.

General Background and Project History

On average, eighty five percent of the City of San Diego's water supply is imported from the Colorado River and Northern California. This reliance on imported water causes San Diego to be vulnerable to supply shortages and price increases. With few local water supply options, the City has explored non-potable and potable re-use options of treated wastewater.

The Pure Water Program would create 83 million gallons per day (MGD) of locally controlled water, reducing inflows to the Point Loma Wastewater Treatment Plant, which would ultimately reduce total suspended solids discharged while recycling a valuable and limited resource that is currently discharged to the ocean. The Pure Water Program would be implemented in two phases over a 20-year period. The Pure Water Program facilities are grouped into geographical areas to facilitate delivery: North City, Central Area, and South Bay.

The North City Project would be the first group of facilities to be constructed; construction is scheduled to be completed by 2021, and the project would produce 30 MGD of purified water. The Central Area and South Bay projects are scheduled to be completed by 2035 and would produce a combined total up to 53 MGD.

Ocean discharge from the City's Point Loma Wastewater Treatment Plant is regulated by the California Regional Water Quality Control Board under National Pollutant Discharge Elimination System (NPDES) Permit No. CA0107409. The NPDES permit is modified by a variance under Clean Water Act Sections 301(h) and (j)(5), approved by the Environmental Protection Agency, that allows ocean discharge with a waiver of full secondary treatment requirements.

The modified NPDES permit expired on July 30, 2015, and the City applied for renewal in January 2015. The new permit application is based on the City's commitment to reduce future Point Loma Ocean Outfall discharge flows by implementing the Pure Water Program. The Pure Water Program would reduce influent flows and solids loads to the PLWTP so that the ultimate discharge of total suspended solids would be reduced to levels comparable to secondary treatment standards (i.e., secondary treatment equivalency).

The Pure Water Program would include property and easement acquisition, discretionary permitting, construction, facility startup, testing, operation and maintenance of new facilities, and public education and community engagement.

EIR/EIS Format and Content

The EIR/EIS will serve to inform governmental agencies and the public of the project's environmental impacts. Emphasis must be on identifying feasible solutions to environmental problems. The objective is not simply to describe and document impacts, but to actively create and suggest mitigation measures or project alternatives that would avoid or substantially reduce significant adverse environmental impacts. The adequacy of the EIR/EIS will depend greatly on the thoroughness of this effort. The EIR/EIS must be written in an objective, clear, and concise manner, and must meet the requirements of CEQA and NEPA. Wherever possible, graphics will be used to replace extensive word descriptions and to assist in clarification. Conclusions will be supported by substantial evidence that is presented in the EIR/EIS or otherwise contained in the administrative record, with quantitative and qualitative information to the extent practicable.

Prior to distribution of the Draft EIR/EIS, conclusions for the project will be prepared. These conclusions will not be prepared until an approved draft has been submitted and accepted for release by the City. The EIR/EIS will include a title page that will include the project number, State Clearinghouse Number (SCH No.), date of publication, and an executive summary. The executive summary will reflect the EIR/EIS outline for each issue area identified below, but need not contain every element of the EIR/EIS. Additional information regarding specific content and formatting of the EIR/EIS can be found in the City's Environmental Impact Report Guidelines (updated December 2005), as outlined below.

I. Introduction

Introduce the proposed project with a brief discussion on the intended use and purpose of the EIR/EIS. Describe and/or incorporate by reference any previously certified environmental documents that address the project site. Briefly describe areas where the proposed project is in compliance or non-compliance with assumptions and mitigation contained in these previously certified documents. Provide projected time lines for the start and completion of the project. It shall also note the history of environmental documents prepared for the existing operations.

II. Environmental Setting

The EIR/EIS should (i) describe the precise location of the proposed project and present it on a detailed topographic map and regional map; (ii) provide a local and regional description of the environmental setting of the project, as well as adjacent land uses, area topography, drainage characteristics and vegetation; and (iii) include any applicable land use plans/overly zones that affect the project site, such as the City of San Diego's Multiple Species Conservation Program (MSCP)/Multi-Habitat Planning Area (MHPA), environmentally sensitive lands such as steep hillsides, wetlands, and the

Federal Emergency Management Agency (FEMA) 100-year floodplains or flood ways that intersect with the project components.

III. Project Description/Alternatives

The EIR/EIS shall include a detailed discussion of the goals and objectives of the project and a project description. The project description/alternatives chapter shall provide a discussion of all applicable discretionary actions required for the project (e.g., Planned Development Permit, Site Development Permit, Community Plan Amendment, Rezone), as well as a discussion of all permits and approvals required by federal, state, and other regulatory agencies.

CEQA Guidelines Section 15126.6(e) and NEPA regulations (40 CFR 1502.14) require that the EIR/EIS shall describe a range of reasonable alternatives to the proposed project, including "substantial treatment" of each of alternative. The EIR/EIS should analyze reasonable alternatives that can avoid or substantially reduce the proposed project's significant environmental impacts. These alternatives should be identified and discussed in detail, and should address all significant impacts associated with the project. A section entitled "Alternatives Considered but Not Carried Forward to Analysis" shall follow the detailed discussion of alternatives. This section should include a discussion of preliminary alternatives that were considered but not analyzed in detail. The reason for rejection should also be explained.

At a minimum, the following alternatives shall be considered and described in the EIR/EIS at a comparable level of detail as the proposed project:

i. No Project Alternative

CEQA Guidelines Section 15126.6(e) and NEPA regulations (40 CFR 1502.14(d)) require that a No Project (CEQA) and No Action (NEPA) Alternative be analyzed in an EIR and an EIS to allow decision makers to compare the impacts of not approving the action with those of approving the action.

Under the No Project/No Action Alternative, the proposed project would not be implemented. The North City Advanced Water Purification Facility and the associated improvements at other treatment facilities and pumping and conveyance facilities would not be constructed. Therefore, 30 MGD of purified water would not be produced. Instead, potable water demand would continue to be met through imported water supplies. In addition, current levels of wastewater flows would continue to the Point Loma Wastewater Treatment Plant. It is anticipated that the Point Loma Wastewater Treatment Plant would continue operating under a modified permit.

ii. San Vicente Reservoir Alternative

The San Vicente Reservoir (SVR) Alternative would produce 30 MGD annual average daily flow of purified water at a new advanced water purification facility located across Eastgate Mall Road to the north of the North City Water Reclamation Plant. Purified water would be pumped approximately 28 miles to the San Vicente Reservoir. An additional pump station, the Mission Trails Booster Station, would be located approximately halfway along the pipeline alignment along Mission Gorge Road. The advanced water purification facility would include microfiltration, reverse osmosis, and ultraviolet advanced oxidation process within the treatment process, but would not include an ozone system or biological activated carbon. Under this alternative, at least 30 MGD of purified water would be produced by the City by December 31, 2021.

IV. History of Project Changes

This section of the EIR/EIS shall outline the history of the project and any physical changes that have been made to the project in response to environmental concerns raised during the City's review of the proposed project.

V. Existing Conditions/Affected Environment

The EIR/EIS shall describe the physical, social, and regulatory setting for each of the following key environmental issue areas: land use; aesthetics/visual effects and neighborhood character; air quality and odor; biological resources; energy; environmental justice; geology and soils; greenhouse gas emissions; health and safety/hazards; historical resources/Indian trust assets; hydrology and water quality; noise; paleontological resources; public services; public utilities; transportation, circulation, and parking; and water supply.

This chapter shall summarize the current conditions related to each key environmental issue area as they relate to the potential effects of each of the alternatives. The chapter shall include a brief discussion of the geographic area for each given resource (covering the entire potential affected area for all alternatives), and, as needed, include the history, development, past disturbances, natural events, and interactions that have helped shape current conditions.

VI. Environmental Analysis/Environmental Consequences

The potential for significant environmental impacts must be thoroughly analyzed and mitigation measures identified that would avoid or substantially lessen any such significant impacts. The EIR/EIS must represent the independent analysis of the City of San Diego as lead agency; therefore, all impact analysis must be based on the City's current CEQA Significance Determination Thresholds.

The analysis shall include all potential project components that may be implemented and would provide a comprehensive approach to outlining potential environmental effects.

Below are key environmental issue areas that have been identified for this proposed project that have issue statements that must be addressed individually. Discussion of each issue statement will include an impact analysis, significance determination, and appropriate mitigation. The impact analysis will address potential direct, indirect, and cumulative impacts that could be created through implementation of the proposed project/proposed action. The impact analysis should also include a thorough analysis of the potential direct, indirect, and cumulative impacts of each of the alternatives. Identification of a reasonable range of mitigation measures for each identified potentially significant impact should be included.

A. Land Use

Issue 1: Would the proposed project be inconsistent or conflict with the environmental goals, objectives, and recommendations of the City of San Diego General Plan (General Plan), the City of San Diego Municipal Code, or the various community plans where the project would be located, or other applicable land use plans?

Issue 2: Would the proposed project result in a conflict with the provisions of the MSCP or other adopted environmental plans for the area?

Issue 3: Would the proposed project result in land uses which are not compatible with an adopted Airport Land Use Compatibility Plan (ALUCP)?

The EIR/EIS should evaluate how the proposed project accomplishes or fails to implement the environmental goals, objectives, and recommendations of the General Plan, San Diego Municipal Code, City of San Diego's Land Development Code, and relevant community plans. If any inconsistencies are identified, the Land

Use Section of the EIR/EIS should also identify if these inconsistencies would result in a direct or indirect environmental impact. The EIR/EIS should also address land use compatibility with the final MSCP Plan (August 1998), the City's MSCP Subarea Plan (March 1997), and other environmental plans.

B. Visual Effects and Neighborhood Character

Issue 1: Would the proposed project result in a substantial change to natural topography or other ground surface relief features through landform alteration?

Issue 2: Would implementation of the proposed project result in the blockage of public views from designated open space land areas, roads, or to any significant visual landmarks or scenic vistas?

Issue 3: Would the proposed project result in substantial alteration to the existing character of the area?

Issue 4: Would the proposed project be compatible with surrounding development in terms of bulk, scale, materials, or style?

To the extent feasible, the EIR/EIS should include an evaluation of potential impacts on the natural landforms resulting from implementation of project components. The City's Significance Determination Thresholds include the following in determining such impacts: exceed the allowed height or bulk regulations and existing patterns of development in the surrounding area by a significant margin, and/or located in a highly visible area and would strongly contrast with the surrounding development or natural topography through excessive bulk, signage, or architectural projection. If any project components include such elements, this section of the EIR/EIS should include a conceptual description and analysis of the allowed building mass, bulk, height, and architectural style that could result from the proposed project. The EIR/EIS shall also analyze the use of materials or components that could emit or reflect a significant amount of light or glare, and any potential effect on light-sensitive species or on adjacent aviation uses. Renderings, cross-sections, and/or visual simulations of new or modified structures and buildings proposed to be built should be incorporated into the EIR/EIS section when possible.

C. Air Quality/Odor

Issue 1: Would the proposed project conflict with or obstruct the implementation of the applicable air quality plans?

Issue 2: Would the proposed project result in a violation of any air quality standard or contribute substantially to an existing or projected air quality violation?

Issue 3: Would implementation of the proposed project result in air emissions that would substantially deteriorate ambient air quality, including the exposure of sensitive receptors to substantial pollutant concentrations?

Issue 4: Would the proposed project create objectionable odors affecting a substantial number of people?

Issue 5: Would the proposed project exceed 100 pounds per day of respirable particulate matter (PM_{10}) or 55 pound per day of fine particulate matter ($PM_{2.5}$)?

The EIR/EIS should describe the area's climatological setting within the San Diego Air Basin and the basin's current attainment levels for state and federal Ambient Air Quality Standards (AAQS). It should discuss the potential stationary and non-stationary air emission sources related to the land use modifications associated with the project, particularly vehicle and facility emission sources and dust creation during construction.

The EIR/EIS will include a quantitative analysis of potential impacts to air quality and compliance with AAQS associated with implementation of the proposed project, including quantification of construction-related emissions estimated to occur with construction activities associated with treatment plants and pipelines, and operational emissions associated with facilities.

The EIR/EIS should discuss the proposed project's impact on the ability of the San Diego Air Basin to meet regional air quality strategies (RAQS). It should discuss any short-term, long-term, and cumulative impacts the proposed project may have on regional air quality, including construction- and transportation-related sources of air pollutants, and potential impacts from the increase in vehicle trips to the RAQS, the overall air quality impacts from such trips, and any proposed mitigation measures.

The EIR/EIS should also discuss consistency with the Federal Air Quality Act.

D. Biological Resources

Issue 1: Would the proposed project result in impacts to a sensitive habitat or sensitive natural community as identified in local, regional, state, or federal plans, policies, or regulations?

Issue 2: Would the proposed project result in an impact on City, state, or federally regulated wetlands through direct removal, filling, hydrological interruption or other means?

Issue 3: Would implementation of the proposed project result in a reduction in the number of any unique, rare, endangered, sensitive, or fully protected species of plants or animals?

Issue 4: Would the proposed project result in interference with the movement of any native resident or migratory wildlife through linkages or wildlife corridors?

Issue 5: Would the proposed project conflict with provisions of adopted local habitat conservation plans or policies protecting biological resources?

Issue 6: Would the proposed project introduce land uses within or adjacent to the MHPA that would result in adverse edge effects?

Issue 7: Would the proposed project introduce invasive species into natural open space areas?

A series of diverse habitats and sensitive species could potentially be directly or indirectly affected by the proposed project and should be fully discussed in this section of the EIR/EIS. A Biological Resources Technical Report, based on existing inventory, vegetation mapping, and species-specific surveys, should be prepared. The analysis must identify any rare and sensitive species (including species listed as threatened or endangered under the Endangered Species Act), MSCP covered and narrow endemic flora and fauna that are known to be, or to have a potential to exist, in the proposed project area, and an inventory of sensitive habitat types and wetlands.

The impacts to identifiable wetland habitat should be addressed within this section of the EIR/EIS. Wetland habitat types should be shown graphically and include recommendations to sustain their functionality. If impacts to any wetlands or wetlands buffers are identified, a discussion of the feasibility or infeasibility of avoiding such impacts should be included. The analysis must identify whether the proposed project and associated components would have any adverse effects on existing reservoirs or related habitat.

Project components may be located within and/or adjacent to the MHPA and would, therefore, require conformance with the Land Use Adjacency Guidelines. The analysis will discuss how the project would be in conformance with the guidelines related to land use, drainage, toxic substances, lighting, noise, invasive plant species, and predator and pedestrian management.

E. Energy

Issue 1: Would the construction and operation of the proposed project facilities result in the use of excessive amounts of electrical power or use excess amounts of fuel?

Appendix F of the State CEQA Guidelines requires that potentially significant energy implications of a project be considered in an EIR to the extent relevant and applicable to the project. Particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy should be included in this section. The EIR/EIS section shall address the estimated energy use for the proposed project and assess whether the proposed project would generate a demand for energy (electricity and/or natural gas) that would exceed the planned capacity of the energy suppliers, and would include any water-saving project features. This section would be cross-referenced with the greenhouse gas emissions discussion section of the EIR/EIS, as appropriate; shall describe any proposed measures included as part of the proposed project directed at conserving energy and reducing energy consumption; and shall address all applicable issues described within Appendix F of the CEQA Guidelines.

F. Environmental Justice

Issue 1: Would the proposed project result in a disproportionately high and adverse human health or environmental effect on minority populations or low-income populations?

Significance thresholds or standards for environmental justice effects are not generally provided under CEQA Guidelines Section 15131. CEQA does not address environmental justice effects unless it can be demonstrated that a physical effect on the environment will result. An EIS considers the effects of a proposed project on the human environment consistent with NEPA, and considers the effects on minority populations and low-income populations as described in Executive Order 12898. The EIR/EIS shall determine the affected geographical area, determine the demographic characteristics of the geographic area, determine whether the populations within the affected geographic area include an environmental justice community, and determine whether potential adverse effects of the proposed project would disproportionately affect environmental justice communities.

G. Geology/Soils

Issue 1: Would the proposed project expose people or property to geologic hazards such as earthquakes, landslides, mudslides, liquefaction, ground failure, or similar hazards?

Issue 2: Would the proposed project increase potential for erosion of soils on site or off site?

Issue 3: Would the proposed project be located on a geological unit or soil that is unstable or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

The geologic and subsurface conditions in the proposed project area will be described in this section, along with existing topography, geology (surface and subsurface), tectonics, and soil types. The impact analysis should include issues such as the potential for liquefaction, slope instability, and rockfall hazards. Any secondary issues due to soils/geology (e.g., excavation of unsuitable soils) should be addressed.

H. Greenhouse Gases

Issue 1: Would the project generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?

Issue 2: Would the project conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?

This section shall present an overview of greenhouse gas (GHG) emissions, including the most recent information regarding the current understanding of the mechanisms behind current conditions and trends, and the broad environmental issue related to global climate change. A discussion of current legislation, plans, policies, and programs pertinent to global climate change shall also be included. The EIR/EIS shall provide details of the project's sustainable features that meet the criteria outlined in the Conservation Element of the General Plan and the Climate Action Plan Consistency Checklist.

The analysis of greenhouse gas impacts shall include a discussion of the project's compatibility with the City of San Diego's Climate Action Plan (CAP). If the project is determined to be consistent with CAP, as determined through the use of the Climate Action Plan Consistency Checklist, it may rely on the CAP for the cumulative impacts analysis of GHG emissions. If the project is determined not to be consistent with the CAP, preparation of a comprehensive project-specific analysis of GHG emissions, including quantification of existing and projected GHG emissions and incorporation of the measures as detailed within the checklist to the extent feasible shall be provided. Cumulative GHG impacts would be significant for any project that is not consistent with the CAP.

I. Health and Safety

Issue 1: Would the proposed project expose people or property to health hazards, including fire?

Issue 2: Would the proposed project create future risk of an explosion or the release of hazardous substance (including, but not limited to gas, oil, pesticides, chemicals, or radiation)? Would the proposed project expose people or the environment to a significant hazard through the routine transport, use, or disposal of hazardous materials?

Issue 3: Would any component of the proposed project interface or intersect with a site that is included on a hazardous material sites list compiled pursuant to Government Code Section 6596.25 and, as a result, pose a potential hazard to the public or environment?

Issue 4: Would the proposed project result in a safety hazard for people working in a designated airport influence area?

Various aspects of water treatment employ the use of chemicals, gases, and potentially hazardous processes. The EIR/EIS shall provide an analysis of the hazardous materials to be stored, used, and transported for the proposed project, and assess the potential for significant human health and safety impacts.

The project proposes to supplement the region's drinking water supply with purified water. The EIR/EIS shall discuss the potential of water contamination from mishandling, error, or equipment malfunction, and the potential for significant human health or public safety impacts.

The EIR/EIS will include a description of potential hazards and hazardous materials issues that intersect or interface with the proposed project area, including disclosure of sites on a list maintained by the state that has been compiled in accordance with Government Code Section 6596.25.

J. Historical Resources/Indian Trust Assets

Issue 1: Would the proposed project result in the alteration or destruction of a prehistoric or historic archaeological site, or any adverse physical or aesthetic effects to a prehistoric or historic building, structure, object, or site?

Issue 2: Would the proposed project result in any impact to existing religious or sacred uses or result in the disturbance of any human remains within the potential impact area?

Issue 3: Would the proposed project result in impacts to Indian trust assets including changes in the value of Indian trust assets?

The proposed project would include improvements located in or near areas where archeological sites have been previously recorded. The project could have a potentially significant impact on these sites. A cultural resources report would be prepared for the proposed project (including facilities and pipelines) to address existing conditions, potential impacts related to cultural and historic resources within the project area, and proposed mitigation. The analysis would include a records search of local databases and pedestrian surveys of undisturbed areas where proposed improvements would occur. A report would be prepared in accordance with the City of San Diego's Land Development Code Historical Resources Guidelines (amended April 30, 2001) and discussed in the EIR/EIS. Based on background research and review of archaeological site records, the EIR/EIS would identify areas of high, moderate, and low sensitivity, and provide recommendations for further evaluation to determine significance when applicable, and include recommendations for appropriate mitigation. The EIR/EIS would identify requirements for archaeological monitoring during grading operations and specific mitigation requirements for discoveries. This section must also include a discussion of potential impacts to Native American cultural resources, and include an ethnographic discussion of the San Diego tribal community relative to the project study area.

"Indian trust assets" are defined as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Native American tribes and individual Native Americans (Bureau of Indian Affairs 303 DM 2.5.C). The EIR/EIS will describe the Indian trust assets that could be affected by the proposed project. The impact assessment will be based on changes in asset value attributable to the proposed project. Pursuant to Section 106 of the National Historic Preservation Act of 1966, the lead federal agency shall consult with the identified State Historic Preservation Officer to identify whether any historic properties will be affected.

K. Hydrology and Water Quality

Issue 1: Would the proposed project increase impervious surfaces and associated increased runoff?

Issue 2: Would the proposed project result in a substantial alteration to on- and off-site drainage patters due to changes in runoff flow rates or volumes?

Issue 3: Would the proposed project create discharges into surface or ground water, or in any alteration of surface or ground water quality, including, but not limited to, temperature, dissolved oxygen or turbidity? Would there be increases in pollutant discharges including downstream sedimentation?

Issue 4: Would the proposed project, when considered in combination with past, current, and future projects in the affected watersheds, result in cumulatively significant impacts on hydrology and water quality?

Hydrology deals with the properties, distribution, and circulation of surface water, ground water, and atmospheric water. The quantity of water that flows in a creek or river is calculated based on historic climatic conditions combined with the watershed characteristics. The slope and shape of the watershed, soil properties, recharge area, and relief features are all watershed characteristics that influence the quantity of surface flows. The EIR/EIS will address the existing conditions and potential impacts related to hydrology resources within the project study area.

Water quality is affected by sedimentation caused by erosion, runoff carrying contaminants, and direct discharge of pollutants (point-source pollution). Also, as land is developed, the impervious surfaces send an increased volume of runoff containing oils, heavy metals, pesticides, fertilizers, and other contaminants (non-point source pollution) into adjacent watersheds. Degradation of water quality could impact human health and wildlife systems. Sedimentation can cause impediments to stream flow. In addition, oxygen availability is affected by sedimentation, which can significantly influence aquatic and riparian habitats. Therefore, the EIR/EIS will discuss how the proposed project could affect water quality within the project area, in discharge reservoirs, and downstream. The EIR/EIS will address the existing conditions and potential impacts related to water quality within the project study area.

L. Noise

Issue 1: Would the proposed project result in or create a significant increase in the existing ambient noise level?

Issue 2: Would the construction noise associated with implementation for any component of the proposed project exceed the City's adoption noise ordinance or noise levels as established by the General Plan?

A Noise Technical Report will be prepared that will consist of a comparison of the change in noise levels projected along affected roadways (as identified in the traffic study) and in surrounding areas resulting from project implementation. This analysis and the discussion in the EIR/EIS will focus on areas that would be subject to potentially significant noise impacts as a result of the proposed project, and will include discussion of potential measures that could be used to reduce noise levels.

The noise analysis will also address potential construction-related impacts, including a general delineation of noise-sensitive uses located in proximity to project components, and a description of noise levels associated with typical construction activities, including general quantification of typical construction activity type noise levels at interval distances (e.g., confined earthmoving equipment with a typical noise level of 90 A-weighted decibels (dBA) at 50 feet would result in noise levels of approximately 84 dBA at 100 feet, 78 dBA at 200 feet, 72 dBA at 400 feet).

M. Paleontological Resources

Issue 1: Would the proposed project result in the loss of significant paleontological resources?

The proposed project would have facilities constructed in the following high-sensitivity geologic formations: Ardath Shale, Stadium Conglomerate, Friars Formation, Mission Valley Formation, and San Diego Formation. As such, there is potential for the project to impact paleontological resources due to excavation in high-resource-potential areas. The EIR/EIS would include a paleontological resources discussion that identifies the underlying soils and formations within the geographic area of the proposed project and the likelihood of the project to uncover paleontological resources during grading and excavation activities. The EIR/EIS will identify requirements for paleontological monitoring during grading operations and specific mitigation requirements for discoveries.

N. Public Services

Issue 1: Would the proposed project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services?

The EIR/EIS analysis of public facilities would determine if the proposed project would result in impacts to police or fire-rescue services within the project area. The EIR/EIS would describe the public services currently available and how they intersect or interface with proposed project.

O. Public Utilities

Issue 1: Would the proposed project result in new systems or require substantial alterations to existing utilities including solid waste disposal, the construction of which would create a physical effect on the environment? These systems include communications systems, storm water drainage and solid waste disposal.

The proposed project would involve construction of new and expansion of existing water and wastewater facilities. This section will discuss the existing public utilities that serve the area and how they intersect or interface within the proposed project, as well as potential conflicts. The EIR/EIS analysis would determine if the project would result in significant impacts to solid waste facilities.

P. Transportation/Circulation/Parking

Issue 1: Would implementation of the proposed project result in an increase in projected traffic specifically associated with project-related construction that is substantial in relation to the capacity of the existing and planned circulation system?

Issue 2: Would the proposed project create alterations to present circulation movements in the areas including effects on existing public access points?

The EIR/EIS would include a traffic analysis that estimates vehicular trip generation, temporary traffic impacts associated with construction, and operational traffic associated with operations of all North City facilities. Construction trip generation estimates will be developed for each of the proposed staging areas along the pipeline alignments. The operational analysis will evaluate the impact of operational trips generated by the AWPF at both intersections and roadway segments. The traffic analysis would form the basis of the impacts analysis for this section of the EIR/EIS. The traffic analysis and EIR/EIS would include descriptions and applicable graphics of the existing transportation/circulation conditions within the project area.

Q. Water Supply

Issue 1: Would the project affect the ability of water serving agencies to provide water?

The proposed project would involve development of a water resource that diversifies the regional's potable water sources. The proposed project's effect on water agencies will be analyzed in this section of the EIR/EIS.

VII. Comparison of Alternatives

This section of the EIR/EIS will include a brief summary of the detailed analysis of alternatives to be provided under Chapter VI, Environmental Analysis/Environmental Consequences, including a matrix comparing the potential impacts of each in relation to the other alternatives.

VIII. Cumulative Impacts

When the proposed project is considered with other past, present, and reasonably foreseeable projects in the project area, implementation could result in significant environmental changes that are individually limited but cumulatively considerable.

Therefore, in accordance with Section 15130 of the CEQA Guidelines, potential cumulative impacts should be discussed in a separate section of the EIR/EIS.

Issue 1: What are the cumulative impacts of the proposed project in conjunction with other approved or proposed projects within the region?

CEQA requires a discussion of cumulative impacts when they are significant. The determination of cumulative significance calls for reasonable effort to discover and disclose other related projects. The direct and indirect impacts of each related project need to be identified and looked at comprehensively. CEQA provides various alternative methods to achieve an adequate discussion of cumulative impacts (see CEQA Guidelines Section 15130, noting the repealed Sections 15064(i)(4) and 15130(a)(4)). Specific sections of the City's Significance Thresholds provide significance determination criteria for cumulative impacts under individual issue areas (e.g. biology, air quality, traffic). However, in general, the following should apply for determining significant cumulative impacts:

i. If there are known documented existing significant impacts occurring in a community, additional increments would exacerbate the impact (e.g., an overloaded transportation system).

ii. If a community plan and/or precise plan identifies cumulative impacts in the community-wide EIR, individual projects which contribute significantly to the community-wide impacts would be considered cumulatively significant.

iii. A large-scale project (usually regional in nature) for which direct impacts are mitigated by the collective number of individual impacts results in a cumulative impact.

As defined in Section 15355, a cumulative impact consists of an impact that is created as a result of the combination of the project evaluated in the EIR/EIS with other projects causing related impacts. An EIR should not discuss impacts that do not result from the project evaluated in the EIR/EIS.

Section 15355 defines "cumulative impact" as follows:

Cumulative impacts refers to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts.

i. The individual effects may be changes resulting from a single project or a number of separate projects;

ii. The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time.

The EIR/EIS cumulative analysis would be based on a summary of projections contained in adopted general plans, community plans, and other related long-range planning documents. The cumulative analysis would also include a list of relevant projects to determine the proposed project's contribution to a cumulative effect.

IX. Effects Not Found To Be Significant

A separate section of the EIR/EIS would include a brief discussion of issue areas that were not considered to be potentially significant, such as agricultural resources, recreation, mineral resources, and population/housing. If these or other potentially significant issue areas arise during detailed environmental investigation of the project, however, consultation is recommended to determine if these other issue areas need to be addressed in the EIR/EIS. Additionally, as supplementary information is submitted, the EIR/EIS may need to be expanded to include additional issue areas. The City of San Diego's Public Utilities Department will consult with the Development Services Department to determine if subsequent issue area discussions need to be added to the EIR/EIS. The justification for these findings will be summarized in the EIR/EIS.

X. Other CEQA/NEPA Required Sections

i. Significant/Adverse Environmental Effects Which Cannot Be Avoided If The Proposed Project Is Implemented

This section will describe the significant unavoidable impacts of the proposed project, including those significant impacts that can be mitigated but not reduced to below a level of significance.

ii. Significant Irreversible Environmental Changes/Irreversible and Irretrievable Commitments of Resources

In conformance with CEQA Section 15126.2(b) and (c) and NEPA Section 1502.16, the EIR/EIS will discuss the significant environmental effects that cannot be avoided if the proposed project is implemented, and the significant irreversible changes that would result from implementation of the proposed project. This section will address the use of nonrenewable resources during the construction and life of the project.

iii. Relationship Between Local Short-Term Uses of [the] Environment and the Maintenance and Enhancement of Long-Term Productivity

In conformance with NEPA Section 1502.16, the EIR/EIS will discuss potential short-term effects on and uses of the environment (i.e., during construction), and the long-term effects (i.e., during operation and maintenance).

iv. Growth Inducement

The EIR/EIS will address the potential for growth inducement through implementation of the proposed project. The EIR/EIS will discuss the ways in which the proposed project could foster economic or population growth either directly or indirectly. Accelerated growth could further strain existing community facilities or encourage activities that could significantly affect the environment. This section need not conclude that growth-inducing impacts, if any, are significant unless the project would induce substantial growth or concentration of population.

XI. Mitigation Monitoring and Reporting Program

For each of the issue areas discussed above, mitigation measures, if necessary, will be clearly identified and discussed, and their effectiveness assessed in each issue section of the EIR/EIS. A Mitigation Monitoring and Reporting Program (MMRP) for each mitigation measure must be included. At a minimum, the project will identify (1) the City department or entity responsible for the monitoring, (2) the monitoring and reporting schedule, and (3) the completion requirements. The separate MMRP will also be contained (verbatim) as a separate chapter within the EIR/EIS.

XII. Other

The EIR/EIS will include sections for references, individuals and agencies consulted, and a certification page. Appendices will be included in the Table of Contents, but will be bound under separate cover and/or be included on a CD attached to the back page of the EIR/EIS. In addition, other specific direction regarding formatting, content, and processing of the EIR/EIS will be provided by environmental staff prior to submittal of the first screencheck draft EIR/EIS for internal staff review.

DISTRIBUTION:

United States Government
Federal Aviation Administration
Naval Facilities Engineering Command, SW Division, Environmental Planning
MCAS Miramar
Marine Corps Recruit Depot Facilities Div.
Environmental Protection Agency
U. S. Fish and Wildlife Service
USDA Natural Resources Conservation Services
Army Corps of Engineers
Bureau of Reclamation

State of California
Caltrans District 11
Department of Fish and Wildlife
Cal Recycle
Dept of Health Services Division of Drinking Water & Environmental Mgmt
California Environmental Protection Agency
Department of Toxic Substance Control
State Parks
Department of Parks and Recreation
Natural Resources Agency
Regional Water Quality Control Board, Region 9
Department of Water Resources
State Clearinghouse
California Coastal Commission
California Air Resources Board
California Transportation Commission
California Transportation Commission
California Boating & Waterways
California State Coastal Conservancy
State Water Resources Control Board Division of Clean Water Programs
Native American Heritage Commission
California Energy Commission
California Dept. of Conservation
California State Lands Commission
Department of Transportation
State Office of Historic Preservation

San Diego County
Agriculture Department
Air Pollution Control Board
Planning and Land Use

Planning and Development
Parks Department
Noise Control Hearing Board
Public Works
County Water Authority
Department of Environmental Health

<u>City of San Diego</u>
Office of the Mayor
  Scott Chadwick
  Stacey LoMedico
  Paz Gomez
  David Graham
  Ron Villa
Office of the City Attorney
  Shannon Thomas
  Christine Leone
Council President Lightner, District 1
Councilmember Zapf, District 2
Councilmember Gloria, District 3
Councilmember Cole, District 4
Councilmember Kersey, District 5
Councilmember Cate, District 6
Councilmember Sherman, District 7
Councilmember Alvarez, District 8
Councilmember Emerald, District 9

<u>Public Utilities Department (Applicant)</u>
Halla Razak, Director
John Helminski
Amy Dorman
Keli Balo

<u>Planning Department</u>
Jeff Murphy, Director
Myra Herrmann
Kristy Forburger
Alyssa Muto

<u>Development Services Department</u>
Robert Vacchi, Director
Kerry Santoro
Anita Eng
Leonard Wilson

Mark Brunette
Helene Deisher

Public Works Department
James Nagelvoort, Director
Marnell Gibson
Carrie Purcell

Economic Development
Russ Gibbon
Jim Davies

Park and Recreation Department
Herman Parker, Director
Chris Zirkle

Fire-Rescue Department
Chief Javier Mainar
Fire and Life Safety Services
Kenneth Barnes, Fire –Rescue Dept Logistics

Police Department
Chief Shelley Zimmerman

Environmental Services Department
Mario Sierra, Director
Darren Greenhalgh
Lisa Wood

Transportation & Storm Water Department
Kris McFadden, Director
Andrew Kleis
Ruth Kolb

Real Estate Assets Department
Cybele Thompson, Director
Barry Slotten

Libraries
Central Library, Government Documents
Balboa Branch Library
Beckwourth Branch Library
Benjamin Branch Library
Carmel Mountain Ranch Branch Library

Carmel Valley Branch Library
City Heights/Weingart Branch Library
Clairemont Branch Library
College-Rolando Branch Library
Kensington-Normal Heights Branch Library
La Jolla/Riford Branch Library
Linda Vista Branch Library
Logan Heights Branch Library
Malcolm X Library & Performing Arts Center
Mira Mesa Branch Library
Mission Hills Branch Library
Mission Valley Branch Library
North Clairemont Branch Library
North Park Branch Library
Oak Park Branch Library
Ocean Beach Branch Library
Otay Mesa-Nestor Branch Library
Pacific Beach/Taylor Branch Library
Paradise Hills Branch Library
Point Loma/Hervey Branch Library
Rancho Bernardo Branch Library
Rancho Peñasquitos Branch Library
READ San Diego
San Carlos Branch Library
San Ysidro Branch Library
Scripps Miramar Ranch Branch Library
Serra Mesa Branch Library
Skyline Hills Branch Library
Tierrasanta Branch Library
University Community Branch Library
North University Branch Library
University Heights Branch Library

City Government
Civic San Diego
San Diego Housing Commission
Community Forest Advisory Board
Small Business Advisory Board
La Jolla Shores PDO Advisory Board

City Advisory Committees
Mission Bay Park Committee
Airports Advisory Committee
Historical Resources Board

Park and Recreation Board
Wetlands Advisory Board
Community Forest Advisory Board

<u>Other City Governments</u>
City of Chula Vista
City of Coronado
City of Del Mar
City of El Cajon
City of Escondido
City of Imperial Beach
City of La Mesa
City of Lemon Grove
City of National City
City of Poway
City of Santee
San Diego Association of Governments
San Diego Unified Port District
San Diego County Regional Airport Authority
Metropolitan Transit System
San Diego Gas & Electric
San Dieguito River Park JPA

<u>School Districts</u>
Chula Vista School District
Grossmont Union High School District
La Mesa-Spring Valley School District
National School District
Poway Unified School District
San Diego Unified School District
San Ysidro School District
Santee School District
South Bay Unified School District
San Diego Community College District
UCSD Library

<u>Community Groups, Associations, Boards, Committees and Councils</u>
Community Planners Committee
Balboa Park Committee
Black Mountain Ranch –Subarea I
Otay Mesa - Nestor Planning Committee
Otay Mesa Planning Committee
Clairemont Mesa Planning Committee
Greater Golden Hill Planning Committee

Serra Mesa Planning Group
Kearny Mesa Community Planning Group
Linda Vista Community Planning Committee
La Jolla Community Planning Association
La Jolla and Golden Triangle Chamber of Commerce
City Heights Area Planning Committee
Kensington-Talmadge Planning Committee
Normal Heights Community Planning Committee
Eastern Area Planning Committee
Midway/Pacific Highway Community Planning Group
Mira Mesa Chamber of Commerce
Mira Mesa Community Planning Group
Mira Mesa Town Council
Mission Beach Precise Planning Board
Mission Valley Unified Planning Organization
Navajo Community Planners Inc.
Carmel Valley Community Planning Board
Del Mar Mesa Community Planning Board
North Park Planning Committee
Ocean Beach Planning Board
Old Town Community Planning Committee
Pacific Beach Community Planning Committee
Pacific Highlands Ranch – Subarea III
Rancho Peñasquitos Planning Board
Peninsula Community Planning Board
Point Loma Ecological Conservation Area Working Group
Rancho Bernardo Community Planning Board
Sabre Springs Community Planning Group
San Pasqual - Lake Hodges Planning Group
San Ysidro Planning and Development Group
Scripps Ranch Civic Association
Scripps Ranch Recreation Council
Scripps Ranch Community Planning Group
Scripps Ranch Villages HOA
Miramar Ranch North Planning Committee
Skyline - Paradise Hills Planning Committee
Torrey Hills Community Planning Board
Southeastern San Diego Planning Committee
Encanto Neighborhoods Community Planning Group
College Area Community Planning Board
Tierrasanta Community Council
The Promontory and Scripps Lake HOA
Torrey Highlands – Subarea IV
Torrey Pines Community Planning Board

University City Community Association
University City Community Planning Group
Uptown Planners

Town/Community Councils
Town Council Presidents Association
Barrio Station, Inc.
Downtown Community Council
Harborview Community Council
Clairemont Town Council
Serra Mesa Community Council
La Jolla Town Council
Rolando Community Council
Oak Park Community Council
Darnell Community Council
Mission Beach Town Council
Mission Valley Community Council
San Carlos Area Council
Carmel Mountain Ranch Community Council
Ocean Beach Town Council, Inc.
Pacific Beach Town Council
Rancho Penasquitos Town Council
Rancho Bernardo Community Council, Inc.
San Dieguito Planning Group
United Border Community Town Council
Tierrasanta Community Council
Murphy Canyon Community Council

Other Agencies, Organizations and Individuals
San Diego Chamber of Commerce
Building Industry Association
San Diego River Park Foundation
San Diego River Coalition
Sierra Club
San Diego Canyonlands
San Diego Natural History Museum
San Diego Audubon Society
Jim Peugh
San Diego River Conservancy
Environmental Health Coalition
California Native Plant Society
San Diego Coast & Baykeeper
Citizens Coordinate for Century 3
Endangered Habitats League

San Diego Tracking Team
League of Women Voters
National City Chamber of Commerce
Carmen Lucas
South Coastal Information Center
San Diego Historical Society
San Diego Archaeological Center
Save Our Heritage Organization
Ron Chrisman
Clint Linton
Frank Brown - Inter-Tribal Cultural Resource Council
Campo Band of Mission Indians
San Diego County Archaeological Society Inc.
Kuumeyaay Cultural Heritage Preservation
Kuumeyaay Cultural Repatriation Committee
Native American Distribution
- Barona Group of Capitan Grande Band of Mission Indians
- Campo Band of Mission Indians
- Ewiiaapaayp Band of Mission Indians
- Inaja Band of Mission Indians
- Jamul Indian Village
- La Posta Band of Mission Indians
- Manzanita Band of Mission Indians
- Sycuan Band of Mission Indians
- Viejas Group of Capitan Grande Band of Mission Indians
- Mesa Grande Band of Mission Indians
- San Pasqual Band of Mission Indians
- Ipai Nation of Santa Ysabel
- La Jolla Band of Mission Indians
- Pala Band of Mission Indians
- Pauma Band of Mission Indians
- Pechanga Band of Mission Indians
- Rincon Band of Luiseno Indians
- San Luis Rey Band of Luiseno Indians
- Los Coyotes Band of Mission Indians

Otay Valley Regional Park CAC – John Willett
Tijuana River National Estuarine Reserve
Chuck Tanner – County San Diego OVRP Rep
Downtown San Diego Partnership
Deron Bear – Marion Bear Natural Park Recreation Council
Tecolote Canyon Citizens Advisory Committee
Friends of Tecolote Canyon
Tecolote Canyon Rim Owner’s Protection Association
Friends of Switzer Canyon

Marion Bear Natural Park Recreation Council
UCSD Natural Reserve System
Theresa Quiroz
John Stump
Chollas Lake Park Recreation Council
Friends of Los Peñasquitos Canyon Preserve, Inc.
Surfer's Tired of Pollution
Debbie Knight
League of Conservation Voters
Mission Bay Lessees
San Diego River Conservancy
Friends of the Mission Valley Preserve
River Valley Preservation Project
Mission Trails Regional Park Citizens Advisory Committee
Carmel Valley Trail Riders Coalition
Carmel Mountain Conservancy
Los Peñasquitos Canyon Preserve Citizens Advisory Committee
Ocean Beach Merchant's Association
Friends of Rose Canyon
San Dieguito Lagoon Committee
San Dieguito River Park CAC
Friends of San Dieguito River Valley
San Dieguito River Valley Conservancy
RVR PARC
Beeler Canyon Conservancy
Jim Dawe
Mission Trails Regional Park
Scott Andrews
Sandy Wetzel-Smith
Richard Gilb
Joel Young
Barbara Zarogoza
Ted Anasis
Ed Spriggs
McMillin-NTC, LLC
Water Reliability Coalition
Laborers International Union of North America/Local Union 89
Lozeau Drury LLP
Raymond Paulson
Al Lau
Save Everyone's Access
Water Reliability Coalition

Independent Rates Oversight Committee (IROC)

Jeff Justus
Gordon Hess
Christopher Dull
Irene Stallard-Rodriguez
Jack Kubota
Tiffany Mittal
Jim Peugh
Gail Welch
Ken Williams
Jerry Jones
Jim Peasley
Yen Tu

County Water Authority and Member Agencies

County Water Authority
Carlsbad MWD
City of Del Mar
City of Escondido Utilities Department
Fallbrook Public Utility Dist
Helix Water District
Lakeside Water District
City of National City
City of Oceanside
Olivenhain MWD
Otay Water District
Padre Dam MWD
Pendleton Military Preservation
City of Poway
Rainbow MWD
Ramona MWD
Rincon Del Diablo MWD
San Dieguito Water District
Santa Fe Irrigation District
South Bay Irrigation District
Sweetwater Authority
Vallecitos Water District
Valley Center MWD
Vista Irrigation District
Yuima MWD

Metro Wastewater Joint Powers Authority

Lori Anne Peoples
Steven Miesen
Roberto Yano
Jerry Jones, Vice-Chair
Mike James
Bill Sandke
Ed Walton
Sherryl Parks
Eric Minicilli
Tony Ambrose
Dennis Davies
Brian Bilbray
Hank Levien
Chris Helmer
Bill Baber
Greg Humora
Albert Mendivil
Kuna Muthusamy
Jose Lopez
Mark Robak
Jim Peasley
Al Lau
John Mullin
Mike Obermiller
Dianne Jacob
Dan Brogadir

Pure Water Working Group

Council District 3
Water Reliability Coalition
San Diego Regional Chamber of Commerce
NAIOP/BOMA
Asian Business Association
Hospital Association of San Diego and Imperial Counties
League of Women Voters of San Diego
Building Industry Association of San Diego
Navy Region Southwest
Qualcomm
SDG&E
CONNECT
Industrial Environmental Association
San Diego County Medical Society

Asian Pacific American Coalition
San Diego Audubon Society
Community Planners Committee
Surfrider San Diego
NAIOP/BOMA
Urban League of San Diego County
City 10
San Diego Unified Council of PTAs
Council District 8
Coastal Environmental Rights Foundation
San Diego Coastkeeper
University Community Planning Group
Council District 6
BIOCOM
Council District 4
Council District 7
San Diego County Apartment Association
San Diego State University
Sharp HealthCare
Metro Wastewater JPA
San Diego Regional Chamber of Commerce
Water Reliability Coalition
San Diego Regional Economic Development Corporation
Greater San Diego Association of Realtors
Food & Beverage Association of San Diego
San Diego County Taxpayers Association
Council District 9
Council District 1
San Diego Taxpayers Association
BIA
Cox Communications

4332-90

DEPARTMENT OF THE INTERIOR

Bureau of Reclamation

[RR03510000, XXXR0680R1, RR171260120019400]

Notice of Intent to Prepare an Environmental Impact Report/Environmental Impact Statement for the Pure Water San Diego Program, North City Project, San Diego County, California.

AGENCY: Bureau of Reclamation, Interior.

ACTION: Notice.

SUMMARY: The Bureau of Reclamation and the City of San Diego will prepare a joint Environmental Impact Report/Environmental Impact Statement to evaluate the effects of the North City Project, the first phase of the Pure Water San Diego Program (Pure Water Program). The Pure Water Program is a water and wastewater facilities plan to produce potable water from recycled water.

Interested parties are invited to comment on the scope of the environmental analysis and the proposed alternatives. Two public meetings are scheduled.

DATES: Please submit written comments on or before [INSERT DATE 30 DAYS FROM DATE OF PUBLICATION IN THE FEDERAL REGISTER].

Public meeting dates:

1. August 23, 2016, 6 p.m. to 7:30 p.m., Scripps Miramar Ranch Public Library.

2. August 25, 2016, 6:30 p.m. to 8 p.m., City of San Diego Public Utilities Department.

ADDRESSES: Send written comments to Doug McPherson, Southern California Area

Office, Bureau of Reclamation, 27708 Jefferson Avenue, Suite 202, Temecula, CA 92590; or e-mail to dmcpherson@usbr.gov.

Public meeting locations:

1. Scripps Miramar Ranch Public Library, 10301 Scripps Lake Drive, San Diego, CA.

2. City of San Diego Public Utilities Department, 9192 Topaz Way, San Diego, CA.

FOR FURTHER INFORMATION CONTACT: Doug McPherson, Southern California Area Office general telephone number 951-695-5310; or e-mail dmcpherson@usbr.gov.

SUPPLEMENTARY INFORMATION: This notice is provided pursuant to the National Environmental Policy Act (NEPA) (42 U.S.C. 4332 (2) (c)), and Department of the Interior regulations for implementation of NEPA (43 CFR Part 46).

North City Project

The proposed project will expand the existing North City Water Reclamation Plant and construct an adjacent Advanced Water Purification Facility with a purified water pipeline to Miramar Reservoir. A project alternative would install a longer pipeline to deliver product water to the larger San Vicente reservoir.

Other project components include: a new pump station and forcemain to deliver additional wastewater to the North City Water Reclamation Plant, a brine discharge pipeline, and upgrades to the existing Metropolitan Biosolids Center to accommodate additional biosolids from the increased treatment capacity at the North City Water Reclamation Plant.

A new electrical transmission line is proposed, connecting the North City Water Reclamation Plant to the future cogeneration facility at the Metropolitan Biosolids Center to deliver power for North City Project components. The electrical transmission line would cross Marine Corps Air Station Miramar and will require approval by the United States Marine Corps.

Background

On average, eighty-five percent (85%) of the City's water supply is imported from the Colorado River and northern California. This reliance on imported water causes San Diego to be vulnerable to supply shortages and price increases.

With few local water supply options, the City has explored potable and non-potable reuse options of treated wastewater. In 2011, the City started operating a one million gallon per day (MGD) demonstration scale advanced water purification facility at the North City Water Reclamation Plant site and confirmed that the purified water complied with all federal and state drinking water standards.

Pure Water San Diego Program

The Pure Water Program will ultimately produce 83 MGD of locally-controlled water, recycling a valuable and limited resource that is currently discharged to the Pacific ocean. The program will be implemented in phases over a 20-year period, grouped by geographical area: North City, Central Area and South Bay.

The North City Project will produce 30 MGD of purified water and is scheduled to be operational in 2021. The Central Area and/or South Bay projects are scheduled to be completed by December 31, 2035 and will produce a combined total up to 53 MGD.

The Pure Water Program will make San Diego more water independent while providing increased protection of the ocean environment. The City made a commitment to begin implementing the Pure Water Program in their application to renew the Clean Water Act §301(h) modified ocean discharge permit for the Point Loma Wastewater Treatment Plant (NPDES permit no. CA0107409).

Authority

Federal assistance is authorized by the Reclamation Wastewater and Groundwater Study and Facilities Act of 1992 (Title XVI of Pub. L. 102–575). Section 1612, San Diego Area Water Reclamation Program, directs the Secretary of the Interior, in cooperation with the city of San Diego, to participate in the planning, design, and construction of demonstration and permanent facilities to reclaim and reuse water in the San Diego metropolitan service area. This authority is delegated to the Bureau of Reclamation. The Federal share of the costs of the facilities shall not exceed 25 per cent of the total. Federal Funds for the operation or maintenance of the project are not authorized.

Scoping Process

The City is filing a Notice of Preparation pursuant to the California Environmental Quality Act, and will hold two public scoping meetings. To avoid duplication with State and local procedures, we plan to use the scoping process initiated by the City. The Notice of Preparation, Notice of Scoping Meetings, and a proposed Scope of Work are available at https://www.sandiego.gov/planning/programs/ceqa.

The site proposed for the Advanced Water Purification Facility contains vernal pool habitat supporting endangered species. The City is preparing a Vernal Pool Habitat Conservation Plan to comply with the Endangered Species Act.

Pipeline alignments and/or drinking water service areas may include areas of low income and minority populations. Environmental justice issues are not anticipated, but will be evaluated. No known Indian Trust Assets are associated with the proposed action.

Written comments are requested to help identify alternatives and issues that should be analyzed. Federal, State and local agencies, tribes, and the general public are invited to participate in the environmental review process.

Public Disclosure

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Dated: ________________________________

Signed: ________________________________
Terrance J. Fulp, Ph.D.
Regional Director, Lower Colorado Region

LIST OF PERSONS, ORGANIZATIONS, AND PUBLIC AGENCIES THAT COMMMENTED ON THE NOTICE OF PREPARATION OF AN ENVIRONMENTAL IMPACT REPORT FOR THE PURE WATER SAN DIEGO PROGRAM, NORTH CITY PROJECT

Scoping Period:

The following is a listing of the names and addresses of persons, organizations, and public agencies that commented during this public review period.

	Name	Date	Address
Federal Agencies			
1	U.S. Army Corps of Engineers	08-Aug-2016	Shari Johnson 5900 La Place Court, Suite 100 Carlsbad, CA 92008
2	United States Environmental Protection Agency Region IX	06-Sept-2016	75 Hawthorne Street, San Francisco, CA 94105-3901
State Agencies			
3	State of California, Native American Heritage Commission	10-Aug-2016	Gayle Totton Native American Heritage Commission 1550 Harbor Blvd. Room 100 West Sacramento, CA 95691
4	Department of Toxic Substances Control	18-Aug-2016	Johnson P. Abraham 5796 Corporate Avenue Cypress, California 90630
5	Caltrans, District 11	24-Aug-2016	Jacob Armstrong 4050 Taylor St, MS 240 San Diego, CA 92110
6	California Department of Fish and Wildlife (CDFW)	01-Sept-2016	Gail K. Sevrens 3883 Ruffin Road, San Diego, CA 92123
County, City And Other Local Agencies			
7	County of San Diego Planning and Development Services	30-Aug-2016	Joe Farace, Group Program Manager 5510 Overland Avenue, Suite 310 San Diego, CA 92123
Local Organizations			
8	Rincon Band of Luiseno Indians	15-Aug-2016	Vincent Whipple Rincon Culture Resources Dept 1 W. Tribal Road Valley Center, CA 92082
9	San Diego County Archaeological Society, Inc.	01-Sept-2016	
10	WateReuse	02-Sept-2016	WaterReuse 1199 North Fairfax St, Suite 410 Alexandria, VA 22314

	Name	Date	Address
Individuals			
11	John Stump		John Stump 2413 Shamrock Street City Heights, CA 92105
12	Lozeau Drury	25-Aug-2016	410 12th Street, Ste 250 Oakland, CA 94607
13	Scott Andrews (1)	03-Sept-2016	Scott300@earthlink.net
14	Scott Andrews (2) –Save Everyone's Access	04-Sept-2016	Scott300@earthlink.net
Other			
	Scripps Miramar Ranch Library Scoping Comments	23-Aug-2016	
	PUD MOC II Scoping Comments	25-Aug-2016	
	Scoping Meeting Transcript (1)	23-Aug-2016	
	Scoping Meeting Transcript (2)	25-Aug-2016	
Internal (Not Official Scoping Comments)			
	City of SD Storm Water Division & Transportation	01-Sept-2016	Mark Stephens

UNITED STATES MARINE CORPS
MARINE CORPS AIR STATION MIRAMAR
P.O. BOX 452001
SAN DIEGO, CA 92145-2001

IN REPLY REFER TO:
5090 4725
S7 15 NOV 2016

From: Deputy Director of Environmental, Marine Corps Air Station Miramar

To: Mr. William J. Steele
Area Manager, U.S. Bureau of Reclamation
Lower Colorado Region
Southern California Area Office
27708 Jefferson Avenue
Temecula, CA 92590-2628

Ref: (1) Marine Corps Order 5090.2A Ch3

Encl: (a) Survey map(s)

Dear Mr. Steele:

SUBJECT: PURE WATER SAN DIEGO PROGRAM NORTH CITY PROJECT

Thank you for your recent letter inviting the U.S. Marine Corps to be a cooperating agency in preparation of the joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Pure Water San Diego Program, North City project in San Diego County, California. We accept your invitation in accordance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ) regulations, consistent with Marine Corps Order (MCO) 5090.2A Ch 3.

The proposed federal action would incorporate two utility easements across portions of Marine Corps Air Station (MCAS) Miramar. The first would expand an existing easement running generally north-south between the Miramar Landfill and the North City Water Reclamation Plant. This easement crosses the Miramar National Cemetery between those points. The second easement would run east-west under a portion of Miramar Road between

Miramar Mall and a point short of the BNSF Railway crossing (see enclosed survey maps).

For this federal action we anticipate staff involvement from three Marine Corps organizations: Headquarters Marine Corps (HQMC), Marine Corps Installations West (MCIWEST) and MCAS Miramar. We have a particular interest in how the proposed federal action may affect MCAS Miramar operations and security, the Marine Corps mission, and any sensitive resources aboard the air station.

Our role as a cooperating agency during document preparation will be technical in nature, and this assistance does not abridge or otherwise affect our responsibilities for independent review of the draft and final joint (or related technical) document(s) under NEPA, CEQ regulations, and/or MCO 5090.2A Ch3.

The Marine Corps lead contact for this project will be Ms. Susan VanWinkle, Deputy Director of Environmental at MCAS Miramar (858.577.1134 or susan.vanwinkle@usmc.mil). Ms. VanWinkle will be coordinating with the MCIWEST Regional Planner, Mr. Zachery H. Likins (760.763.7948 or zachery.likins@usmc.mil) who will coordinate with HQMC staff, as appropriate. At this time, we do not anticipate the need for a memorandum of agreement formalizing our participation.

We look forward to working with the Bureau of Reclamation and the other participating agencies in this important infrastructure project that will help ensure San Diego's future water security position.

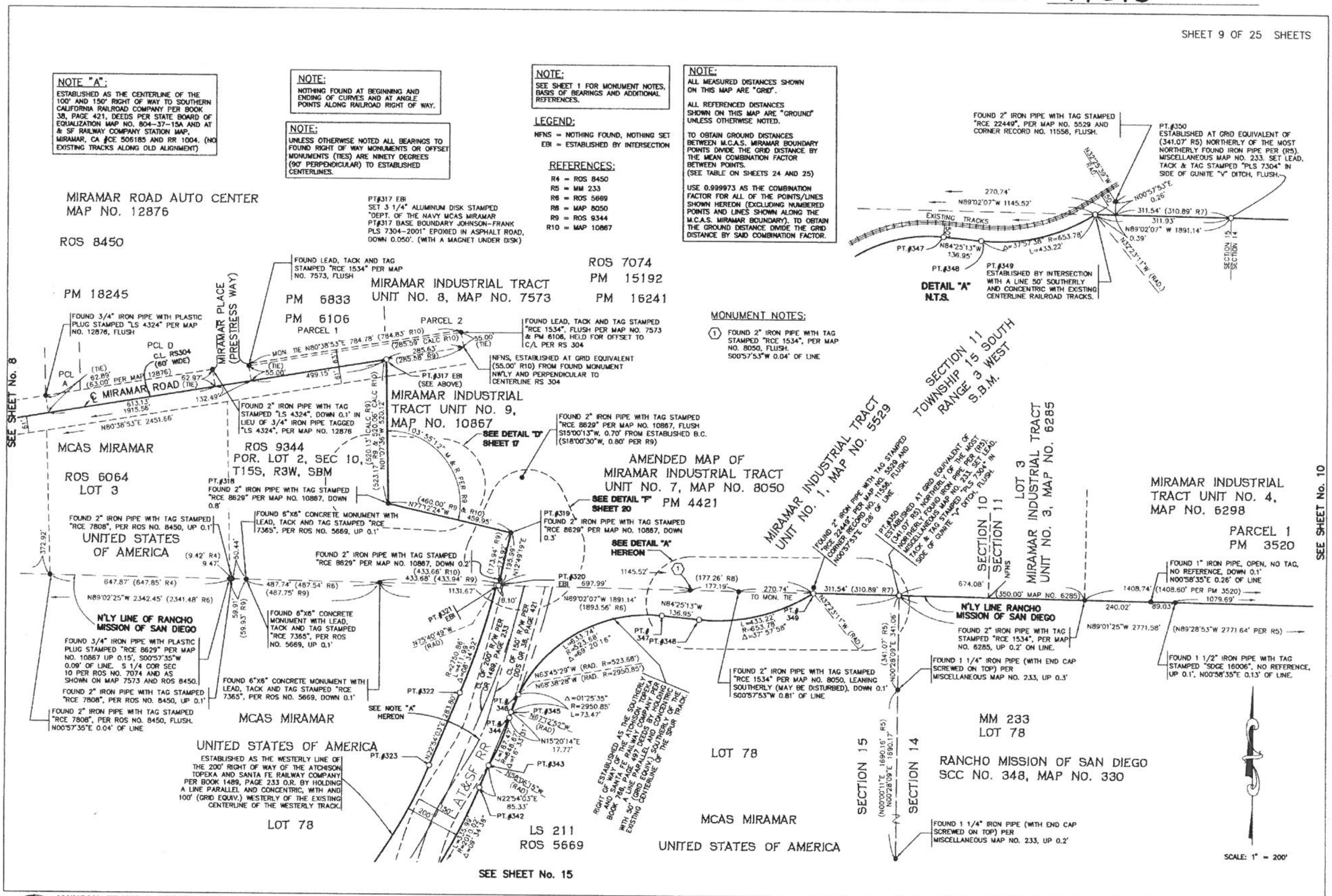
Sincerely,

S. M. VanWinkle

S. M. VanWinkle
By Direction
of the Commanding Officer

Copy to: MCIWEST CG

RECORD OF SURVEY MAP NO. 17316



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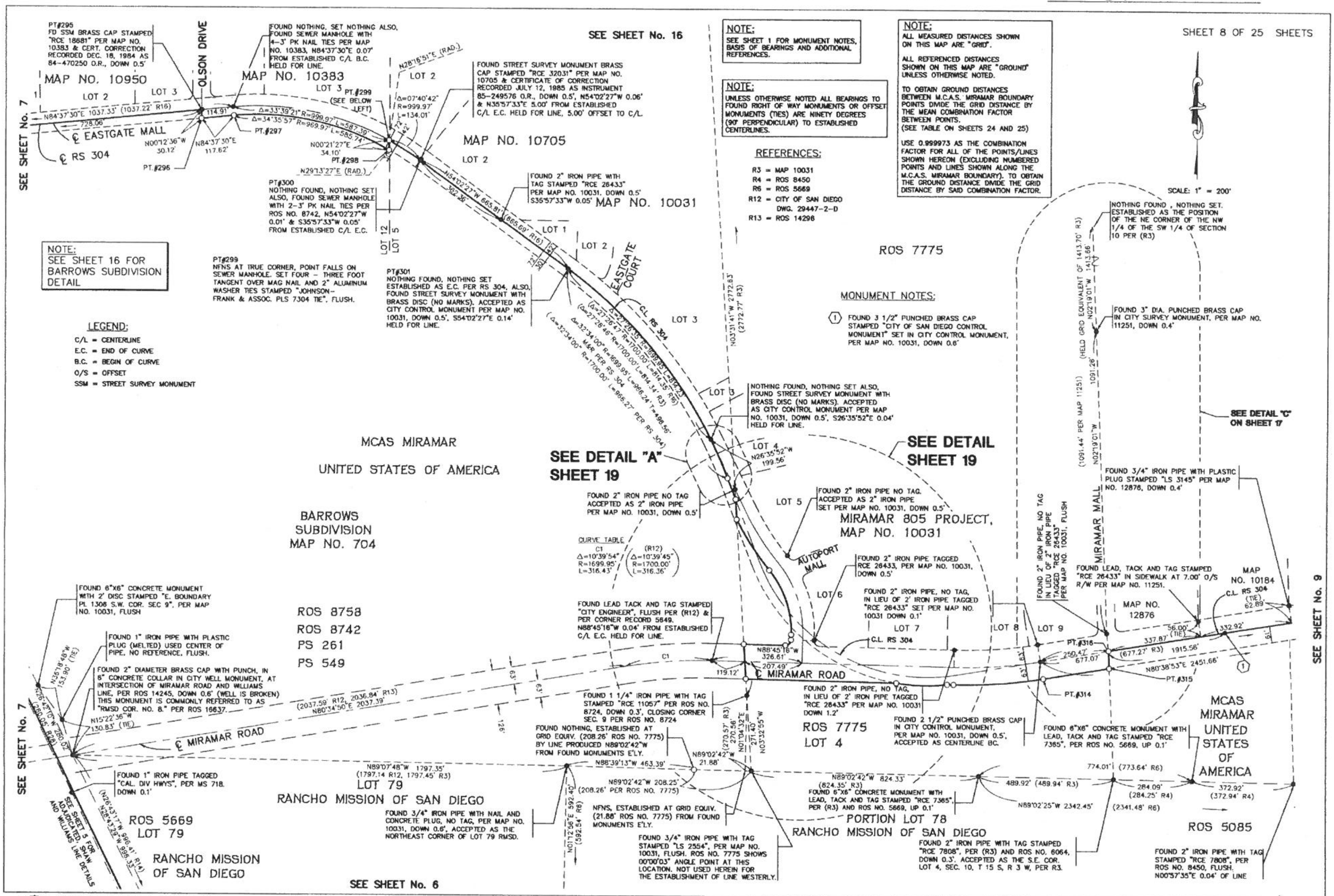
LAND SURVEYING – MAPPING
5150 E. HUNTER AVENUE
ANAHEIM, CALIFORNIA 92807-2049

ASSESSOR PARCEL NO. 343-040

RECORD OF SURVEY MAP NO. 17316



JOHNSON-FRANK & ASSOC., INC.
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(714) 777-8877 FAX (714) 777-1641

ASSESSOR PARCEL NO. 343-020

S:\SHARED\97287.2\ACAD\...\dwg\97287-2b.dwg 03/12/2002 10:00:32 AM PST

DEPARTMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Washington DC 20420

Mr. Doug McPherson
United States Department of the Interior
Bureau of Reclamation
Lower Colorado Region, Southern California Area Office
27708 Jefferson Avenue, Suite 202
Temecula, CA 92590-2628

Subject: Pure Water Sand Diego Program, North City Project

Dear Mr. McPherson:

On behalf of VA's National Cemetery Administration (NCA), the Office of Real Property (ORP) would like to accept your invitation to become a NEPA cooperating agency in the development of the Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for an existing easement through Miramar National Cemetery.

As a cooperating agency, VA understands it has retained the right to review and comment on administrative drafts of the EIS/EIR at various milestones throughout its preparation. As a preliminary matter, we do not agree to the proposed easement expansion, or the proposal of a new easement, due to the significant negative impact these actions would have on the burial capacity of the Miramar National Cemetery.

I know that Kent Walker of my staff, as well as other VA stakeholders, have already communicated many of these concerns. We will follow up shortly with additional documentation regarding our position.

If you have questions, please contact Kent Walker, Realty Specialist, at (202) 632-5129 or Kent.Walker@va.gov.

Thank you,

Amanda Hendry
Director, Real Property Western Region

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
2177 Salk Ave, Suite 250
Carlsbad, California 92011

In Reply Refer To:
FWS-SDG-15B0078-17TA0076

November 18, 2016
Sent by Email

Mr. Doug McPherson
Environmental Protection Specialist
Bureau of Reclamation
Southern California Area Office
27708 Jefferson Ave, Suite 202
Temecula, California 92590

Subject: Comments on the Notice of Intent to Prepare an Environmental Impact Statement/Environmental Impact Report for the Pure Water San Diego Program, North City Project

Dear Ms. Herrmann:

The U.S Fish and Wildlife Service (Service) has reviewed your October 19, 2016, letter and the Notice of Intent (NOI) to prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Pure Water San Diego Program, North City Project (project) dated August 5, 2016. The Service has identified potential effects of this project on wildlife and sensitive habitats. The project details provided herein are based on the information provided in the NOP and our knowledge of sensitive and declining vegetation communities in the region, and our participation in the Multiple Species Conservation Program (MSCP) and the City of San Diego's (City) MSCP Subarea Plan (SAP).

The primary concern and mandate of the Service is the protection of public fish and wildlife resources and their habitats. The Service has legal responsibility for the welfare of migratory birds, anadromous fish, and endangered animals and plants occurring in the United States. The Service is also responsible for administering the Federal Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.), including habitat conservation plans (HCP) developed under section 10(a)(1)(B) of the Act. The City participates in the Service's HCP program by implementing its SAP.

According to the NOI and your letter, the project is the first phase of the Pure Water San Diego Program and proposes to expand the North City Water Reclamation Plant and construct the adjacent North City Pure Water Facility with a pipeline that will extend to the Miramar Reservoir or an alternative pipeline to San Vicente Reservoir. In addition the project will include a new pump station and force-main, a brine discharge pipeline, upgrades to the Metropolitan Bio-solids Center and a new electrical line connecting the reclamation plant with the bio-solids center.

Your letter includes an invitation for the Service to be a cooperating agency in the development of the EIR/EIS. While we appreciate the invitation, the Service will not be a cooperating agency. However we offer the enclosed comments and recommendations to assist the Bureau of Reclamation in avoiding, minimizing, and adequately mitigating project-related impacts to biological resources, and to ensure that the project is consistent with the City's SAP.

We appreciate the opportunity to comment on this NOI. We are hopeful that further consultation among our agencies will ensure the protection we find necessary for the biological resources that would be affected by this project. If you have questions or comments regarding this letter, please contact Patrick Gower (760) 431-9440.

Sincerely,

Digitally signed by DAVID ZOUTENDYK
Date: 2016.11.18 11:47:21 -08'00'

for Karen A. Goebel
Assistant Field Supervisor
U.S. Fish and Wildlife Service

Enclosure

Enclosure

Wildlife Agency Comments and Recommendations on the Notice of Intent (NOI) to Prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Pure Water San Diego Program

Specific Comments

1. The EIS/EIR should explain the relationship of the Pure Water San Diego Program to, and evaluate consistency with, the City's SAP and Biology Guidelines. The direct, indirect and cumulative impact analysis should include figures of the designated MSCP preserve areas that exist within and adjacent to the entirety of the project boundaries, as well as address the current status and long-term management obligations associated with these areas and any potential impacts to these areas that may result from the proposed project.

2. If the project proposes to impact federally listed species not covered under the MSCP or if the project is not consistent with the provisions of the MSCP, consultation under section 7 of the Act may be required.

3. The San Vicente Reservoir purified water pipeline would extend into key locations associated with the County of San Diego's MSCP SAP. If the analysis from this document is intended to be used to satisfy future County of San Diego permit requirements, the Pure Water San Diego Program should also evaluate consistency with the County of San Diego's Biological Mitigation Ordinance, Resource Protection Ordinance, and MSCP SAP.

4. The Service emphasizes that one of the purposes of the EIS/EIR is to "prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible." Because of the proximity of the project site to sensitive species and habitats that could be negatively affected or lost by the proposed project, the alternatives analysis for this project is extremely important. We are particularly interested in the EIS/EIR describing a range of reasonable alternatives to the project (particularly options to maximize open space), which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives. The range of feasible alternatives should be selected and discussed in a manner to foster meaningful public participation and informed decision making. The Service will consider the alternatives analyzed in the context of their relative impacts on biological resources on both a local and regional level.

5. The expansion of the North City Water Reclamation Plant may impact vernal pools. Project activities that alter hydrology, increase vernal pool habitat fragmentation, or decrease land types suitable for vernal pool formation have the potential to limit the survivability and recovery of federally listed vernal pool species such as the San Diego fairy shrimp (*Branchinecta sandiegonensis*), Riverside fairy shrimp (*Streptocephalus woottoni*), San Diego mesa mint (*Pogogyne abramsii*), and San Diego button celery (*Eryngium aristulatum* var. *parishii*). The EIR/EIS should include measures to avoid/minimize impacts to vernal pools and evaluate consistency with the City's draft Vernal Pool HCP.

6. For those portions of the project area that have the potential to support the federally-listed Quino checkerspot butterfly (*Euphydryas editha quino*; Quino), the Service recommends the City survey for Quino consistent with the Service's 2014 Quino Checkerspot Survey Guidelines.

7. To guide project planning to avoid/minimize impacts to listed species, we recommend that protocol-level surveys be conducted for any listed species with the potential to occur within the project site. Surveys should be performed no more than one year prior to an application for a permit from the Service, and the EIR/EIS should include the survey results.

8. All construction and post-construction best management practices (BMPs) should be located within the development footprint (i.e., included in the impact analysis as loss of habitat). The EIR/EIS should include a figure depicting the location of BMPs in relation the development footprint.

9. Native plants should be used to the greatest extent feasible in landscaped areas adjacent to and/or near mitigation/open space areas and/or wetland/riparian areas. The applicant should not plant, seed, or otherwise introduce invasive exotic plant species to landscaped areas adjacent to and/or near native habitat areas. Exotic plant species not to be used include those species listed on the California Invasive Plant Council's (Cal-IPC) Invasive Plant Inventory. This list includes such species as: pepper trees, pampas grass, fountain grass, ice plant, myoporum, black locust, capeweed, tree of heaven, periwinkle, sweet alyssum, English ivy, French broom, Scotch broom, and Spanish broom.[1] In addition, landscaping adjacent to native habitat areas should not use plants that require intensive irrigation, fertilizers, or pesticides. Water runoff from landscaped areas should be directed away from mitigation/open space and/or wetland/riparian areas and contained and/or treated within the development footprint.

General Comments

To enable us to adequately review and comment on the proposed project from the standpoint of the protection of plants, fish and wildlife, we recommend the following information be included in the EIS/EIR:

1. A complete discussion of the purpose and need for, and description of, the proposed project, including all staging areas and access routes to the construction and staging areas.

2. A complete list and assessment of the flora and fauna within and adjacent to the project area, with particular emphasis upon identifying State or federally listed rare, threatened, endangered, or proposed candidate species, California Species-of-Special Concern and/or State Protected or Fully Protected species, and any locally unique species and sensitive habitats. Specifically, the EIR/EIS should include:

    a. A thorough assessment of Rare Natural Communities on site and within the area of impact. We recommend following the California Department of Fish and Wildlife's Guidelines for Assessing Impacts to Rare Plants and Rare Natural Communities.

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[1] A copy of the complete list can be obtained by contacting the California Invasive Plant Council at 1442-A Walnut Street, Suite #462, Berkeley, California 94709, or by accessing their web site at http://www.cal-ipc.org.

b. A current inventory of the biological resources associated with each habitat type on site and within the area of impact.

c. An inventory of rare, threatened, and endangered species on site and within the area of impact.

d. Discussions regarding seasonal variations in use by sensitive species of the project site as well as the area of impact on those species, using acceptable species-specific survey procedures as determined through consultation with the Service. Focused species-specific surveys, conducted in conformance with established protocols at the appropriate time of year and time of day when the sensitive species are active or otherwise identifiable, are required.

3. A thorough discussion of direct, indirect, and cumulative impacts expected to adversely affect biological resources. All facets of the project should be included in this assessment. Specifically, the EIS/EIR should provide:

a. Specific acreage and descriptions of the types of wetlands, coastal sage scrub, and other sensitive habitats that will or may be affected by the proposed project or project alternatives. Maps and tables should be used to summarize such information.

b. Discussions regarding the regional setting with special emphasis on resources that are rare or unique to the region that would be affected by the project. This discussion is critical to an assessment of environmental impacts.

c. Detailed discussions, including both qualitative and quantitative analyses, of the potentially affected listed and sensitive species (fish, wildlife, plants), and their habitats on the proposed project site, area of impact, and alternative sites, including information pertaining to their local status and distribution. The anticipated or real impacts of the project on these species and habitats should be fully addressed.

d. Discussions regarding indirect project impacts on biological resources, including resources in nearby public lands, open space, adjacent natural habitats, riparian ecosystems, and any designated and/or proposed NCCP reserve lands. Impacts on, and maintenance of, wildlife corridor/movement areas, including access to undisturbed habitats in adjacent areas, should be fully evaluated and provided. A discussion of potential adverse impacts from lighting, noise, human activity, exotic species, and drainage. The latter subject should address: project-related changes on drainage patterns on and downstream of the project site; the volume, velocity, and frequency of existing and post-project surface flows; polluted runoff; soil erosion and/or sedimentation in streams and water bodies; and post-project fate of runoff from the project site.

e. Discussions regarding possible conflicts resulting from wildlife-human interactions at the interface between the development project and natural habitats. The zoning of areas for development projects or other uses that are nearby or adjacent to natural areas may inadvertently contribute to wildlife-human interactions.

f. An analysis of cumulative effects. General and specific plans, and past, present, and anticipated future projects, should be analyzed concerning their impacts on similar plant communities and wildlife habitats.

g. If applicable, an analysis of the effect that the project may have on completion and implementation of regional and/or subregional conservation programs. We recommend that the Lead Agency ensure that the development of this and other proposed projects do not interfere with the goals and objectives of established or planned long-term preserves and that projects conform with other requirements of the NCCP program.

4. Mitigation measures for unavoidable adverse project-related impacts on sensitive plants, animals, and habitats. Mitigation measures should emphasize avoidance, and where avoidance is infeasible, reduction of project impacts. For unavoidable impacts, off-site mitigation through acquisition and preservation in perpetuity of the affected habitats should be addressed. We generally do not support the use of relocation, salvage, and/or transplantation as mitigation for impacts on rare, threatened, or endangered species. Studies have shown that these efforts are experimental in nature and largely unsuccessful.

5. This discussion should include measures to perpetually protect the targeted habitat values where preservation and/or restoration is proposed. The objective should be to offset the project-induced qualitative and quantitative losses of wildlife habitat values. Issues that should be addressed include restrictions on access, proposed land dedications, monitoring and management programs, control of illegal dumping, water pollution, increased human intrusion, etc. Plans for restoration and revegetation should be prepared by persons with expertise in southern California ecosystems and native plant revegetation techniques. Each plan should include, at a minimum:

a. the location of the mitigation site;

b. the plant species to be used;

c. a schematic depicting the mitigation area;

d. time of year that planting will occur;

e. a description of the irrigation methodology;

f. measures to control exotic vegetation on site;

g. success criteria;

h. a detailed monitoring program;

i. contingency measures should the success criteria not be met; and

j. identification of the entity(ies) that will guarantee achieving the success criteria and provide for conservation of the mitigation site in perpetuity.

Mitigation measures to alleviate indirect project impacts on biological resources must be included, including measures to minimize changes in the hydrologic regimes on site, and means to convey runoff without damaging biological resources, including the morphology of on-site and downstream habitats.

6. As discussed previously, descriptions and analyses of a range of alternatives to ensure that alternatives to the proposed project are fully considered and evaluated. The analyses must include alternatives that avoid or otherwise reduce impacts to sensitive biological resources. Specific alternative locations should be evaluated in areas of lower resource sensitivity where appropriate.

Balo, Keli

From: Johnson, Shari SPL <Shari.Johnson@usace.army.mil>
Sent: Monday, August 08, 2016 2:38 PM
To: Balo, Keli
Subject: RE: North City Project (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Dear Ms. Balo:

It has come to our attention that you are evaluating the North City Project.

This activity may require a U.S. Army Corps of Engineers permit.

A Corps of Engineers permit is required for:

a) structures or work in or affecting "navigable waters of the United States" pursuant to Section 10 of the Rivers and Harbors Act of 1899. Examples include, but are not limited to,

1. constructing a pier, revetment, bulkhead, jetty, aid to navigation, artificial reef or island, and any structures to be placed under or over a navigable water;

2. dredging, dredge disposal, filling and excavation;

b) the discharge of dredged or fill material into, including any redeposit of dredged material other than incidental fallback within, "waters of the United States" and adjacent wetlands pursuant to Section 404 of the Clean Water Act of 1972. Examples include, but are not limited to,

1. creating fills for residential or commercial development, placing bank protection, temporary or permanent stockpiling of excavated material, building road crossings, backfilling for utility line crossings and constructing outfall structures, dams, levees, groins, weirs, or other structures;

2. mechanized landclearing, grading which involves filling low areas or land leveling, ditching, channelizing and other excavation activities that would have the effect of destroying or degrading waters of the United States;

3. allowing runoff or overflow from a contained land or water disposal area to re-enter a water of the United States;

4. placing pilings when such placement has or would have the effect of a discharge of fill material;

c) the transportation of dredged or fill material by vessel or other vehicle for the purpose of dumping the material into ocean waters pursuant to Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972;

d) any combination of the above.

An application for a Department of the Army permit is available on our website:

http://www.usace.army.mil/Portals/2/docs/civilworks/permitapplication.pdf .

If you have any questions, please contact me (contact information below).

Shari Johnson
Regulatory Assistant
U.S. Army Corps of Engineers, Los Angeles District Regulatory Division, Carlsbad Field Office
5900 La Place Court, Suite 100
Carlsbad, CA 92008
Tel 760.602.4829; Fax 760.602.4848

Assist us in better serving you! Please complete our brief customer survey, located at the following link:
http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey

CLASSIFICATION: UNCLASSIFIED

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

SEP 0 6 2016

Doug McPherson
U.S. Bureau of Reclamation
Southern California Area Office
27708 Jefferson Ave. Suite 202
Temecula, CA 92590

Subject: Notice of Intent to Prepare a Draft Environmental Impact Statement/Draft Environmental Impact Report for the Pure Water Project, San Diego County, CA

Dear Mr. McPherson:

The U.S. Environmental Protection Agency has reviewed the Federal Register Notice published August 5, 2016 requesting comments on the U.S. Bureau of Reclamation's decision to prepare a Draft Environmental Impact Statement / Environmental Impact Report for the Pure Water Project. Our comments are provided pursuant to the National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and our NEPA review authority under Section 309 of the Clean Air Act.

Reclamation, in partnership with the City of San Diego, intends to prepare a joint Draft EIS/EIR to evaluate the effects of the North City Project, the first phase of the Pure Water San Diego Program (Pure Water Program). Federal assistance from Reclamation for this project includes planning, design, and construction of demonstration and permanent facilities to reclaim and reuse water in the San Diego metropolitan area. EPA supports San Diego's plans to develop potable reuse capacity to reduce the region's reliance on imported supplies. We have several recommendations for your consideration in preparing the Draft EIS/EIR. Please see our attached detailed comments.

We appreciate the opportunity to provide comments on this Notice of Intent. Please send one hard copy and one CD of the Draft EIS to this office (mail code ENF-4-2) at the same time it is officially filed with our Washington D.C. Office. If you have any questions, please contact me at (415) 972-3098 or gordon.stephanieS@epa.gov

Sincerely,

Stephanie Gordon

Stephanie Gordon
Environmental Review Section
Enforcement Division

Enclosures: EPA's Detailed Comments

Cc via email: Keli Balo, Project manager kbalo@sandiego.gov

EPA DETAILED SCOPING COMMENTS ON THE PURE WATER PROJECT, SAN DIEGO COUNTY, CALIFORNIA, SEPTEMBER 6, 2016

Purpose and Need

The Draft EIS for the proposed project should clearly identify the underlying purpose and need that is the basis for proposing the range of alternatives (40 CFR 1502.13). The *purpose* of the proposed action is typically the specific objectives of the activity, while the *need* for the proposed action may be to eliminate a broader underlying problem or take advantage of an opportunity.

The purpose and need should be a clear, objective statement of the rationale for the proposed project, as it provides the framework for identifying project alternatives. The Draft EIS should concisely identify why the project is being proposed, why it is being proposed now, and should focus on the specific desired outcomes of the project (e.g. secure reliable water supply, maximize beneficial use of recycled water). The purpose and need should also clearly describe Reclamation's role and federal action in the project, particularly as it relates to funding availability and mechanisms.

Regulatory Framework

The Draft EIS for the proposed project should include a comprehensive description of the regulatory context of the project. This section should include a description of any permits and/or modifications to those permits that the project will require (e.g. National Pollutant Discharge Elimination System permits for discharges to Waters of the United States). Additionally, Reclamation should discuss the project in the context of the State Water Resources Control Board's updated "General Waste Discharge Requirements for Recycled Water Use"[1] published on June 3, 2014 and the upcoming "Uniform Water Recycling Criteria for Direct Potable Reuse."[2]

The Draft EIS/EIR should discuss how the proposed action would support or conflict with the objectives of federal, state, tribal or local land use plans, policies and controls in the project areas. The term "land use plans" includes all types of formally adopted documents for land use planning, conservation, zoning and related regulatory requirements. Proposed plans not yet developed should also be addressed it they have been formally proposed by the appropriate government body in a written form (CEQ's Forty Questions, #23b).

Range of Alternatives

All reasonable alternatives that fulfill the project's purpose and need should be evaluated in detail, including alternatives outside the legal jurisdiction of Reclamation (40 CFR Section 1502.14(c)). The Draft EIS should provide a clear discussion of the reasons for the elimination of alternatives which are not evaluated in detail.

A robust range of alternatives will include options for avoiding significant environmental impacts. The Draft EIS should clearly describe the rationale used to determine whether impacts of an alternative are significant or not. Thresholds of significance should be determined by considering the context and intensity of an action and its effects (40 CFR 1508.27).

The environmental impacts of the proposal and alternatives should be presented in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public (40 CFR 1502.14). The potential environmental impacts (including benefits) of

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[1] http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2014/wqo2014_0090_dwq_revised.pdf

[2] http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/RecycledWater.shtml

each alternative should be quantified to the greatest extent possible (e.g. acres of wetlands impacted; change in water quality parameters).

The No Action Alternative should clearly describe the current wastewater discharge regimes in San Diego. It should specify the regulatory vehicle that governs the discharge regimes and include details of all permits and transfers related to the current discharge. The description of the No Action Alternative should also indicate the recipients and volumes of water currently discharged from the North City Water Reclamation Plant.

The Draft EIS/EIR should describe the methodology and criteria used for determining the pipeline and transmission line route and alternative routes. The alternatives analysis should include a discussion of environmentally preferable routes for the pipeline, as well as alternative sites and configurations for any access roads and ancillary facilities.

Water Supply

Water supply and demand for the San Diego region should be throughly discussed in the Draft EIS/EIR. Reclamation should present the information in the context of imported water from the Colorado River and Sacramento San Joaquin Bay Delta region, and how the project will contribute to or alleviate ongoing stressors in each of those systems.

The Draft EIS/EIR should discuss the water supply needs for all the customers that would receive water from the Pure Water Program. The document should describe and quantify the proposed percentage distribution of project water for irrigation, groundwater recharge, drinking water, and other uses and the framework by which this distribution might change over time as the project is implemented for all Alternatives, including the No Action.

Water Quality

Each of the Action Alternatives should include a robust discussion of impacts to water quality.

This should include identifying the applicable water quality standards and beneficial uses of receiving waters that receive discharges from the proposed project. This should include a brief discussion of the current demonstration program.

The analysis should include a description of the impacts from increased or decreased discharge volume to the current discharge locations and waters, including, but not limited to, any impacts to the quantity and quality of water in the reservoirs in the proposed Alternatives.

Aquatic Resources

Geographic Extent of Waters of the United States

The project applicant should coordinate with the U.S. Army Corps of Engineers to determine if the proposed project requires a Section 404 permit under the Clean Water Act. Section 404 regulates the discharge of dredged or fill material into waters of the United States (WUS), including wetlands and other special aquatic sites. The Draft EIS/EIR should describe all WUS that could be affected by the project alternatives, and include maps that clearly identify all such waters within the project area. The discussion should include acreages and channel lengths, habitat types, values and functions of these waters. The EPA recommends that Reclamation include a jurisdictional delineation for all WUS, including ephemeral drainages, in accordance with the 1987 *Corps of Engineers Wetlands Delineation Manual and the December 2006 Arid West Region Interim Regional Supplement to the Corps of*

Engineers Wetland Delineation Manual: Arid West Region. A jurisdictional delineation will confirm the presence or absence of WUS in the project area and help determine whether or not the proposed project would require a Section 404 permit.

If a permit is required, the EPA may review the project for compliance with *Federal Guidelines for Specification of Disposal Sites for Dredged or Fill Materials* (40 CFR 230), promulgated pursuant to Section 404(b)(1) of the CWA. Pursuant to 40 CFR 230, any permitted discharge into WUS must be the *least environmentally damaging practicable alternative* available to achieve the project purpose. The Draft EIS/EIR should include an evaluation of the project alternatives in this context in order to demonstrate the project's compliance with the 404(b)(1) Guidelines. If, under the proposed project, dredged or fill material would be discharged into WUS, the Draft EIS/EIR should discuss alternatives to avoid those discharges.

Biological Resources, Habitat and Wildlife

The Draft EIS/EIR should identify all petitioned and listed threatened and endangered species and critical habitat that might occur within the project area. The document should identify and quantify which species or critical habitat might be directly, indirectly, or cumulatively affected by each alternative and mitigate impacts to these species. Emphasis should be placed on the protection and recovery of species due to their status or potential status under the federal or state Endangered Species Act. Pipeline and transmission line rights of way are anthropogenic disturbances which alter the spatial structure of habitat elements, creating linear patches or line corridors which in turn impact ecological integrity by modifying ecological processes (abiotic & biotic) at various scales. Pipeline Right-of-Ways can result in habitat fragmentation and increased habitat edge effects, affecting individual species with different intensity.

The Draft EIS/EIR should include a discussion of how the proposed action would comply with ESA requirements, including any necessary ESA Section 7 consultation efforts with the U.S. Fish and Wildlife Service. We recommend that any relevant documents associated with the ESA Section 7 consultation process, including Biological Assessments and Biological Opinions, be summarized and included in an appendix in the Draft EIS/EIR.

We also recommend that Reclamation coordinate across field offices and with USFWS and California Department of Fish and Wildlife to ensure that current and consistent surveying, monitoring, and reporting protocols are applied in protection and mitigation efforts.

Analysis of impacts and mitigation on covered species should include:

- Baseline conditions of habitats and populations of the covered species.
- A clear description of how avoidance, mitigation and conservation measures will protect and encourage the recovery of the covered species and their habitats in the project area.
- Monitoring, reporting and adaptive management efforts to ensure species and habitat conservation effectiveness.

If the applicant is to acquire compensation lands, the location(s) and management plans for these lands should be discussed in the Draft EIS/EIR. Information on the compensatory mitigation proposals (including quantification of acreages, estimates of species protected, costs to acquire compensatory lands, etc.) for unavoidable impacts to waters of the State and biological resources, as applicable should be incorporated.

Reclamation should identify compensatory mitigation lands or quantify, in the Draft EIS/EIR, available lands for compensatory habitat mitigation for this project, as well as reasonably foreseeable projects in the area. The EIS should specify provisions that will ensure habitat selected for compensatory mitigation will be protected in perpetuity. It should also incorporate, into the Draft EIS/EIR, mitigation, monitoring, and reporting measures that result from consultation with the USFWS and CDFW, and that incorporate lessons learned from other pipeline projects and recently released guidance to avoid and minimize adverse effects to sensitive biological resources.

The Draft EIS/EIR should describe the potential for habitat fragmentation and obstructions for wildlife movement from the construction of this project and other projects in the area.

We recommend that the need for monitoring, mitigation, and if applicable, translocation management plans for the sensitive biological resources be discussed. This could include, but is not limited to, an Avian or Invertebrate Monitoring, Management, and Control Plan, and Special-Status Plant Impact Avoidance and Mitigation Plan.

The Draft EIS/EIR should describe the extent of construction, installation, and maintenance and the associated impacts on habitat and threatened and endangered species. We encourage habitat conservation alternatives that avoid and protect high value habitat and create or preserve linkages between habitat areas to better conserve the covered species.

Climate Change

We recommend that climate change issues be analyzed consistent with the Council on Environmental Quality's (CEQ) August 5, 2016 final guidance for Federal agencies' consideration of GHG emissions and climate change impacts when conducting environmental reviews under NEPA. Accordingly, we recommend the Draft EIS include an estimate of the GHG emissions associated with the project, qualitatively describe relevant climate change impacts, and analyze reasonable alternatives and/or practicable mitigation measures to reduce project-related GHG emissions. More specifics on those elements are provided below. In addition, we recommend that the NEPA analysis address the appropriateness of considering changes to the design of the proposal to incorporate GHG reduction measures and resilience to foreseeable climate change. The Draft EIS/EIR should make clear whether commitments have been made to ensure implementation of design or other measures to reduce GHG emissions or to adapt to climate change impacts.

More specifically, we suggest the following approach:

"Affected Environment" Section

- Include in the "Affected Environment" section of the Draft EIS a summary discussion of climate change and ongoing and reasonably foreseeable climate change impacts relevant to the project, based on U.S. Global Change Research Program[3] assessments, to assist with identification of potential project impacts that may be exacerbated by climate change and to inform consideration of measures to adapt to climate change impacts. (Among other things, this will assist in identifying resilience-related changes to the proposal that should be considered).

[3] http://www.globalchange.gov/

"Environmental Consequences" Section

- Estimate the GHG emissions associated with the proposal and its alternatives. Example tools for estimating and quantifying GHG emissions can be found on CEQ's NEPA.gov website[4]. For actions which are likely to have less than 25,000 metric tons of CO2-e emissions/year, provide a qualitative estimate unless quantification is easily accomplished. *In most cases quantification of GHG emissions involves a relatively straightforward calculation.* In addition to estimating emissions caused by the proposal itself, we recommend estimating the reasonably foreseeable emissions from "upstream" and "downstream" activities indirectly caused by the proposal.[5]

- The estimated GHG emissions can serve as a reasonable proxy for climate change impacts when comparing the proposal and alternatives. In disclosing the potential impacts of the proposal and reasonable alternatives, consideration should be given to whether and to what extent the impacts may be exacerbated by expected climate change in the action area, as discussed in the "affected environment" section.

- Describe measures to reduce GHG emissions associated with the project, including reasonable alternatives or other practicable mitigation opportunities and disclose the estimated GHG reductions associated with such measures. The DEIS alternatives analysis should, as appropriate, consider practicable changes to the proposal to make it more resilient to anticipated climate change. EPA further recommends that the Record of Decision commits to implementation of reasonable mitigation measures that would reduce or eliminate project-related GHG emissions.

- We recommend that the project discuss energy usage for all aspects of the Pure Water program, including in particular the new pump station. Reclamation should explore the feasibility of powering the pump station with renewable energy and quantify the reduction in greenhouse gas emissions that could result.

Hazardous Materials/Hazardous Waste/Solid Waste

The Draft EIS/EIR should address potential direct, indirect and cumulative impacts of hazardous waste from construction and operation of the proposed pipeline and other project components, including the potential disinfection and pumping facilities. The Draft EIS/EIR should identify projected hazardous waste types and volumes, and expected storage, disposal, and management plans. It should address the applicability of state and federal hazardous waste requirements. Appropriate mitigation should be evaluated, including measures to minimize the generation of hazardous waste (i.e., hazardous waste minimization). Alternate industrial processes using less toxic materials should be evaluated as mitigation since such processes could reduce the volume or toxicity of hazardous materials requiring management and disposal as hazardous waste.

Floodplain Executive Orders

On January 30, 2015 President Obama issued Executive Order 13690 – Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, which amends Executive Order 11988 – Floodplain Management. Section 2(i) of E.O. 13690 establishes

[4] https://ceq.doe.gov/current_developments/GHG_accounting_methods_7Jan2015.html

[5] Recognizing that climate impacts are not attributable to any single action, but are exacerbated by a series of smaller decisions, we do not recommend comparing GHG emissions from a proposed action to global emissions. As noted by the CEQ guidance, "[t]his approach does not reveal anything beyond the nature of the climate change challenge itself: [t]he fact that diverse individual sources of emissions each make relatively small additions to global atmospheric GHG concentrations that collectively have huge impact."

a new definition of the term "floodplain." Rather than basing the floodplain on the area subject to a one percent or greater chance of flooding in any given year, the floodplain would be established using one of the following approaches:

> Unless an exception is made under paragraph (2), the floodplain shall be:
> (i) the elevation and flood hazard area that result from using a climate-informed science approach that uses the best-available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science. This approach will also include an emphasis on whether the action is a critical action as one of the factors to be considered when conducting the analysis;
> (ii) the elevation and flood hazard area that result from using the freeboard value, reached by adding an additional 2 feet to the base flood elevation for non-critical actions and by adding an additional 3 feet to the base flood elevation for critical actions;
> (iii) the area subject to flooding by the 0.2 percent annual chance flood; or
> (iv) the elevation and flood hazard area that result from using any other method identified in an update to the Federal Flood Risk Management Standards.

EPA recommends that the Draft EIS explain how each alternative would be consistent with the directives in Executive Order 13690. For more information, go to: https://www.fema.gov/federal-flood-risk-management-standard-ffrms.

Public Health and Safety – Valley Fever

Coccidioidomycosis, (kok-sid-oy-doh-my-KOH-sis), or Valley Fever, is a fungal infection that is almost always acquired from the environment via the inhalation of fungal spores. It can affect humans, many species of mammals and some reptiles.[6] The fungus, *Coccidioides*, is endemic in the soil of the southwestern United States, Mexico, and parts of Central and South America. *Coccidioides* can live for long periods of time in soil under harsh environmental conditions including heat, cold, and drought.[7] *Coccidioides* can be released into the air when soil containing the fungus is disturbed, either by strong winds or activities such as farming or construction. Distribution of the fungus is typically patchy, but in some "hot spots," up to 70% of the human population has been infected.

The number of reported Valley Fever cases in the U.S. has risen from less than 5,000 in 2001 to more than 20,000 cases in 2011.[8] An estimated 150,000 more cases go undiagnosed every year. The majority of reported cases are located in Arizona and California.[9] The California Department of Public Health 2015 Yearly Summary report, reported 107 cases in San Diego County. The reason for the recent increase in cases, however, is unclear. Dust storms in endemic areas are often followed by outbreaks of coccidioidomycosis. If the dust storms are severe, the fungal spores can be carried outside the endemic area into neighboring counties, where outbreaks follow.[10]

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[6] Coccidioidomycosis, Technical Fact Sheet, The Center for Food Security and Public Health, 2010. Accessed on June 12, 2013, from http://www.cfsph.iastate.edu/Factsheets/pdfs/coccidioidomycosis.pdf

[7] Coccidioidomycosis Fact Sheet, California Department of Public Health. Accessed on June 12, 2013, from http://www.cdph.ca.gov/HealthInfo/discond/Pages/Coccidioidomycosis.aspx.

[8] Centers for Disease Control and Prevention. December 2012. Fungal pneumonia: a silent epidemic Coccidioidomycosis (valley fever) Fact Sheet. Accessed on June 12, 2013, from http://www.cdc.gov/fungal/pdf/cocci-fact-sheet-sw-us-508c.pdf.

[9] Centers for Disease Control and Prevention. Increase in Reported Coccidioidomycosis – United States, 1998-2011. MMWR 2013;62: 217-221. Accessed on June 12, 2013, from http://www.cdc.gov/mmwr/pdf/wk/mm6212.pdf.

[10] Pappagianis, D. & H. Einstein. 1978. Tempest from Tehachapi takes toll or Coccidioides immitis conveyed aloft and afar. West J. Med. 129: 527–530.

The Draft EIS/EIR should assess potential exposures to the fungus, *Coccidioides*, and susceptibilities of workers and nearby residents to Valley Fever due to soil-disturbing activities of the project. Mitigation or prevention measures that may be used to protect workers and nearby residents should also be described.

Cumulative and Indirect Impacts

The cumulative impacts analysis should identify how resources, ecosystems, and communities in the vicinity of the project have already been, or will be, affected by past, present, or future activities in the project area. These resources should be characterized in terms of their response to change and capacity to withstand stresses. Trends data should be used to establish a baseline for the affected resources, to evaluate the significance of historical degradation, and to predict the environmental effects of the project components.

For the cumulative impacts assessment, we recommend focusing on resources of concern or resources that are "at risk" and/or are significantly impacted by the proposed project, before mitigation. For this project, Reclamation should conduct a thorough assessment of the cumulative impacts to aquatic and biological resources, especially in the context of the other developments occurring and proposed in the area.

The EPA assisted in the preparation of a guidance document for assessing cumulative impacts in California that we find to be very useful. While this guidance was prepared for transportation projects in California, the principles and the 8-step process outlined therein can be applied to other types of projects and offers a systematic way to analyze cumulative impacts for a project. The guidance is available at: http://www.dot.ca.gov/ser/cumulative_guidance/purpose.htm. In accordance with this guidance, the EPA recommends that the Draft EIS/EIR identify which resources are analyzed, which ones are not, and why. For each resource analyzed, the Draft EIS/EIR should:

- Identify the current condition of the resource as a measure of past impacts. For example, the percentage of species habitat lost to date.
- Identify the trend in the condition of the resource as a measure of present impacts. For example, the health of the resource is improving, declining, or in stasis.
- Identify all on-going, planned, and reasonably foreseeable projects in the study area, including all phases of the Pure Water Program, which may contribute to cumulative impacts.
- Identify the future condition of the resource based on an analysis of impacts from reasonably foreseeable projects or actions added to existing conditions and current trends.
- Assess the cumulative impacts contribution of the proposed alternatives to the long-term health of the resource, and provide a specific measure for the projected impact from the proposed alternatives.
- When cumulative impacts are identified for a resource, mitigation should be proposed.
- Disclose the parties that would be responsible for avoiding, minimizing, and mitigating those adverse impacts.
- Identify opportunities to avoid and minimize impacts, including working with other entities.

The Draft EIS/EIR should consider the cumulative impacts associated with other development projects proposed in the area and the potential impacts on various resources including: water supply, endangered species, and habitat.

The Draft EIS/EIR should quantify cumulative impacts across resources areas, as well as describe and evaluate feasible mitigation measures to avoid and minimize the identified adverse cumulative impacts. Although these mitigation measures may be outside the jurisdiction of the lead agency or project proponents, describing them in the Draft EIS/EIR would serve to alert other agencies or officials who can implement these extra measures (CEQ 40 Questions No. 19(b)).

STATE OF CALIFORNIA Edmund G. Brown Jr., Governor

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August 10, 2016

Mark Brunette
City of San Diego
1222 First Avenue, MS-501
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sent via e-mail:
DSDEAS@sandiego.gov

RE: SCH# 2016081016; Pure Water San Diego Program, North City EIR/EIS (PTS No. 477184) Project, Notice of Preparation for Draft Environmental Impact Report, San Diego County, California

Dear Mr. Brunette:

The Native American Heritage Commission has received the Notice of Preparation (NOP) for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code § 21000 et seq.), specifically Public Resources Code section 21084.1, states that a project that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, § 15064.5 (b) (CEQA Guidelines Section 15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an environmental impact report (EIR) shall be prepared. (Pub. Resources Code § 21080 (d); Cal. Code Regs., tit. 14, § 15064 subd.(a)(1) (CEQA Guidelines § 15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources with the area of project effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a **separate category of cultural resources**, "tribal cultural resources" (Pub. Resources Code § 21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.2). Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code § 21084.3 (a)). **AB 52 applies to any project for which a notice of preparation or a notice of negative declaration or mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements.** If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. § 800 et seq.) may also apply.

The NAHC recommends **lead agencies consult with all California Native American tribes** that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments. **Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.**

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a **lead agency** shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:
    - **a.** A brief description of the project.
    - **b.** The lead agency contact information.
    - **c.** Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code § 21080.3.1 (d)).
    - **d.** A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code § 21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A **lead agency** shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code § 21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or environmental impact report. (Pub. Resources Code § 21080.3.1(b)).
    a. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code § 65352.4 (SB 18). (Pub. Resources Code § 21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:
    a. Alternatives to the project.
    b. Recommended mitigation measures.
    c. Significant effects. (Pub. Resources Code § 21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:
    a. Type of environmental review necessary.
    b. Significance of the tribal cultural resources.
    c. Significance of the project's impacts on tribal cultural resources.
    d. If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code § 21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code sections 6254 (r) and 6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code § 21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:
    a. Whether the proposed project has a significant impact on an identified tribal cultural resource.
    b. Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code section 21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code § 21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:
    a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or
    b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code § 21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code section 21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code section 21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code § 21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code section 21084.3 (b). (Pub. Resources Code § 21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:
    a. Avoidance and preservation of the resources in place, including, but not limited to:
        i. Planning and construction to avoid the resources and protect the cultural and natural context.

ii. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.

b. Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:
   i. Protecting the cultural character and integrity of the resource.
   ii. Protecting the traditional use of the resource.
   iii. Protecting the confidentiality of the resource.

c. Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.

d. Protecting the resource. (Pub. Resource Code § 21084.3 (b)).

e. Please note that a federally recognized California Native American tribe or a nonfederally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code § 815.3 (c)).

f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code § 5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An environmental impact report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:
    a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code sections 21080.3.1 and 21080.3.2 and concluded pursuant to Public Resources Code section 21080.3.2.
    b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.
    c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code section 21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code § 21082.3 (d)).

    This process should be documented in the Cultural Resources section of your environmental document.

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires **local governments** to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code § 65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf

Some of SB 18's provisions include:

1. Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code § 65352.3 (a)(2)).
2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code section 65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code sections 5097.9 and 5097.993 that are within the city's or county's jurisdiction. (Gov. Code § 65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
   a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
   b. Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (http://ohp.parks.ca.gov/?page_id=1068) for an archaeological records search. The records search will determine:
   - **a.** If part or all of the APE has been previously surveyed for cultural resources.
   - **b.** If any known cultural resources have been already been recorded on or adjacent to the APE.
   - **c.** If the probability is low, moderate, or high that cultural resources are located in the APE.
   - **d.** If a survey is required to determine whether previously unrecorded cultural resources are present.

2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
   - **a.** The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.
   - **b.** The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:
   - **a.** A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.
   - **b.** A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.
   - **a.** Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, section 15064.5(f) (CEQA Guidelines section 15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.
   - **b.** Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.
   - **c.** Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code section 7050.5, Public Resources Code section 5097.98, and Cal. Code Regs., tit. 14, section 15064.5, subdivisions (d) and (e) (CEQA Guidelines section 15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

Please contact me if you need any additional information at gayle.totton@nahc.ca.gov.

Sincerely,

Gayle Totton

Gayle Totton, M.A., PhD.
Associate Governmental Program Analyst

cc: State Clearinghouse

Department of Toxic Substances Control

Matthew Rodriquez
Secretary for
Environmental Protection

Barbara A. Lee, Director
5796 Corporate Avenue
Cypress, California 90630

Edmund G. Brown Jr.
Governor

August 18, 2016

Mr. Mark Brunette
Senior Environmental Planner
City of San Diego Development Services Department
1222 First Avenue, MS 501
San Diego, California 92101

NOTICE OF PREPARATION (NOP) FOR PURE WATER SAN DIEGO PROGRAM, ENVIRONMENTAL IMPACT REPORT, NORTH CITY PROJECT EIR/EIS 499621 (SCH# 21003699)

Dear Brunette:

The Department of Toxic Substances Control (DTSC) has received your submitted document for the subject project. As stated in your document: "The Pure Water Program is a water and wastewater facilities plan to produce potable water from recycled water. The Pure Water Program consists of the design and construction of new advanced water treatment facilities, waste water treatment facilities, pump station, and pipelines."

Based on the review of the submitted document DTSC has the following comments:

1. The Environmental Impact Report (EIR) should identify and determine whether current or historic uses at the project site may have resulted in any release of hazardous wastes/substances.

2. The EIR should identify any known or potentially contaminated sites within the proposed project area. For all identified sites, the EIR should evaluate whether conditions at the site may pose a threat to human health or the environment.

3. If during construction/demolition of the project, soil and/or groundwater contamination is suspected, construction/demolition in the area should be ceased and appropriate health and safety procedures should be implemented and appropriate government agency be notified.

If you have any questions regarding this letter, please contact me at (714) 484-5476 or email at Johnson.Abraham@dtsc.ca.gov.

Sincerely,

Johnson P. Abraham
Project Manager
Brownfields Restoration and School Evaluation Branch
Brownfields and Environmental Restoration Program - Cypress

cc: Governor's Office of Planning and Research (via e-mail)
State Clearinghouse
P.O. Box 3044
Sacramento, California 95812-3044

CEQA Tracking Center
Department of Toxic Substances Control
Office of Environmental Planning and Analysis
1001 I Street, 22nd Floor, M.S. 22-2
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Mr. Guenther W. Moskat, Chief (via e-mail)
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CEQA# 21003699

DEPARTMENT OF TRANSPORTATION
DISTRICT 11, DIVISION OF PLANNING
4050 TAYLOR ST, M.S. 240
SAN DIEGO, CA 92110
PHONE (619) 688-6960
FAX (619) 688-4299
TTY 711
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Serious Drought.
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August 24, 2016

11-SD-VAR
Pure Water San Diego Program
North City Project
Notice of Preparation
SCH # 2016081016
PTS No. 499621

Mr. Mark Brunette
City of San Diego
1222 First Avenue, MS-501
San Diego, CA 92101

Dear Mr. Brunette:

The California Department of Transportation (Caltrans) has reviewed the Notice of Preparation (NOP) for the Pure Water San Diego Program North City Project (PTS No. 499621). Caltrans has the following comments:

Caltrans policy with regard to freeway and expressways is to exclude utilities from within access controlled highway rights-of-way (R/W), to the extent practicable. Requests for utility encroachment or utility access within freeway or expressway R/W are considered an exception to policy and are to be submitted to the Division Chief of the Division of Design (DOD, Chief) for approval. See the PDPM, Chapter 17 for Caltrans policy and justification for exceptions to policy.

http://www.dot.ca.gov/hq/oppd/pdpm/chap_pdf/chapt17.pdf

Caltrans recommends that the environmental documents for this project specifically identify the potential for any environmental impacts to Caltrans facilities, highways and resources that are within the state R/W, and describe measures to avoid, minimize, or mitigate those impacts. This includes identifying all utility work within Caltrans' R/W, as well as traffic control plans.

Storm Water Compliance:
The City proposes trenchless methods which is largely dependent upon the anticipated ground conditions. Trenchless methods typically require excavation of jacking and receiving pits with shoring and bracing system. The construction footprint at grade is heavily dependent of the selected method and contractor's decisions on staging, means and methods. Steel pipes are typically required for Caltrans highways and railroads crossings.

Hazardous Waste/Materials:
Any work done within our R/W that proposes to disturb unpaved soil may get into elevated or hazardous levels of Aerially Deposited Lead (ADL). Prior to disturbance, they would need to complete an ADL study.

Any work performed within Caltrans R/W will require discretionary review and approval by Caltrans and an encroachment permit will be required for any work within the Caltrans R/W prior to construction.

As part of the encroachment permit process, the applicant must provide an approval final environmental document including the California Environmental Quality Act (CEQA) determination addressing any environmental impacts within the Caltrans' R/W, and any corresponding technical studies. If these materials are not included with the encroachment permit application, the applicant will be required to acquire and provide these to Caltrans before the permit application will be accepted. Identification of avoidance and/or mitigation measures will be a condition of the encroachment permit approval as well as procurement of any necessary regulatory and resource agency permits. Encroachment permit submittals that are incomplete can result in significant delays in permit approval.

If you have any questions, or require further information, please contact Vanessa De La Rosa at (619)688-4289 or email at Vanessa.DeLaRosa@dot.ca.gov.

Sincerely,

JACOB ARMSTRONG, Branch Chief
Development Review Branch

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
South Coast Region
3883 Ruffin Road
San Diego, CA 92123
(858) 467-4201
www.wildlife.ca.gov

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

September 1, 2016

Mark Brunette, Senior Environmental Planner
City of San Diego Development Services Department
1222 First Avenue, MS 501
San Diego, CA 92101
DSDEAS@sandiego.gov

Subject: Comments on the Notice of Preparation of a Draft Environmental Impact Report for the Pure Water San Diego Program, North City Project EIR/EIS Project Number 499621; SCH# 2016081016

Dear Mr. Brunette:

The California Department of Fish and Wildlife (CDFW) has reviewed the above-referenced Notice of Preparation (NOP) for the Pure Water Program, North City Project (proposed project) Draft Environmental Impact Report (DEIR).

Thank you for the opportunity to provide comments and recommendations regarding those activities involved in the Project that may affect California fish and wildlife. Likewise, we appreciate the opportunity to provide comments regarding those aspects of the Project that CDFW, by law, may be required to carry out or approve through the exercise of its own regulatory authority under the Fish and Game Code.

CDFW ROLE

CDFW is California's Trustee Agency for fish and wildlife resources, and holds those resources in trust by statute for all the people of the State. (Fish & G. Code, §§ 711.7, subd. (a) & 1802; Pub. Resources Code, § 21070; CEQA Guidelines § 15386, subd. (a).) CDFW, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species. (*Id.*, § 1802.) Similarly for purposes of CEQA, CDFW is charged by law to provide, as available, biological expertise during public agency environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect fish and wildlife resources.

CDFW is also a Responsible Agency under CEQA. (Pub. Resources Code, § 21069; CEQA Guidelines, § 15381.) CDFW may need to exercise regulatory authority as provided by the Fish and Game Code. As proposed, for example, the Project may be subject to CDFW's lake and streambed alteration regulatory authority. (Fish & G. Code, § 1600 et seq.) Likewise, to the extent implementation of the Project as proposed may result in "take" as defined by State law of any species protected under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.), related authorization as provided by the Fish and Game Code will be required.

CDFW also administers the Natural Community Conservation Planning (NCCP) program. The City of San Diego (City) participates in the NCCP program by implementing its' approved Multiple Species Conservation Program (MSCP) Subarea Plan (SAP).

Project Location: The proposed project would include a variety of facilities located throughout the central coastal areas of San Diego County in the North City geographic area. The new advanced water purification facility, proposed pipelines and three pump stations would be located within the corporate boundaries of the City. Potential electrical transmission facilities would traverse federal lands within Marine Corps Air Station (MCAS) Miramar.

Project Description/ Objective: The objective of the project is to create 83 million gallons per day (MGD) of locally controlled drinking water, reducing inflows to the Point Loma Wastewater Treatment Plant, which would ultimately reduce total suspended solids discharged while recycling water that is currently discharged to the ocean. Primary project activities include two phases over a 20-year period. The Pure Water Program facilities are grouped into geographical areas to facilitate delivery: North City, Central Area, and South Bay. The proposed project would consist of the design and construction of new advanced water treatment facilities, wastewater treatment facilities, pump stations, transmission lines, and pipelines. Phase one of the proposed project includes:

North City Water Reclamation Plant Expansion. The North City Water Reclamation Plant would be expanded from its current treatment capacity of 30 MGD to 52 million MGD. To increase capacity, a number of new process units and tankage would be required. Process units requiring expansion would consist of influent screening, primary sedimentation, flow equalization, aeration basins, secondary clarification, and tertiary filtration. A new influent pump station would be located at the reclamation plant site and would pump tertiary effluent via a pipeline across Eastgate Mall Road connecting the reclamation plant to the purification facility. Additional wastewater flows to the expanded plant would be delivered from the new Morena Pump Station and wastewater force main.

North City Pure Water Facility. The new North City Pure Water Facility would be located on the vacant lot owned by the City of San Diego, across Eastgate Mall Road to the north of the existing water reclamation plant and would be designed to produce 30 MGD of purified water. The water purification facility would use multiple treatment processes including an ozone system, biological activated carbon filtration, membrane filtration, reverse osmosis and ultraviolet/advanced oxidation process, before it is stabilized and chlorinated prior to being pumped out to the Miramar Reservoir.

North City Pure Water Pump Station and Pipeline A new pump station and a purified water pipeline would be needed to convey the purified water produced at the North City Pure Water Facility to the Miramar Reservoir.

Morena Pump Station, Wastewater Force Main, and Brine Conveyance. To use the proposed expanded capacity of the water reclamation plant, additional wastewater flows that would normally be conveyed to the Point Loma Wastewater Treatment Plant would be diverted to the North City Water Reclamation Plant to be recycled. The Morena Pump Station is proposed to be located near the intersection of Friars Road and Interstate 5 to collect wastewater flows from a combination of trunk sewers and sewer interceptors to pump the diverted flows to the reclamation plant through a new wastewater force main. Additional brine from the reverse osmosis process at the water purification facility would be conveyed via a gravity flow line back to the proposed Morena Pump Station in the same corridor as the wastewater force main. The brine line would discharge downstream of the diversion structures back to into the sewer system.

Electrical Transmission. A new electrical transmission line is proposed to connect the North City Water Reclamation Plant to the future cogeneration facility at the Metropolitan Biosolids Center to deliver power to North City Project components. The electrical transmission line would cross MCAS Miramar property and require approval by the United States Marine Corps.

Metropolitan Biosolids Center Improvements. Process improvements would be required for handling future flows from the expanded North City Water Reclamation Plant. These improvements would upsize existing equipment and provide additional units to handle the increased flows. Improvements may include replacement of raw solids feed pumps, expansion of the grit removal facility, installation of one new grit separator, and installation of one new clarifier, snail, and screw conveyor.

COMMENTS AND RECOMMENDATIONS

CDFW offers the following comments and recommendations to assist the City in adequately identifying and/or mitigating the project's significant, or potentially significant, direct and indirect impacts on fish and wildlife (biological) resources.

Specific Comments

Feasible Project Alternatives

1. Given the geographic reach and varied habitat types traversed by the proposed project, it is critical that the DEIR provide a range of alternatives to the proposed project alignment. At the time of the NOP, only one alternative is identified, Alternative A, which utilizes the San Vincente Reservoir rather than Miramar Reservoir for treated water storage. The NOP does not provide alternative locations or alignments associated with the pipelines, pump stations, or transmission lines. The DEIR should present a range of feasible alternatives which, at a minimum, include alternative alignments designed to avoid and minimize project impacts. The DEIR should include a comparative discussion of each alignment alternative and the merits and detractors of each proposal. Alignments should focus on minimizing impacts to biological resources and, to the maximum extent feasible, conform to City Environmentally Sensitive Lands (ESL) regulations section 143.0150. In addition to the ESL regulations and CEQA tenets of avoiding and minimizing impacts, Council Policy number 600-13 and 600-14 (City of San Diego, 2002) make clear it is in the City's best interest to minimize public utility impacts to canyons and ESL to minimize environmental impacts, while concurrently facilitating routine and timely maintenance. While Council Policies 600-13 and 600-14 specifically address sewer lines, the same principles of minimizing environmental impacts and improving facility access apply to water distribution facilities and should be analyzed with respect to proposed project.

2. In an effort to minimize the proposed project's impacts to biological resources, the DEIR should focus on alternatives that collocate pipelines, transmission lines, lift stations and other project features with existing infrastructure including but not limited to roadways, and

disturbed utility right-of-ways (ROW). According to the NOP, the first phase (North City) of the proposed project is anticipated to be completed in 2021; thus sufficient time remains to negotiate easements, ROWs, and encroachments to collocate the proposed project with existing infrastructure, outside of Multi-Habitat Planning Area (MHPA).

Project Figures and Maps

3. The DEIR should include project figures depicting the location of the proposed project and specific infrastructure in relation to MHPA and other biological resources. Project figures should be appropriately scaled and include a figure depicting the entirety of the proposed project within the regional context and large scale maps for each alignment. The maps should complement each other allowing the reader to quickly cross reference the small scale maps with the large scale maps depicting site-specific biological resources such that "[t]he location and extent of each resource must be clearly identified on a map of an appropriate scale (same scale as development drawings), on which the acreage of each vegetation community must be provided" (City Biological Guidelines, 2012). CDFW requests that these maps and the project alignments be provided to us in either an ESRI shape file or ESRI geodatabase.

Project Purpose and Need

4. The purpose and need for the Morena Pump Station and associated pipeline should be clearly articulated in the DEIR. While the NOP cites that "...[t]o use the proposed expanded capacity of the water reclamation plant, additional wastewater flows that would normally be conveyed to the Point Loma Wastewater Treatment Plant would be diverted to the North City Water Reclamation Plant to be recycled" it is not clear if the expanded capacity of the water reclamation plant could not be leveraged utilizing nearer wastewater sources that require no or fewer impacts to natural habitats associated with pipeline infrastructure.

5. Similarly, the DEIR should analyze alternative sources of energy using existing or readily upgradeable infrastructure. If the Metropolitan Biosolids Center's electrical demand cannot be met with existing transmission lines, the DEIR should evaluate the existing transmission infrastructure (e.g., transmission towers and other physical structures) for improvements to accommodate a new transmission line without the need for ground disturbing activities, easement acquisition, or right of way acquisition. Should the DEIR find that existing transmission towers cannot be upgraded due to physical design limitations, the DEIR should analyze an underground transmission alternative.

Recreational Fisheries

6. The programmatic environmental impact report (PEIR; SCH # 2014111068), which the current DEIR for the proposed project tiers from, states on page 11-20 'If...Miramar Reservoir and Lake Murray were converted to primarily purified water reservoirs, impacts could result to the fisheries supported by the reservoir, resulting in indirect impacts to recreation.' The PEIR identifies that the Pure Water Program could result in indirect impacts to recreational fishing at Miramar Reservoir. Accordingly, the DEIR should address these potential impacts and provide an analysis of the proposed project's effect on recreational angling at Miramar Reservoir and how those affects will be mitigated. We are concerned that the project's proposal to introduce 30 MGD of treated water (by year 2021) will negatively

impact fishery resources by reducing nutrient availability. Miramar Reservoir already suffers from decreased nutrients in the water as a result of quagga mussels (*Dreissena rostriformis bugensis*). Quagga mussels are prolific breeders and filter feeders, which can quickly eliminate the planktonic food sources of juvenile game fish and the forage species on which adult fish rely (Loomis et al. 2011.) A single quagga mussel can filter between 3 to 7 gallons per day (Link, 2010). The introduction of purified, nutrient deficient, treated water will result in a lower concentration of nutrients in the reservoir and is likely to increase competition between mussels and resident fish species for nutrients and resources (e.g., phytoplankton and diatoms). Nutrient deficient waters decrease juvenile recruitment of game fish and planktivorous fish that will reduce fish size and abundance in greater trophic levels. Furthermore, the introduction of nutrient deficient waters may lead to a decrease in avian resources at Miramar Reservoir if fisheries resources decline as ospreys, grebes, cormorants, herons, and others species would have difficulty finding sufficient prey species.

Miramar Reservoir has a long history of producing trophy largemouth bass with five of the top 25 bass in the world caught at Miramar (sdfish.com), the largest weighing 20.9 lbs. In 2014, two 16 pound largemouth bass were caught. At the request of the City's constituents CDFW stocks rainbow trout in the reservoir to improve fishing opportunities. CDFW gages reservoir fishing success by examining the catch-per-unit effort (CPUE), typically expressed in number of fish caught per hour fished. CDFW seeks to attain CPUEs of 1.0 fish per hour or greater. A reservoir fishery is classified as good to excellent if the CPUE is 1.0 fish per hour or greater, fair to good if the CPUE is 0.5 to 1.0 fish per hour, and poor to fair if the CPUE is 0.0 to 0.5 fish per hour. In 2014, CDFW surveyed 38 anglers at Miramar Reservoir; the CPUE was 0.9 fish per hour, which would classify fishing in this reservoir as fair to good (CDFW file report).

CDFW is concerned with the proposed project's potential to result in Miramar Reservoir (or any other recreational fishery reservoir) becoming oligotrophic or nutrient deficient, which will negatively impact the aquatic resources in the lake. To understand the potential negative aquatic impacts the City should demonstrate that the treated water has sufficient nutrient concentrations to maintain current fisheries populations and that the water storage time is sufficient to allow for those nutrients to be adequately stored in the reservoir.

To mitigate for the loss of aquatic resources the City should investigate the following mitigation options: 1) supplemental fish stocking; 2) create and maintain fish habitat (e.g., woody debris, brush shelters); 3) increase nutrient loading (e.g., reservoir seeding); and 4) adjust facility treatment levels to allow more nutrients to be deposited in Miramar Reservoir. CDFW recommends that a recreational angling monitoring and management plan be identified within the DEIR as a condition of project approval. An appropriate monitoring program needs to have record of environmental indicators (data that are scientific, practical, and applicable to the program). Indicators should have the following qualities that are: measurable/quantitative, sensitive to perturbation, discriminatory, accurate, and referential to a benchmark or baseline. With the establishment of measurable and quantifiable indicators, an appropriate baseline of conditions can be used as a reference to which all future data can be compared.

General Comments

Lake and Streambeds

7. CDFW has responsibility for wetland and riparian habitats. It is the policy of CDFW to strongly discourage development in wetlands or conversion of wetlands to uplands. We oppose any development or conversion which would result in a reduction of wetland acreage or wetland habitat values, unless, at a minimum, project mitigation assures there will be "no net loss" of either wetland habitat values or acreage. Development and conversion include but are not limited to conversion to subsurface drains, placement of fill or building of structures within the wetland, and channelization or removal of materials from the streambed. All wetlands and watercourses, whether ephemeral, intermittent, or perennial, should be retained and provided with substantial setbacks which preserve the riparian and aquatic values and maintain their value to on-site and off-site wildlife populations. Mitigation measures to compensate for impacts to mature riparian corridors must be included in the DEIR and must compensate for the loss of function and value of a wildlife corridor.

   a) The CDFW also has regulatory authority over activities in streams and/or lakes that will divert or obstruct the natural flow, or change the bed, channel, or bank (which may include associated riparian resources) of any river, stream, or lake or use material from a river, stream, or lake. For any such activities, the project applicant (or "entity") must provide written notification to CDFW pursuant to section 1600 et seq. of the Fish and Game Code. Based on this notification and other information, CDFW determines whether a Lake and Streambed Alteration Agreement (LSA) with the applicant is required prior to conducting the proposed activities. CDFW's issuance of a LSA for a project that is subject to CEQA will require CEQA compliance actions by CDFW as a Responsible Agency. CDFW as a Responsible Agency under CEQA may consider the local jurisdiction's (lead agency) Negative Declaration or Environmental Impact Report for the project. To minimize additional requirements by CDFW pursuant to section 1600 *et seq.* and/or under CEQA, the document should fully identify the potential impacts to the stream or riparian resources and provide adequate avoidance, mitigation, monitoring and reporting commitments for issuance of the LSA.[1]

To enable CDFW to adequately review and comment on the proposed project from the standpoint of the protection of plants, fish, and wildlife, we recommend the following information be included in the DEIR. The document should contain a complete discussion of the purpose and need for, and description of, the proposed project, including all staging areas and access routes to the construction and staging areas.

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1 A notification package for a LSA may be obtained by accessing the Department's web site at www.wildlife.ca.gov/habcon/1600.

Biological Resources within the project's Area of Potential Effect

8. The document should provide a complete assessment of the flora and fauna within and adjacent to the project area, with particular emphasis upon identifying endangered, threatened, sensitive, and locally unique species and sensitive habitats. This should include a complete floral and faunal species compendium of the entire project site, undertaken at the appropriate time of year. The DEIR should include the following information.

   a) CEQA Guidelines, section 15125(c), specifies that knowledge on the regional setting is critical to an assessment of environmental impacts and that special emphasis should be placed on resources that are rare or unique to the region.

   b) A thorough, recent floristic-based assessment of special status plants and natural communities, following CDFW's Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (see http://www.dfg.ca.gov/habcon/plant/). CDFW recommends that floristic, alliance-based and/or association-based mapping and vegetation impact assessments be conducted at the Project site and neighboring vicinity. The Manual of California Vegetation, second edition, should also be used to inform this mapping and assessment (Sawyer et al. 2008), or R.F. Holland codes per the SAP Bio Guidelines, attachment II).

   c) Adjoining habitat areas should be included in this assessment where site activities could lead to direct or indirect impacts offsite. Habitat mapping at the alliance level will help establish baseline vegetation conditions.

   d) A current inventory of the biological resources associated with each habitat type on site and within the area of potential effect. CDFW's California Natural Diversity Data Base in Sacramento should be contacted at www.wildlife.ca.gov/biogeodata/ to obtain current information on any previously reported sensitive species and habitat, including Significant Natural Areas identified under Chapter 12 of the Fish and Game Code.

   e) An inventory of rare, threatened, endangered and other sensitive species on site and within the area of potential effect. Species to be addressed should include all those which meet the CEQA definition (see CEQA Guidelines, § 15380). This should include sensitive fish, wildlife, reptile, and amphibian species. Seasonal variations in use of the project area should also be addressed. Focused species-specific surveys, conducted at the appropriate time of year and time of day when the sensitive species are active or otherwise identifiable, are required. Acceptable species-specific survey procedures should be developed in consultation with CDFW and the U.S. Fish and Wildlife Service.

Analyses of the Potential Project-Related Impacts on the Biological Resources

5. To provide a thorough discussion of direct, indirect, and cumulative impacts expected to adversely affect biological resources, with specific measures to offset such impacts, the following should be addressed in the DEIR.

   a) A discussion of potential adverse impacts from lighting, noise, human activity, exotic species, and drainage should also be included. The latter subject should address: project-related changes on drainage patterns on and downstream of the project site; the volume, velocity, and frequency of existing and post-project surface flows; polluted runoff; soil erosion and/or sedimentation in streams and water bodies; and post-project fate of runoff from the project site. The discussions should also address the proximity of the extraction activities to the water table, whether dewatering would be necessary, and the potential resulting impacts on the habitat, if any, supported by the groundwater. Mitigation measures proposed to alleviate such impacts should be included.

b) Discussions regarding indirect project impacts on biological resources, including resources in nearby public lands, open space, adjacent natural habitats, riparian ecosystems, and any designated and/or proposed or existing reserve lands (e.g., preserve lands associated with a NCCP). Impacts on, and maintenance of, wildlife corridor/movement areas, including access to undisturbed habitats in adjacent areas, should be fully evaluated in the DEIR.

c) The zoning of areas for development projects or other uses that are nearby or adjacent to natural areas may inadvertently contribute to wildlife-human interactions. A discussion of possible conflicts and mitigation measures to reduce these conflicts should be included in the environmental document.

d) A cumulative effects analysis should be developed as described under CEQA Guidelines, section 15130. General and specific plans, as well as past, present, and anticipated future projects, should be analyzed relative to their impacts on similar plant communities and wildlife habitats.

<u>Mitigation for Project-related Biological Impacts</u>

6. The DEIR should include measures to fully avoid and otherwise protect Rare Natural Communities from project-related impacts. CDFW considers these communities as threatened habitats having both regional and local significance.

7. The DEIR should include mitigation measures for adverse project-related impacts to sensitive plants, animals, and habitats. Mitigation measures should emphasize avoidance and reduction of project impacts. For unavoidable impacts, on-site habitat restoration or enhancement should be discussed in detail. If on-site mitigation is not feasible or would not be biologically viable and therefore not adequately mitigate the loss of biological functions and values, off-site mitigation through habitat creation and/or acquisition and preservation in perpetuity should be addressed.

8. For proposed preservation and/or restoration, the DEIR should include measures to perpetually protect the targeted habitat values from direct and indirect negative impacts. The objective should be to offset the project-induced qualitative and quantitative losses of wildlife habitat values. Issues that should be addressed include restrictions on access, proposed land dedications, monitoring and management programs, control of illegal dumping, water pollution, increased human intrusion, etc.

9. CDFW recommends that measures be taken to avoid project impacts to nesting birds. Migratory nongame native bird species are protected by international treaty under the Federal Migratory Bird Treaty Act (MBTA) of 1918 (Title 50, § 10.13, Code of Federal Regulations). Sections 3503.5 and 3513 of the California Fish and Game Code prohibit take

of all raptors and other migratory nongame birds and section 3503 prohibits take of the nests or eggs of all birds. Proposed project activities (including, but not limited to, staging and disturbances to native and nonnative vegetation, structures, and substrates) should occur outside of the avian breeding season which generally runs from February 1 to September 1 (as early as January 1 for some raptors) to avoid take of birds or their eggs. If avoidance of the avian breeding season is not feasible, CDFW recommends surveys by a qualified biologist with experience in conducting breeding bird surveys to detect protected native birds occurring in suitable nesting habitat that is to be disturbed and (as access to adjacent areas allows) any other such habitat within 300 feet of the disturbance area (within 500 feet for raptors). Project personnel, including all contractors working on site, should be instructed on the sensitivity of the area. Reductions in the nest buffer distance may be appropriate depending on the avian species involved, ambient levels of human activity, screening vegetation, or possibly other factors.

10. CDFW generally does not support the use of relocation, salvage, and/or transplantation as mitigation for impacts to rare, threatened, or endangered species. Studies have shown that these efforts are experimental in nature and largely unsuccessful.

11. Plans for restoration and revegetation should be prepared by persons with expertise in southern California ecosystems and native plant revegetation techniques. Each plan should include, at a minimum: (a) the location of the mitigation site; (b) the plant species to be used, container sizes, and seeding rates; (c) a schematic depicting the mitigation area; (d) planting schedule; (e) a description of the irrigation methodology; (f) measures to control exotic vegetation on site; (g) specific success criteria; (h) a detailed monitoring program; (i) contingency measures should the success criteria not be met; and (j) identification of the party responsible for meeting the success criteria and providing for conservation of the mitigation site in perpetuity.

CONCLUSION

CDFW appreciates the opportunity to comment on the NOP to assist the City in identifying and mitigating project impacts on biological resources. Questions regarding this letter or further coordination should be directed to Eric Weiss, Senior Environmental Scientist at (858) 467-4289 or eric.weiss@wildlife.ca.gov.

Sincerely,

Jaidy Flaherty for

Gail K. Sevrens
Environmental Program Manager
South Coast Region

ec: Office of Planning and Research, State Clearinghouse, Sacramento
Doreen Stadtlander, USFWS
Patrick Gower, USFWS
John O'Brien, CDFW

REFERENCES

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County of San Diego

MARK WARDLAW
DIRECTOR
PHONE (858) 694-2962
FAX (858) 694-2555

PLANNING & DEVELOPMENT SERVICES
5510 OVERLAND AVENUE, SUITE 310, SAN DIEGO, CA 92123
www.sdcounty.ca.gov/pds

DARREN GRETLER
ASSISTANT DIRECTOR
PHONE (858) 694-2962
FAX (858) 694-2555

August 30, 2016

Mark Brunette
Senior Environmental Planner
City of San Diego Development Services Department
1222 First Avenue, MS 501
San Diego, CA 92101

Via email to DSDEAS@sandiego.gov

COMMENTS ON NOTICE OF PREPARATION OF AN ENVIRONMENTAL IMPACT REPORT AND SCOPING MEETINGS FOR THE PURE WATER SAN DIEGO PROGRAM, NORTH CITY PROJECT - 4999621

Dear Mr. Brunette,

The County of San Diego (County) has reviewed the Notice of Preparation of an Environmental Impact Report and Scoping Meetings for the Pure Water San Diego Program, North City Project - 4999621, and appreciates this opportunity to provide input. The County has completed their review and has the following comments regarding the proposed project.

WATERSHED PROTECTION

1. The project must demonstrate compliance with the adopted San Diego Municipal Storm Water Permit Order No. R9-2013-0001, (as amended by Order Nos. R9-2015-0001 and R9-2015-0100). Pending the project category (i.e. – Priority Development Project), the project may be required by the Regional Water Quality Control Board to implement permanent Site Design, Storm Water Treatment, and Hydromodification Management pollutant control and flow control Best Management Practices (BMPs) in accordance with the County's BMP Design Manual since Alternative A is located within lands regulated by the County Watershed Protection Ordinance.

FLOOD CONTROL

1. Project Alternative A could potentially result in impacts to County Flood Control facilities. Close coordination with the County for the Alternative A design would be required.

2. Alternative A alignment would impact the FEMA and County-mapped Floodway/Floodplain of the San Diego River. Any changes to the base flood elevation or limits due to the proposed work would require a County Letter of Map Revision (LOMR) to be processed through the County and FEMA in accordance with the Flood Damage Prevention Ordinance (FDPO) Section 811.503(b). Any proposed work in the Floodway would require a "No-Rise" Certificate and Analysis in accordance with the FDPO Section 811.506.

PLANNING & DEVELOPMENT SERVICES

1. Please describe more specifically, or demonstrate through finer scaled graphics, the locations where proposed project elements are within the unincorporated portion of San Diego County.

2. It appears that certain elements of the proposed project would be located within the unincorporated County, but the NOP does not specify what, if any discretionary actions will be requested of the County. Please clearly describe any and all the approvals and authorities needed by the City as it relates to the location of construction and construction staging for the project in areas within the County's jurisdiction.

3. For each resource area that is evaluated for consistency with an applicable plan or regulation, or where the potential impact is addressed by plans or regulations, please specify which plan or regulation is referenced. Please also explain how they preclude potential impacts from occurring. For all City Plans and Regulations referenced, please describe how they are comparable or exceed the corresponding County Plan or Regulation listed below. The County Guidelines for Determining Significance include:

    - Agricultural Resources
    - Air Quality
    - Airport Hazards
    - Biological Resources
    - Cultural Resources
    - Dark Skies and Glare
    - Emergency Response Plans
    - Geology/Geologic Hazards/Soils
    - Groundwater
    - Hazardous Materials and Existing Contamination
    - Hydrology/Water Quality
    - Mineral Resources
    - Noise
    - Paleontological Resources
    - Transportation and Traffic
    - Unique Geology
    - Vectors

- Visual Resources
- Water Quality
- Wildland Fire and Fire Protection/Fire Hazards

Additional County Planning Documents include:

- Revegetation Planning
- Zoning Ordinance
- Grading Ordinance
- General Plan

The County looks forward to receiving future documents and/or notices related to this project and providing additional assistance at your request. If you have any questions regarding these comments, please contact Danny Serrano, Land Use / Environmental Planner at (858) 694-3680, or via email at daniel.serrano@sdcounty.ca.gov.

Sincerely,

Joe Farace, Group Program Manager
Advance Planning Division
Planning & Development Services

Email cc:

Taylor Dupont, Legislative Assistant, Board of Supervisors, District 2
Keith Corry, Policy Advisor, Board of Supervisors, District 3
Melanie Wilson, Board of Supervisors, District 4
Megan Jones, Group Program Manager, LUEG
Jeff Kashak, Planner, Department of Public Works
Peter Eichar, Land Use and Environmental Planning Manager, Planning & Development Services

RINCON BAND OF LUISEÑO INDIANS
Environmental Department
1 W. Tribal Road · Valley Center, California 92082 ·
(760) 297-2330 Fax:(760) 297-2339

August 15, 2016

Mark Brunette
City of San Diego
Development Services Department
1222 First Avenue, MS 501
San Diego, CA 92101

Re: Pure Water San Diego Program, North City Project No. 499621

Dear Mr. Brunette:

This letter is written on behalf of the Rincon Band of Luiseño Indians. Thank you for inviting us to submit comments on the Pure Water San Diego Program, North City Project No. 499621. Rincon is submitting these comments concerning your projects potential impact on Luiseño cultural resources.

The Rincon Band has concerns for the impacts to historic and cultural resources and the finding of items of significant cultural value that could be disturbed or destroyed and are considered culturally significant to the Luiseño people. This is to inform you, your identified location is not within the Luiseño Aboriginal Territory. We recommend that you locate a tribe within the project area to receive direction on how to handle any inadvertent findings according to their customs and traditions.

If you would like information on tribes within your project area, please contact the Native American Heritage Commission and they will assist with a referral.

Thank you for the opportunity to protect and preserve our cultural assets.

Sincerely,

Vincent Whipple
Manager
Rincon Cultural Resources Department

SAN DIEGO COUNTY ARCHAEOLOGICAL SOCIETY

San Diego County Archaeological Society, Inc.

Environmental Review Committee

1 September 2016

To: Mr. Mark Brunette
Development Services Department
City of San Diego
1222 First Avenue, Mail Station 501
San Diego, California 92101

Subject: Notice of Preparation of a Draft Environmental Impact Report
Pure Water San Diego Program, North City Project
Project No. 499621

Dear Mr. Brunette:

Thank you for the Notice of Preparation for the subject project, received by this Society last month.

We are pleased to note the inclusion of historical resources in the list of subject areas to be addressed in the DEIR, and look forward to reviewing it during the upcoming public comment period. To that end, please include us in the distribution of the DEIR, and also provide us with a copy of the cultural resources technical report(s).

SDCAS appreciates being included in the City's environmental review process for this project.

Sincerely,

James W. Royle, Jr.

James W. Royle, Jr., Chairperson
Environmental Review Committee

cc: SDCAS President
File

P.O. Box 81106 San Diego, CA 92138-1106 (858) 538-0935

WATEREUSE
1199 North Fairfax St, Suite 410 • Alexandria, VA 22314

September 2, 2016

Mr. Doug McPherson
Southern California Area Office
Bureau of Reclamation
27708 Jefferson Avenue, Suite 202
Temecula, CA 92590

Dear Mr. McPherson:

WateReuse fully supports the Pure Water San Diego Program, North City Project in San Diego County, California. WateReuse encourages the Bureau of Reclamation to consider both the principal and ancillary environmental benefits of this project, including project benefits to regional water supply, as it prepares the Environmental Impact Report/Environmental Impact Statement (FR Doc. 2016-18616).

Most importantly, this project will provide a safe, reliable, locally-controlled water supply to the families and businesses of Southern California. Water supply managers in areas with limited water sources require extensive, flexible toolkits to meet the demands of their communities and reusing wastewater for potable purposes provides a resilient water supply, in the face of climate change, while protecting traditional sources.

On behalf of the more than 200 utilities represented by WateReuse, thank you for your consideration.

Sincerely,

Melissa L. Meeker
Executive Director

JOHN W. STUMP
2413 SHAMROCK STREET
CITY HEIGHTS, CALIFORNIA 92105
VOICE: 619-281-4663 EMAIL: **mrjohnstump@cox.net**

City of San Diego via First Class USPS and Email to cityclerk@sandiego.gov purewatersd@sandiego.gov
Development Services; & Storm Water Departments kbalo@sandiego.gov; HMDeisher@sandiego.gov;
202 C Street cityattorney@sandiego.gov; planningcommission@sandiego.gov
San Diego, California 92101

California Regional Water Quality Control Board, San Diego Region
San Diego Storm Water Permit, Implementation, Monitoring and Enforcement
2375 Northside Drive, Suite 100 via USPS & Email: sandiego@waterboards.ca.gov; Rebecca.Stewart@waterboards.ca.gov
San Diego, CA 92108 Main Phone Number: 619-516-1990

RE: PURE Toilet to Tap Water project and Scoping for Pending Studies (Projects: 438188 SCH No. 2014111068 & City Number 21003699) and related, including any request for any California Federal Drinking Water or Sewage Permits

Dear City of San Diego and Regional Water Board,

The City of San Diego appears to be engaged in a program to foster uncontrolled and unsustainable growth by providing an artificial water supply based on new technologies and the expenditure of significant public resources without adequate notice; inadequate consideration of alternatives; and failure to consider the known and cumulative impacts of entering into this project and its components. My testimony and letter of November 17, 2014 (**RE: ITEM-330: Point Loma Wastewater Treatment Plant - National Pollutant Discharge Elimination System (NPDES) Permit Application. (Citywide.) for MEETING OF TUESDAY, NOVEMBER 18, 2014, AT 2:00 PM,)** on file with the San Diego City Clerk and incorporated herein by reference, raised many of the points I present and highlight again.

These proposals are for an expanded approach and direction for regional water production and waste water processing. It assumes a Billion dollar construction program and significant new energy demands for combined sewer water processing and redelivery systems. I am requesting a California environmental review before this proposal becomes the permanent policy of the City. "If CEQA is scrupulously followed, the public will know the basis on which its responsible officials either approve or reject environmentally significant action, and the public, being duly informed, can respond accordingly to action with which it disagrees. The EIR process protects not only the environment but also informed self-government." *Sierra Club* at 13-14 (citing *Laurel Heights Improvement Assn. v. Regents of the University of California.*

The City's Web page states: "Water System Improvement Projects are funded by the rate increases." (SEE: http://tinyurl.com/jrt2n6y). The Notice of the plans and projects under consideration or in progress are inadequate, as they fail to give the public and potential ratepayers any reasonable notice of the plans of the government. These notices should be included in the Water and Sewer bill for the persons currently served by the system. The Notice should be in the languages used in the City of San Diego, under Election Law. These notices should give a reasonable range of the money spent to date and the treasure required in the future. Ratepayers should know that if these plans continue Water, Sewer, and Storm water will increase significantly and the cost of housing will become proportionally less affordable. Please Notice these plans in regular billings. A "…notice must be "reasonably calculated" to inform known parties…" ***Mullane v. Central Hanover Bank & Trust Co.***, 339 U.S. 306 (1950),

The City now has a legally enforceable Climate Action Plan , incorporated by reference herein, which is presented in an article in the May 18, 2016 San Diego Union Tribune newspaper (See: http://tinyurl.com/je49vx6) and a City Attorney Memorandum on Climate Action Plan (See: http://tinyurl.com/zbposv2). These projects and proposals must be evaluated and analyzed against the goals, standards and features of the referenced Climate Action Plan to determine if any project or proposal, including, but not limited to, its energy usages and growth inducing effects are consistent with the Plan. The Climate Action Plan requires change and one of the alternatives that must be considered to obtain Plan compliance must be alternatives that limit growth to sustainable levels, within existing resources.

The City is under a Municipal Storm Water permit and there have several been several enforcement actions imposed or pending concerning the City's lack of compliance with the permit and regulations, particularly on projects it has built for its own purposes or operation, the Municipal Storm Water Permit and Compliance matters are incorporated into these comments by reference (See: http://tinyurl.com/zsktyul). The proposed project and programs must specifically be analyzed for how these programs and projects foster the goals and objects of the Municipal permit. The Municipal Storm Water Permit requires change and one of the alternatives that must be considered to obtain Permit compliance must be alternatives that limit growth to sustainable levels, within existing resources. Please analyze and present reasonable information on how continued growth will contribute to obtainment of the standards required of the permit and settlement agreements. It is inconceivable that the City could continue to provide processed toilet to tap water to foster growth and yet not increase the amount of polluted storm water run-off to the water sheds and ocean. Analysis must include the conjoined effects and induced growth, waste generation, water and sewer demands that result from continued growth of San Diego and its larger sister City Tijuana. San Diego is a linked city like Budapest. We need to think San Dejuana not just North of the wall. Demand is generated together.

In addition to my demands for reasonable Notice and analysis to determine how the proposed projects will foster obtainment and timely compliance with regulatory permits, plans, and regulations, illustrated above without exclusion of other permits and regulations that the City is subject to, I have some specific matters for consideration. These are listed below:

1. Is the system or systems being proposed going to require rate increases and in what range(s);
2. Is the system or systems being proposed based on specific proprietary vendors or suppliers rather than generic methods? If proprietary systems are being proposed what are they and why are they being locked in or chosen?
3. What waste materials and volumes are likely to result from this program and projects operation? Specifically, address what filters and chemicals are going to be used? How will these filters be disposed of? How will used filters and the materials filtered out by the PURE toilet to tap operations be stored and disposed of? What volumes of materials are anticipated? Will this waste increase over the reasonably foreseeable life of the program and project? Are any of these materials classified as Hazardous or radioactive, by California or Federal standards?
4. What, if any, Homeland Security, Police, Fire or related costs will be required to build and operate the facilities proposed by this project or program? Would alternative approaches reduce these costs?;
5. Will all instructions and warnings for this program and project be posted in multiple local languages?
6. Has an emergency procedure manual and procedures been developed for the safety of operational and emergency personnel?
7. On the first day of operation will the proposed program or project fully conform to California and Federal permits? Will any continuing or new waivers of California or Federal law or regulations be required? Please additionally discuss whether the program or project will continue to use chloramine (SEE: http://tinyurl.com/h6cjtw2) and will regardless of the program or project selected will the City be in compliance with current orders to improve the disinfect ion of potable water? Is there any compliance to current orders or standards being held captive to this new approach? ;
8. Will the program or project, by the time of initial operation, have removed all water pipes and facilities containing asbestos. Where and how will any asbestos decommission by this program or project be disposed of? ;
9. The proposed project or program appears to require a new electrical transmission line. How much new power is required and how is it being generated? What is the resultant carbon load from this new project an? Are any carbon offsets being proposed? If the project was not operated how much carbon monoxide and related global warming pollutants would be avoided? Is this project scalable to mitigate and minimize impacts? ;
10. Has the City explored the reuse of the natural gas Rainbow pipeline 1600 to deliver recycled water South of the I-8 Freeway , In Council Districts 3, 4, 8, and 9 where the City has major parks, public facilities and landscaping; so as to reduce water demands? Specifically address the impacts on water demands if recycled water was used at the SD Airport, Balboa Park, SD Zoological, KELCO, Cholas Lake, and other Southern area major water using facilities , to reduce demand and thus the need for the project or a program at this scale. Would more purple pipe supply reduce demand? ;
11. Please analyze whether the rate increases, employment outcomes, and availability of recycled water, in the Southern area, adversely effects persons of color or low income ; so as not to advance Environmental Justice? ;
12. Please discuss and analyze whether the cost of filtering and/or processing of the waters from this program or project will increase the costs of health care, at dialysis or surgical centers, dental or other human care facilities; high technology manufacturing or research facilities; Specifically address how environmental justice is promoted if costs increase or economic costs limit health care, housing affordability, and employment opportunities? ; and
13. Please analyze the externalities that are generated by this program and project. This program and projects should not result in a transfer of costs to the general taxpayers. For example, a filter provider should not be able to provide us a filter that causes extra costs to dispose of it. They should be required to recycle all of that waste. In economics, an **externality** is the cost or benefit that affects a party who did not choose to incur that cost or benefit.[1] Economists often urge governments to adopt policies that "internalize" an externality, so that costs and benefits will affect mainly parties who choose to incur them. [2] [See: https://en.wikipedia.org/wiki/Externality]. I urge the staff planners to be more conscious of the trend towards externalities and suggest consideration of the SEEA Environmental Accounting document standards http://tinyurl.com/hdp6y94 .

I request written responses to my comments and inquiries. I request that my comments be published in the same size font as the response document is presented. I request timely notice of all future opportunities to comment and participate in any public hearings on these matters. These studies should be re-noticed by using both the annual Safe Drinking Water Report and the regular billings for Water, Storm Water, and Sewer. Please prevent even the appearance of ex parte communications consistent with local, State and Federal Law, as expressed in City Attorney Legal Opinion LO 90-2 (See: http://tinyurl.com/hyw7d76.) .

All the best,

/s/ **John W. Stump, San Diego resident, ratepayer, and taxpayer**

LOZEAU DRURY LLP
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richard@lozeaudrury.com

Via Email and U.S. Mail

August 25, 2016

Mark Brunette, Senior Planner
City of San Diego
Development Services Department
1222 First Avenue, MS 501
San Diego, CA 92101
dsdeas@sandiego.gov

Elizabeth Maland, City Clerk
City of San Diego
202 C. Street, Second Floor
San Diego, CA 92101
cityclerk@sandiego.gov

Keli Balo, Project Manager
City of San Diego
Public Utilities Department
525 B Street
San Diego, CA 92101
KBalo@sandiego.gov

Doug McPherson, Environmental Protection Specialist
Bureau of Reclamation, So. CA. Office,
27708 Jefferson Avenue, Suite 202
Temecula, CA 92590
dmcpherson@usbr.gov

Re: CEQA and Land Use Notice Request for the Pure Water Program, North City Project EIR/EIS 49962

Dear Mr. Brunette, Ms. Maland, Ms. Balo and Mr. McPherson:

I am writing on behalf of the Laborers International Union of North America, Local Union 89 and its members living in the City and County of San Diego ("LiUNA"), regarding the Pure Water Program, North City Project EIR/EIS 49962 (SCH 2016081016), including all actions related or referring to the expansion of the existing North City Water Reclamation Plant and construction of an adjacent North City Pure Water Facility with a purified water pipeline to Miramar or San Vicente Reservoirs , new pump station and forcemain to delivery additional wastewater to the North City Water Reclamation Plant, a brine discharge pipeline, and upgrades to the existing Metropolitan Biosolids Center. ("Project").

We hereby request that the City of San Diego ("City") send by electronic mail or U.S. Mail to our firm at the address below notice of any and all actions or hearings related to activities undertaken, authorized, approved, permitted, licensed, or certified by the City and any of its subdivisions, and/or supported, in whole or in part, through contracts, grants, subsidies, loans or other forms of assistance from the City, including, but not limited to the following:

- Notice of any public hearing in connection with the Project as required by California Planning and Zoning Law pursuant to Government Code Section 65091.

- Any and all notices prepared for the Project pursuant to the California Environmental Quality Act ("CEQA"), including, but not limited to:

  - Notices of any public hearing held pursuant to CEQA.
  - Notices of determination that an Environmental Impact Report ("EIR") is required for a project, prepared pursuant to Public Resources Code Section 21080.4.
  - Notices of any scoping meeting held pursuant to Public Resources Code Section 21083.9.
  - Notices of preparation of an EIR or a negative declaration for a project, prepared pursuant to Public Resources Code Section 21092.
  - Notices of availability of an EIR or a negative declaration for a project, prepared pursuant to Public Resources Code Section 21152 and Section 15087 of Title 14 of the California Code of Regulations.
  - Notices of approval and/or determination to carry out a project, prepared pursuant to Public Resources Code Section 21152 or any other provision of law.
  - Notices of approval or certification of any EIR or negative declaration, prepared pursuant to Public Resources Code Section 21152 or any other provision of law.
  - Notices of determination that a project is exempt from CEQA, prepared pursuant to Public Resources Code section 21152 or any other provision of law.
  - Notice of any Final EIR prepared pursuant to CEQA.

Please note that we are requesting notices of CEQA actions and notices of any public hearings to be held under any provision of Title 7 of the California Government Code governing California Planning and Zoning Law. **This request is filed pursuant to Public Resources Code Sections 21092.2 and 21167(f), and Government Code Section 65092**, which requires agencies to mail such notices to any person who has filed a written request for them with the clerk of the agency's governing body.

Please send notice by electronic mail or U.S. Mail to:

Richard Drury
Theresa Rettinghouse
Lozeau Drury LLP
410 12th Street, Suite 250
Oakland, CA 94607
510 836-4200
richard@lozeaudrury.com, theresa@lozeaudrury.com

Please call should you have any questions. Thank you for your attention to this matter.

Sincerely,

Theresa Rettinghouse

Theresa Rettinghouse
Paralegal
Lozeau | Drury LLP

Megan Lawson

From: Brunette, Mark <MBrunette@sandiego.gov>
Sent: Tuesday, September 6, 2016 8:25 AM
To: Balo, Keli; McPherson, Douglas; Megan Lawson; Shawn Shamlou
Cc: Lavan, Tiffany
Subject: FW: Pure Water Proposal Phase 1] Project 49961 EIR/EIS Scoping Comments -- Part 1 of 2

NOP comment letter part 1 from Scott Andrews.

From: Scott Andrews [mailto:scott300@earthlink.net]
Sent: Saturday, September 03, 2016 3:05 PM
To: DSD EAS
Cc: Scott Andrews; john McNab; davidkennedydds@gmail.com; shellifun@yahoo.com; dmitrovich@sbcglobal.net
Subject: Pure Water Proposal Phase 1] Project 49961 EIR/EIS Scoping Comments -- Part 1 of 2

To: Development Services Department, City of San Diego
Re: Pure Water Proposal Public Comments re North City Project [Phase 1] EIR/EIS No. 49961

September 3, 2016

Note: The Pure Water proposal has now been split into three phases, with each requiring a separate EIR/EIS, these in addition to the Programmatic EIR (PEIR).
The original unphased proposal is now listed as Alternative 1A, so we assume and request that all Save Everyone's Access (SEA) and Scott Andrews' prior verbal testimony and written comments still apply, and will be forwarded to each consultant team doing the multiple subsequent EIRs. To facilitate this process, I provided the City at the Phase 1 hearing a second hard copy of the stack of scientific studies we submitted for the PEIR. We request notice when the PEIR is available for review.

"The objective is not to simply to describe and document impacts, but to actively create and suggest mitigation measures or project alternatives that would avoid lor substantially reduce significant adverse environmental impacts."
Pg 13

ENVIRONMENTAL IMPACTS AND MULTIPLE MITIGATIONS TO REPAIR AND PROTECT THE PACIFIC OCEAN,
and IMPAIRED WATER BODIES MISSION BAY AND SAN DIEGO BAY
The Pure Water proposal (project) comes as the City of San Diego is operating it's Pt. Loma (and likely South Bay) sewage treatment and discharge facility[ies] under a third, unprecedented, and now lapsed five year waiver to the Clean Water Act (CWA).
The impacts from this 50 billion gallons per year of under treated discharge to the Pacific Ocean and its nursery bays would apparently continue forever under legal and scientific immunity under a proposal fatal flaw.
We request immediate clarification as to whether the City is negotiating with EPA or RWQCB a perpetual NPDES discharge permit waiver to the CWA.
CURRENT AND MISSING BASELINE DATA
Effective mitigation for San Diego, and the cross border region, depends on studies or discharger/regulator reportage of

baseline data re amounts of discharge, projections of population increases for San Diego and the equally-populated Tijuana, Mexico, direction of local offshore currents, known area NOAA reported marine life species declines and extinctions,
and data interpretation/analysis of trending annual outfall zone cumulative impacts.
Accurate and timely data collection can inform computer graphing projections which should be requisite for any $3.5 billion
proposal involving both human health and marine species' viability.

WAIVERS' IMPACTS

SEA demands the cumulative damage to the marine ecosystem under the City’s three waivers, as described in the prior waiver request’s Heal the Bay and NRDC scientists’ 2009 letter and the new Scripps’ oceanographic study be fully mitigated by the discharger City and regulator RWQCB.
This mitigation would be to divert project funds to install the full treatment to protect an ocean now subjected to:
global warming, acidification, eutraphication, and significant species declines due to overfishing, pollution, and uncontrolled disease epidemics from offshore aquaculture.

OCEAN, BAY MITIGATIONS

• Full mitigation is also demanded by an unprecedented three waivers, and if nearby City aquifers are in fact too contaminated for underground filtration like that employed in Orange County, some quantity of discharge could be deposited there, a method apparently used to close Florida offshore outfalls.
• Ocean discharge could also be mitigated by the City fully deploying a purple pipe system to increase sewage treated for
gray water use on freeway landscaping, golf courses, air conditioning. Reclaimed water might also be pumped to any
county aquifers deemed safe for the natural underground filtration that adds to protection of humans subjected to ingestion
of treated sewage, and as county wells are drying up due to a drought-induced sinking water table, any appropriate
aquifers are likely also increasing in volume capacities.
The above mitigations could mitigate the exposure of human and marine lives to sewage viruses, bacteria, chemicals, chloramines, phosphorus, household chemicals, pharmaceuticals, and estrogen mimics now discharged, and discharged
in raw sewage when the Pt. Loma plant is overrun by storm incidents. Is Point Loma adequate to current population levels? Adequate to SANDAG’s estimated one million more residents? What are population projects for the Tijuana, Baja California region?
If Pt. Loma is overwhelmed during rains, those unpermited releases raise the question of current and future plant capacity to handle another one million residents’ effluent.
What are accurate current, capacity, and anticipated discharge amounts from Pt. Loma and South Bay in both 2035 and 2050
under SANDAG projections?

DUAL BAY IMPACTS

The Pacific and two major regional bays, San Diego Bay and Mission Bay, are also impacted by the strong tidal surges,
which inject the bays with contaminated ocean water. SEA requests the City and regulators provide baseline fish,
invertebrate, and bird population studies for both bays so that significant environmental impacts, if any, can be analyzed.
Re the issue of current and continued discharge, do ocean discharge levels contribute to bay contaminants that currently
impose fishing advisories?

DUAL POLLUTION SOURCES — REGIONAL DOUBLE BENTHIC LOADING FROM U.S., MEXICO

Another major, and international environmental impact to address is Mexican sewage that travels on northern offshore currents from Rosarito Beach and Tijuana municipal sources. A third of the latter river plant's discharge is purportedly viral untreated
raw sewage. SEA requests the study include plant discharge gallonage from this international source.
As with the City of San Diego, it is time these cities' unfunded water pollution infrastructure be brought up to priority standard. These are the region's most significant sources of contamination. What are the population projections for the Tijuana, Baja California region?

HUMAN EXPOSURE IMPACTS OF RECYCLED SEWAGE

Sewage recycling, unlike desalination, is a much newer and unproven technology, very limited in use, so follow up human health and disease studies and data collections should be provided or ordered in the PEIR and project phase EIRs for review.

CUMULATIVE IMPACTS OF SEWAGE DISCHARGE ON MARINE LIFE

San Diego's ecosystem has been exposed to over 15 years of under treated sewage discharge, documented by the aforementioned damage to outfall zone marine life in the aforementioned Heal the Bay and NRDC review. Does City
reportage include levels of plant contaminants such as heavy metals, and, if so, is there evidence of cumulative intake over time?

NEW TECHNOLOGICAL ALTERNATIVES

San Diego's sewage disposal issue is international, and the study should access international advances in treatment
technology, new natural additives, and disposing methodologies.

NATURAL, NON CHEMICAL UNDERGROUND STORAGE FILTRATION ALTERNATIVE

Project proponents cite and promote as a model the Orange County, California sewage "toilet-to-tap" operation. SEA understands that facility employs the natural underground filtration the San Diego project lacks. What is the state and
condition of San Diego regional aquifers?

PROJECT RESERVOIR SWITCH

An August/September 2016 Union Tribune article quoted a project spokesman that because the new, closer Lake Miramar repository is smaller than original project's San Vicente Reservoir, more treatment chemicals "will be needed" and will
apparently completely absorb any cost savings in the reservoir switch.
What are holding capacities and anticipated holding times of sites? Do either contain of serve wildlife or recreation? Please identify and quantify the treatment chemical, and the additional required to treat at Miramar. What are the pipe-to-tap chemicals? Provide studies re the human and pet health of mixing of new fluoridation additives with City reservoir project product treatment chemicals.

PROJECT SECURITY ANALYSIS

Stream-fed and pipe-served open bodies of water are of course subject to sabotage exposure that closed systems like a
desalination plant are not. These exposures demand cost, feasibility, and proficiency review.

From:	Brunette, Mark
To:	Balo, Keli; McPherson, Douglas; Megan Lawson; Shawn Shamlou
Cc:	Lavan, Tiffany
Subject:	FW: Part 2 of 2 Pure Water Proposal [Phase 1] Project 49961 EIR/EIS Scoping Comments
Date:	Tuesday, September 6, 2016 8:27:17 AM

NOP comment letter from Scott Andrews part 2.

From: Scott Andrews [mailto:scott300@earthlink.net]
Sent: Sunday, September 04, 2016 1:07 PM
To: DSD EAS
Cc: Scott Andrews; john McNab; davidkennedydds@gmail.com; shellifun@yahoo.com; dmitrovich@sbcglobal.net
Subject: Part 2 of 2 Pure Water Proposal [Phase 1] Project 49961 EIR/EIS Scoping Comments

To: Development Services Department, City of San Diego
Re: Pure Water Proposal Public Comments The North City Project [Phase 1] EIR/EIS No. 49961

September 4, 2016

[SEA comment letter Part 2 of 2]

LEGAL COMPLIANCE ALTERNATIVE
By any measure, the Pacific's marine ecosystem is declining. The City of San Diego, however, delaying CWA compliance
over three successive EPA waivers, has now demonstrated its intention to avoid compliance with Clean Water Act standards
for sewage discharge to the Pacific Ocean and area bays.
The City now apparently wants to provide new water for development while cementing the waiver, claiming a Pt. Loma plant upgrade would be expensive, and impossible due to space limitations.
The Heal the Bay and NRDC 2009 waiver opposition letter re extensive Pt. Loma outfall marine life harm is dramatic, and six additional years of cumulative impacts require a comprehensive and independent study of the area that employs baseline fish and invertebrate population counts and annual heavy metals tracking under an ocean impacts review.
The last few years have seen the death of a famous San Diego surfer due to viral exposure, and sea star die-offs that echo NOAA-cited forage species' declines.
WAIVER EXCEEDENCES' CUMULATIVE MARINE LIFE DAMAGE
MITIGATION: IMPROVING HUMAN HEALTH
BY IMPROVING EXISTENT CITY WATER QUALITY & MARINE LIFE PROTECTION VIA PT. LOMA UPGRADE
The City Development Services Department NOP fails to note that Pt. Loma expansion can be sited up pipe a bit off the water, like all the new plants in its Pure Water proposal.
The City estimate to upgrade Pt. Loma has doubled to $2B, still well below its proposal's $3.5B estimate.
Re human health impacts, proposal maps show city residents and pets are exposed to concentrated municipal and industrial contaminants at "the end of the pipe", the Colorado River, which calls to question the real ability to purify the City's existing drinking water at present.
The science shows that numerous contaminants are not tested for, or do not have health impact or Maximum Daily Load (MDL) standards set by federal or state regulators. and therefore go

untested for and untreated prior to consumption. The funding of improved treatment of the City’s current drinking water supply merits study as mitigation for past exposure.

DESCAPING ALTERNATIVE

Drought resistant planting and descaping, initially state-subsidized, have reduced water use, and merit study as to the extent of water savings.

CONSERVATION ALTERNATIVE

Drought-driven and governor-ordered statewide conservation, has successfully resulted in a San Diego savings of a significant twenty percent [20%]. Reduced water usage upstate makes more canal supply available here.

DESALINATION ALTERNATIVE

Numerous Southern California cities, Camp Pendleton federal property, and Rosarito Beach, Mexico are in the process of
installing new desalination plants, the Coastal Commission have declared policy to mitigate issues raised by sea water intakes
and briny discharge. Cities to the north will draw less canal water as plants go on line, which makes more canal water theoretically available for San Diego.

PROJECT REDUNDANCY TO STATED ALTERNATIVES

Quantify measures listed that have already increased City supply to date.
What are the established and proposed desalination plants in California and northern Baja, Mexico?
What are their projected drinking water production figures? Will this new privately-financed supply in toto not dwarf
Pure Water’s 83MGD?

PROJECT GROWTH INDUCEMENT

The City Development Services Department NOP does not mention SANDAG’s projected population increase of one million residents. A project consultant admitted that this increase over time would negate any temporary discharge drop due to
project installation, so EIR/EIS study of cumulative impacts of today’s annual 50BGYr level of under treated ocean sewage
discharge, as well as a likely unmitigated projected population and discharge increase for northern Baja, Mexico, is justified.

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U-T

More drinking water for San Diego

By David Schubert

September 12, 2008

Like many communities throughout the world, San Diego has a drinking problem. However, rather than intoxicating alcohol, the problem is toxic pharmaceuticals and consumer goods such as cosmetics that make their way into our drinking water supply from homes, hospitals, businesses and farms.

They primarily pass through sewage (wastewater) systems with only partial removal. The treated wastewater is released into rivers and lakes and ends up in downstream water supplies, like San Diego's. While the concentrations of individual toxins in drinking water is often quite low, there is growing evidence that the amounts are sufficient to cause reproductive problems in aquatic animals and to lead to antibiotic resistance in pathogenic bacteria.

Although scientists and government health agencies have known about this problem for nearly 20 years, little has been done in the United States to stem the flow of these toxins into the environment. It seems to have taken a recent, widely publicized investigation by the Associated Press to raise public concern.

The appearance of pharmaceuticals in rivers, lakes and streams was first reported in Europe in the early 1990s. It was initially believed that these chemicals came exclusively from manufacturing facilities, and indeed some of them did. However, further investigation showed that the majority came from the effluents of community wastewater treatment plants.

Using standard treatment regimes, most of the toxins entering treatment plants are released into the environment in the treated wastewater. The geology of Europe makes the water circulation there more of a closed system than in most other parts of the world.

In some cases, half of the volume of a river is from treated wastewater. Since it is difficult to remove toxins during the subsequent preparation of municipal drinking water, there has been an intense effort in Europe to improve the sewage treatment facilities such that most of the toxins are removed before discharge.

This has not happened in the United States. With a growing population, greater water reuse along the rivers that supply our drinking water, and an overall decrease in the volume of our water supplies, there has been a significant increase in concentrations of toxins in many of our waterways, ground waters and in the drinking water of San Diego.

How can this trend be reversed to eliminate a very real threat to public health? San Diego receives most of its water from the Sacramento River Delta area near San Francisco and from the Colorado River.

Water flowing through the Delta includes agricultural runoff (chemicals and pesticides) and municipal wastewater discharges from cities such as Sacramento. Colorado River water has passed through multiple cities, including Las Vegas, which draws its water from Lake Mead and then discharges reclaimed water back into the lake, which flows into the Colorado River for our downstream consumption.

The best way to reduce the toxin problem along these waterways, as well as at the national level, is to follow the example of Europe and try to remove 80 percent to 90 percent of the toxins at the wastewater treatment facilities. This approach requires a longer retention time in the biological treatment step used by wastewater treatment plants to allow for the degradation of toxins by microbes and oxidation. It also places an additional cost on the operation of these plants, but this is a cost that society should be willing to pay.

However, the only truly effective way of removing the vast majority of the these toxins from our drinking water supply is via the technology currently being proposed for San Diego's poorly named "toilet-to-tap" program. The toilet-to-tap program was created because it is imperative that San Diego find other sources of water besides the Sacramento River Delta and the Colorado River.

The Delta water supply is subject to elimination by an earthquake or a judicial cutback due to a threatened species such as the Delta smelt. Some have estimated that at the current rate of consumption Lake Mead will be dry by 2021, and the water transport system from the Colorado River to San Diego is also subject to earthquake damage.

Since local groundwater supplies are few and of limited volume, alternative water sources for San Diego are very limited. These include seawater desalination, planned for Carlsbad, and reclaimed water, which is taken from treated wastewater.

Reclaimed water is already used in San Diego for landscape watering. This water is heavily chlorinated, so if the reclamation plant is functioning properly, there is minimal risk of infection. But it does contain significant levels of toxins and other contaminants.

For the toilet-to-tap project, this reclaimed water would be taken through three additional purification steps: micro-filtration and reverse osmosis, followed by exposure to a strong oxidant or high intensity ultraviolet light. These extra steps reduce the toxins to undetectable levels, creating essentially pure water. It is so pure that it cannot be used for agriculture unless minerals are added back into it, for example by diluting it into imported water in the San Vicente reservoir.

The purification procedures for the proposed San Diego drinking water program are already being used to recharge the drinking water aquifers under Orange County with advanced treated reclaimed sewage water. Singapore has installed a similar recycling system, called NEWater, so that it is not dependent upon Malaysia for its water supply.

For San Diego to become less dependent upon imported water, it is mandatory that it creates other sources. The production of ultrapure water from our wastewater facilities is a step in this direction, and it should be supported along with conservation and seawater desalination. Perhaps only through these measures will we be able to continue to enjoy a healthy life in a coastal desert.

▪ Schubert is a professor at the Salk Institute for Biological Studies in La Jolla.

»Next Story»

List of Documents Provided
NRDC Heal the Bay letter to EPA Opposing NPDES Permit N301(h) waiver for Pt. Loma WWTP, Jan 28, 2009.
CCC Federal Consistency Certification, City of San Diego, Secondary Treatment Waiver,Oct 7, 2009.
-Heal the Bay/NRDC Comment Letter, Oct 2 2009
West Coast Ocean Acidification and Hypoxia Science Panel, April 2016.
Ocean Outfall Study, Final Report, Department of Environmental Engineering Sciences for Florida Dept. of Environmental Protection, April 2006.
"The Effects of Sewage on Aquatic Ecosystems", Cambell, Kirstin. Web article science.opposing views.com
Electrocoagulation Report, Removal of Metals, Micro Algae and Phosphates,
10th Annual International Cleaning Technology Exposition, Conference March 3-5, 2003.
Removal of 6 Estrogenic Endocrine -Disrupting Compounds (EDCs) from Municipal Wastewater using Alumininum Electrocoagulation
Letter USF, Bench Test Removals of pathogens and viruses using electrocoagulation, August 2010.
"More Drinking Water for San Diego" by David Schubert. San Diego Union Tribune, September 12, 2008.
"Tijuana River Sewage Raises Ocean Pollution Levels" by Aleksandra Konstantinovic, Dec 2014. City New Service.
California Ocean Wastewater Discharge, Report and Inventory, Prepared by Heal the Ocean, March 2010.
California Fish Populations are Declining, Scrippts Institute of Oceanography. October 29, 2015.
Leading Ocean Scientist Recommend Immediate, Coordinated Action Plan to Combat Changes to West Coast Seawater Chemistry. Scrippts Scientific Panel, April 6, 2016.
1988/89 Grand Jury Reports, Water for the City of San Diego.
Cooperative Agreement with CSD for Non-opposition to CWA 301(h) Waiver, Jan 29, 2009.
Marco Gonzalez, Coast Law Group, LLP for Surfrider, San Diego Chapter, and San Diego Coastkeeper.

Additional Electronic Documents

FAQS on Sewage Sludge/Biosolids Annual Reporting - 2014

http://www.waterencyclopedia.com/Po-Re/Pollution-of-the-Ocean-by-Sewage-Nutrients-and-Chemicals.html

https://www3.epa.gov/npdes/pubs/primer.pdf

https://www.epa.gov/npdes/municipal-wastewater

http://vtdigger.org/2015/12/08/state-secures-funds-for-sewage-plant-upgrades/

https://www.epa.gov/eg https://www.epa.gov/biosolids

http://noc.ac.uk/science-technology/seas-under-threat/marine-pollution/sewage

http://www.seaweb.org/resources/briefings/toxic.php

http://wwf.panda.org/about_our_earth/blue_planet/problems/pollution/

http://blog.nature.org/conservancy/2011/09/16/what-a-waste-why-human-sewage-is-laying-waste-to-coral-reefs-globally/

http://www.motherjones.com/politics/2006/03/marine-pollution-how-ocean-became-toxic-waste-dump

Pew: http://www.fws.gov/southeast/grants/pdf/oceans_summary.pdf

http://issues.org/21-1/safina-3/

GREAT One: http://www.iatp.org/files/Marine_Pollution_in_the_United_States.htm

http://library.cqpress.com/cqresearcher/document.php?id=cqrglobal2007100000

http://library.cqpress.com/cqresearcher/document.php?id=cqresrre2005110400

http://oceana.org/our-campaigns/stop_ocean_pollution/campaign

http://www.seashepherd.org/commentary-and-editorials/2015/04/03/the-dilemma-of-toxic-cultures-on-a-toxic-planet-698

ewg Environmental Working Group
http://www.ewg.org/research/water-treatment-contaminants

Water Board
http://www.swrcb.ca.gov/water_issues/programs/owts/docs/disinfection.pdf

Analysis

No mention of aquifer recharge, well injection, or other land based recycling options. After the mixing of recycled water, after a very long pumping ride from PLWWTP, with the two surface bodies of water, reservoirs (name). Eventually the salinity with be restored, why not supplement now with the systems we already have that are recycling.

A shorter pipe gallery would suffice to more local aquifers. In fact from the EPA guidance document, and the best examples cited by your study, the Orange County project, they are getting a 6 month retention time through the aquifer. An aquifer provides a much longer and a more cleansing voyage (retention time) via time honored natural features.

It is likely that this was not considered because of polluted aquifers, but this option was not considered at all. Injection wells, or even well augmentation. You have skipped over this option with miles of pipeline to the two reservoirs. A better and more diverse portfolio as was stated in the report will build resiliency into our whole watershed.

My confidence is much higher for this method rather than adding directly to a fresh body of water that may not respond well to tertiary (H_2O_2 and uv light) treated water. Anything less than that level of treatment would risk our health. While there are ways to measure retention time and mixing in an open body of water, my confidence increases with distance traversed through an aquifer, a time honored tradition of natural treatment.

Because of the lack of confidence of treated wastewater, you realize you only get one chance to get it wrong? If you miss a contaminant because of some process upset, it goes unchecked directly to a reservoir, rather than to a more resilient aquifer.

If recycled water has a few impurities, the worst it can do is kill a little grass, not the people.

Security, Safety and Testing

At some point, when testing recycled water for safety, you can only test for so many pollutants and pathogens, and then treat to remove them. Then hope that nature will scrub some out, and the next step of treatment before tap will get the rest.

It is reprehensible to even think this way, but what about the fringe person who realizes they can flush anything down the toilet and poison the water supply? What about pharmaceuticals, or household hazardous wastes that regularly get flushed down the toilet? By nature nano particulates are not captured by demonstrated technologies, and most packaging is not required by law to state to the consumer that it contains nano particulates.

The current utilities are engineered, secured, and closed to the general public. They are not likely targets for terrorist or fringe acts of destruction.

Where is the mention of adoption of treatment standards for pathogens in recycled ww effluent?

My other concern is the focus and vast expense of what is basically an institutionalized conservation measure, focusing our efforts on a dwindling and unreliable source of water. The aquifers and surface water that provide 80% of our potable water, are borrowed from water resources that are at roughly a third of their historical capacity, hence our efforts. However from the math presented, recycling gets back only about 25% of that, a typical number for these kinds of efforts.

No other conservation methods are mentioned. Our population is getting dense enough that small communities of HOA's can be retrofitted or new ones built only with the caveat of recycled water systems intrinsic to the property. It is the vertical densities that are causing the growth and demand on our water supply. Not to mention the current trend of building Manhattan along our waterfront.

Capture of Stormwater

The best effort I have seen for capture and cleaning of stormwater is Los Angeles. They have created holding ponds that they have turned into water features and constantly reach out to the community to protect this important resource. Surface impoundments or parks, you can't tell the difference up there, and their program is reproducible and successful. We have the real estate to copy this effort, it's called Balboa Park. Flood a section of the park as opposed to the Mission Valley basin.

http://www.lastormwater.org/

Fix Your Leaks

In order to get the most out of the older infrastructure, use current technology such as infrared cameras to locate and fix large leaks. With the kind of pipe ages noted, leak testing and fixes will help increase our efficiencies.

Desalination

Recently, 50 mgd just came on line in Carlsbad, already half of what is expected from recycling, another plant is coming online in Rosarita, Mexico. Considering that we take the last remaining drop of water from the riverbed, I would think they would trade us some desal water for some simple sewer technology. Any master plan that involves basic resources such as water and sewerage should involve Tijuana as part of the scope. We share the same ocean corridor with all its wildlife, and pollution alike. We can't afford to point fingers or be the water villain, this relationship is too important.

Camp Pendelton is also planning to build a desal plant, get in there a get us a slice of that.

Despite the fact that the Point Loma effluent pipe was lengthened, and spills greatly reduced, we are still experiencing blowback via our own discharges coupled with that of Tijuana by way of the North --- current.

Santa Barbara Desalination plant is coming back on-line, and they spent about $1 billion. Poseiden was built without any capital output, just an agreement for fees. What are you waiting for? Spend a billion and stop polluting with our sewage.

Go ahead and recycle from Point Loma but just do one simple pipeline to the farmers, and hand it off at the county line, or send it to Mexico. The Rio Grande will be great again.

The source water for this option is basically limitless and getting larger via freshwater melt from the various ice shelfs in the world, via global warming and sea rise. Currently we are at 8", while the west Greenland ice shelf is losing 5 billion tons per year. The whole ice shelf would raise sea levels 18" on its own, not accounting for any other ice sheet. Water, water, everywhere and not a drop to drink.

Don't forget that your original purpose was to provide potable water to the people in a reliable way. This project does a great job of recycling but does not appear to be cost effective nor does it fill the bill since the sourcing will certainly dwindle as global warming progresses.

My concern is that after expending $3.5B that you be sued for malfeasance, since this is all for creating potable water from a dwindling source. If the drought continues, toilet to tap is useless, as the source water continues to reduce.

Global warming has come home to roost.

This technology is reliable, practiced worldwide and hence a large community of consultants to field problems, and the potable water is very clean as a result of the filtration method. The effects of the brine return from local desalination plants is often offset by mixing with effluent from the wastewater treatment plants. This mixing is best done without adding the polluted solids from the treatment process. ASCE Journal reference.

With good stewardship concentrated saline augmented with some recycled water, and two more desalination plants, we suffer no ill will from what seems to be our permanent drought conditions.

Permanent Drought Measures by Household

Tax breaks for household reductions.

Against NPDES Permit Waiver

It is beyond my comprehension that you are proposing a permit waiver for sewage discharge to the ocean. Even tertiary treatment is harmful to ocean ecosystems. At some point the discharge waters from Point Loma have to be treated to tertiary or better before being recycled back into the environment. Why not start now with simple technologies?

At this point in the project, approaching $ 4 billion, the elimination of the outfall to the ocean is entirely possible. Treatment and removal of solids, and either high heat, or electrocoagulation along with the current cogeneration will eliminate the need to throw away valuable compost material that could be stored at the landfill and used by the public for landscaping.

The MagnaGas option in part or in full will bake the solids, sanitize the liquids, and produce a clean gas that can be burned to feed the grid. Again net zero carbon, balancing out the trips to the landfill in trucks instead of the pipeline that the slurry of solids make to the landfill currently. I recently learned that Magnegas now has a municipal wastewater treatment plant functioning in Italy.

I am not convinced that expansions and hence higher levels of treatment, tertiary even, of the Point Loma treatment plant cannot be accomplished because of space constraints. There are other technologies that can be easily put in place to accomplish this task, without addition of yet stronger chemicals.

There is no guarantee of the destruction of other pathogens, such as viral, antibiotic resistant bacterias, not to mention the endocrine disruptors, and nano particulate matter. Mere chemical treatment does not guarantee sanitization of these vectors. Alternate and efficient technologies can, such as Powell Electrocoagulation, a report summary attached. Note the letter from the College of Marine Science, stating the removal of common viruses and bacteria to undetectable levels.

GHS's

While the plan does do some cursory mathematics for the GHG impact of the projects based on current requirements, there is no mention of offsets if a certain threshold is reached if these calculations are found to be in error once the project commences. Since the calculations indicated the project would actually come in far under the threshold, no other carbon emission offsets were considered. Since we are on the edge of a vast marine environment, kelp supplementation is low hanging fruit as an offset for carbon emissions.

Growing and maintaining a kelp bed for carbon sequestration on behalf of ourselves and the planet cannot be done as effectively if we are still poisoning that environment with untreated or poorly treated sewage.

Also, using oil converting algaes for wastewater treatment was not addressed. what is left behind is an oil laden algae that can be easily extracted to capture the oil and the husks safely composted. Burning of the oil is then net zero carbon emission. This oil can also be sold to our military who are already using this technology in their operations.

At a minimum, having some sort of active program to offset our cities carbon footprint because of the clogged freeways, is in order. A simple process of algae growth as in

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Reference and Abstract: Carbon **Edited by Rao Y. Surampalli, Tian C. Zhang, R. D. Tyagi, Ravi Naidu, B. R. Gurjar, C. S. P. Ojha, Song Yan, Satinder K. Brar, Anushuya** Stock No. 47891 / ISBN: 9780784478912

Reference and Abstract: Carbon Capture and Storage, **Edited by Rao Y. Surampalli, Tian C. Zhang, R. D. Tyagi, Ravi Naidu, B. R. Gurjar, C. S. P. Ojha, Song Yan, Satinder K. Brar, Anushuya**

Sponsored by the Carbon Capture and Storage Task Committee of the Technical Committee on Hazardous, Toxic, and Radioactive Waste Engineering of the Environmental Council of the Environmental and Water Resources Institute of ASCE

Carbon Capture and Storage: Physical, Chemical, and Biological Methods presents comprehensive information on the principles of carbon capture and sequestration (CCS). Among the various climate change mitigation strategies currently being explored, CCS technology allows for the continuous use of fossil fuels and provides time to make a changeover to other energy sources in a systematic way. Many factors decide CCS applicability worldwide, such as technical development, overall potential, flow and shift of the technology to developing countries and their capability to apply the technology, regulatory aspects, environmental concerns, public perception, and costs.

This book provides in-depth information on the principles of CCS technology, different environmental applications, recent advances, critical analysis of new CCS methods and processes, and directions toward future research and development of CCS technology.

Topics include:

- carbon dioxide sequestration and leakage
- monitoring, verification, and accounting of carbon dioxide in different settings
- carbon reuses for a sustainable future
- applications of CCS for the coal-powered electricity industry
- carbon dioxide scrubbing processes and applications
- carbon sequestration via mineral carbonation
- carbon burial and enhanced soil carbon trapping
- algae-based carbon capture
- carbon immobilization enhanced by photosynthesis
- enzymatic sequestration and biochar technology for CCS

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- carbon sequestration in the ocean
- modeling of carbon dioxide storage in deep geological formations

Engineers, scientists, students, government officers, process managers, and practicing professionals will find this book an essential reference on carbon capture and sequestration technology.

I have attached 4 documents that are herein incorporated as part of my comments by reference. These attachments are a History of San Diego Water; The 2015 budget of the Public Utilities Department; City Attorney Opinion restricting Council discussion of CEQA matters; and Section 215 of the SD City Charter on Public record etc.

NRDC
THE EARTH'S BEST DEFENSE

Heal the Bay

January 28, 2009

U.S. Environmental Protection Agency Region IX, WTR-5
75 Hawthorne Street
San Francisco, CA 94105-3901
Attn: Robyn Stuber
stuber.robyn@epa.gov

Re: NPDES Permit and 301(h) Waiver for Point Loma Wastewater Treatment Plant (NPDES Permit No. CA0107409, Tentative Order No. R9-2009-0001)

Dear Ms. Stuber,

We are writing to oppose the reissuance of a waiver of Clean Water Act standards for the E.W. Blom Point Loma Metropolitan Wastewater Treatment Plant and Ocean Outfall ("Plant" or "PLOO"). The Plant is one of the largest sewage treatment plants in California, dumping about 200 million gallons of wastewater into the Pacific Ocean every day. Despite the fact that publicly owned treatment works ("POTW") were required to upgrade to secondary treatment standards over 30 years ago, the Plant continues to operate under a waiver from these federal standards. In fact, the Plant is the *only* POTW in California with a waiver that is not in the process of upgrading to secondary treatment. As a policy matter, continuing to treat our oceans as a dumping ground for minimally-treated sewage is unjustified and unacceptable. As a legal matter, the Plant has failed to meet its burden of proof to obtain another 301(h) waiver under the Clean Water Act; EPA and the San Diego Regional Water Quality Control Board's tentative decision granting the waiver is thus unsupported by evidence.

Applicable Legal Standards

To be eligible to receive a 301(h) waiver, the applicant must demonstrate that it can meet the "environmentally stringent criteria" under the Clean Water Act.[1] In conjunction with nine criteria enumerated under section 301(h), the applicant must demonstrate that it complies with Clean Water Act standards for total suspended solids, biochemical oxygen demand, and pH. Additionally, the Clean Water Act requires that discharge under a 301(h) waiver not conflict with other applicable federal laws.[2] The state water quality requirements with which the

[1] *In re Mayaguez Regional Sewage Treatment Plant Puerto Rico Aqueduct and Sewer Authority*, 4 E.A.D. 772 (1993); 33 U.S.C. § 1311(h).

[2] 40 C.F.R. § 125.59(b)(3).

applicant must show compliance are the requirements in the California Water Code, the California Ocean Plan, and the Basin Plan.[3] These requirements center on the protection and restoration of beneficial uses, and include limitations on bacteria and other pollutants that are harmful to human health and the coastal marine environment.[4] The stringent nature of these requirements means the applicant carries a heavy burden of proof.

In deciding whether to grant another 301(h) waiver, one of the chief obligations of the Regional Board and EPA is to make clear how the agencies arrived at their conclusion by presenting in a written determination a thorough analysis of the evidence and the applicable legal factors or standards.[5] Decisions must "connect the dots" and explain the rationale used by the agencies in reaching conclusions.

Monitoring Program

Failure to demonstrate compliance with any one of the 301(h) criteria precludes issuance of a waiver. One of the criteria is the establishment of a monitoring program pursuant to 40 C.F.R. § 125.63. The monitoring program in general must be "designed to provide data to evaluate the impact of the modified discharge on the marine biota, demonstrate compliance with applicable water quality standards or water quality criteria . . . and measure toxic substances in the discharge . . . ."[6] More specifically, the monitoring program must be designed to demonstrate compliance with 40 C.F.R § 125.62, including that:

- The applicant's outfall and diffuser are "located and designed to provide adequate initial dilution, dispersion, and transport of wastewater such that the discharge does not exceed at and beyond the zone of initial dilution . . . all applicable water quality standards."[7]
- The discharge must allow for "the attainment or maintenance of water quality which assures protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife."[8]

At least three reports demonstrate that, among other deficiencies, the Plant's monitoring program is inadequate and therefore the Plant is unable to assure compliance with water quality standards, the protection and propagation of a balanced indigenous population, or compliance

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[3] *See* State Water Board WDR Order No. 98-15, at 3.

[4] *See id.* at 2-9.

[5] *See, e.g., Topanga Ass'n for a Scenic Community v. County of Los Angeles*, 11 Cal. 3d 506, 515 (1974).

[6] 40 C.F.R. § 125.63(a)(i)(A).

[7] 40 C.F.R. § 125.62(a)(1)(i).

[8] 40 C.F.R. § 125.63(c).

with the Ocean Plan. Moreover, it does not appear that EPA included these reports in its tentative decision analysis, despite the reports' clear relevance.[9]

Scripps Institute of Oceanography Report (2004)

After being hired by the City of San Diego to assess the adequacy of the Plant's monitoring program, Scripps Institute of Oceanography released its findings in 2004. Among other findings, Scripps bluntly concluded, "We don't know where the water goes, or where the plume goes."[10] Scripps described a number of other inadequacies in the Plant's monitoring program:

- "The City does not adequately monitor or understand the physical circulation of the coastal waters relevant to the Point Loma Ocean Outfall in terms of spatial and temporal variability and synoptic patterns (e.g., seasonal variability or in response to episodic events), or the geographic extent of the 'receiving waters.'"

- "The location, movement, and dispersal of the plume from the outfall is also inadequately monitored and understood."

- "Because of the lack of knowledge of the plume's location, its impact on the planktonic community is unclear. The spatial and temporal resolution, and the types of measurements currently made are inadequate to quantify the effects of chronic nutrient loading on the plankton relative to natural nutrient sources and other anthropogenic sources."

- "Understanding the impact of the outfall on the benthic environment requires modification of the existing monitoring program, primarily to provide more appropriate control stations. Currently the control sites, because they are substantially different in the character of their sediments from the other monitoring sites, and because they may be contaminated from sources other than Point Loma, do not provide a basis for evaluating benthic impacts with confidence."

- "Present monitoring does not include integration of littoral transport cells. Therefore, it is possible that contaminated sediments are accumulating downslope from the shelf, and because this area is not monitored, there is presently no way to know if the effects of the PLOO or other sources of contaminants are accumulating in these areas."[11]

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9 EPA, Tentative Decision of the Regional Administrator (Dec. 2, 2008), at 95-97.

10 Scripps Institute of Oceanography, "Point Loma Outfall Project" (Sep. 2004), at 26.

11 Scripps Institute of Oceanography, "Point Loma Outfall Project" (Sep. 2004), at 3.

Further, the report states that in 2004 the City was considering an increase in the Plant's daily discharge from 175 mgd to the Plant's full capacity of 240 mgd. In response, Scripps stated, "A major conclusion of this review is that *there is currently insufficient information to determine how the projected increase in the discharge at Point Loma would affect water quality*. . . ."[12] Although it does not appear that the Plant made changes to its monitoring program in light of Scripps' findings,[13] the Plant has in fact increased its daily discharge to 208 mgd for 2009, and is projected to further increase to 219 mgd for 2014.[14] It follows that the Plant's monitoring program is inadequate to determine how this current and projected increased discharge affects water quality.

Assessment of Water Conditions at Cabrillo National Monument (2006)

Just to the south of the Plant lies the Cabrillo National Monument, part of the National Park Service ("Cabrillo"). In 2006, scientists at the Marine Science Institute at the University of California, Santa Barbara and the Bodega Marina Laboratory released a study of the water quality conditions at Point Loma for the National Park Service's Water Resources Division.[15] Like the Scripps report, this report discusses the problems that arise from insufficient information about the effluent plume:

> This raises the possibility that the PLOO contributes to background concentrations of these constituents in the coastal ocean (i.e., farfield effects). Four of the analytes detected (copper, silver, cyanide and ammonia) were concentrated enough on average in effluent during 2004 to exceed EPA daily maxima or acute exposure criteria for marine life. Although the circumstances that could result in cross-shore transport of the PLOO effluent plume all the way to [Cabrillo] have not been described, it is possible that exposure to poorly diluted effluent could harm some biota. Such an exposure occurred in 1992 at [Cabrillo] when the outfall pipe was ruptured near shore. . . . [We] do not know if the PLOO can be reasonably ruled out as a source of these pollutants in the ocean near [Cabrillo]."[16]

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[12] *Id.* at 26 (emphasis original).

[13] See Application for Renewal of NPDES CA0107409 and 301(h) Modified Secondary Treatment Requirements, Point Loma Ocean Outfall, at I-1. The Plant made changes to its monitoring program in 2003 according to a SCCWRP study but there is no indication that they made changes after the Scripps' report in 2004.

[14] EPA Tentative Decision, at 17.

[15] Engle, D. and Largier, J., "Assessment of Coastal Water Resources and Watershed Conditions at Cabrillo National Monument, California" (Aug. 2006).

[16] *Id.* at 141.

University of California, San Diego Report (2007)

The City of San Diego also requested a scientific review of the impact of the Plant by the Environment and Sustainability Initiative at the University of California, San Diego. The report, which was released in 2007, did not conduct new research, but rather reviewed existing analyses and reports as requested by the City. Like in the 2004 report, the 2007 report found that the Plant's monitoring program was insufficient to track the effluent plume:

- "[T]he complexity of the oceanographic conditions in the Point Loma area demands more observations before any conclusions can be made about the transport of the plume."[17]

- "The physical oceanographic data at present is inadequate to predict with certainty either the location or the dilution rate of the plume."[18]

This report also noted that PCB levels in rockfish caught close to the outfall were "significantly higher" than PCB levels in fish north of the outfall. This may indicate an absence of a balanced indigenous population in the vicinity of the outfall. Yet due to the inadequacies of the monitoring program, there "currently is no way to know definitively whether the elevated levels" were due to the Plant or another source.[19]

Conclusion

This is not meant to be an exhaustive analysis of the Plant's application. Rather, these three reports demonstrate that in at least one of the criteria to obtain a waiver, the Plant has failed to meet its burden of proof—the monitoring program fails to assure compliance with water quality standards, the protection and propagation of a balanced indigenous population, or compliance with the Ocean Plan. For example, the Plant cannot demonstrate compliance with the Ocean Plan, which forbids the discharge of any waste into Areas of Special Biological Significance, because the Plant cannot meet its burden of showing that the plume does not enter either of the two Areas of Special Biological Significance that lie to the north of the Plant. Similarly, EPA and the Regional Board cannot conclude that the discharge meets water quality standards that allow for recreational use, because the Plant cannot meet its burden of showing that the effluent plume does not flow towards the shore and pose a potential health risk to the public. These are merely a few examples of how the Plant cannot meet its heavy burden to qualify for a waiver, because it lacks information needed to track the Plant's discharge.

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[17] Environment and Sustainability Initiative, University of California, San Diego, "Final Report: Point Loma Outfall Review" (Oct. 1, 2007), at 4.

[18] *Id.* at 16.

[19] *Id.* at 9.

Next Tuesday, the State Water Resources Control Board will pass a comprehensive policy to increase water recycling statewide to combat California's increasing water scarcity due to climate change, growth, and recent water rights court decisions. The use of water recycling has never been more important to augment local water supplies and to move California to sustainable water management.

San Diego's neighbors to the north have redoubled their water recycling efforts—Orange County Water District and West Basin Municipal Water District produce nearly 100 mgd of recycled wastewater, and recently the LA County Sanitation Districts agreed to a long term goal in the recently updated Santa Monica Bay Restoration Plan of over 200 mgd from their secondary treatment plant in Carson. Meanwhile, Point Loma continues to operate at primary treatment and San Diego continues to have a poor record on water recycling.

The Point Loma Plant needs to upgrade to full secondary treatment to create water recycling opportunities in San Diego. The region has aggressively moved forward on a controversial desalination plant in Carlsbad with considerable environmental impacts and extensive financial and energy costs, so clearly San Diego has already expressed an interest in finding new, reliable sources of local water. Upgrading the Plant is the smart way for San Diego to create this reliable source of local water.

Sincerely,

Michelle Mehta
Attorney, Water Program
Natural Resources Defense Council

David Beckman
Senior Attorney and Co-Director, Water Program
Natural Resources Defense Council

Mark Gold
President
Heal the Bay

cc: California Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4353
Attn: Melissa Valdovinos
mvaldovinos@waterboards.ca.gov

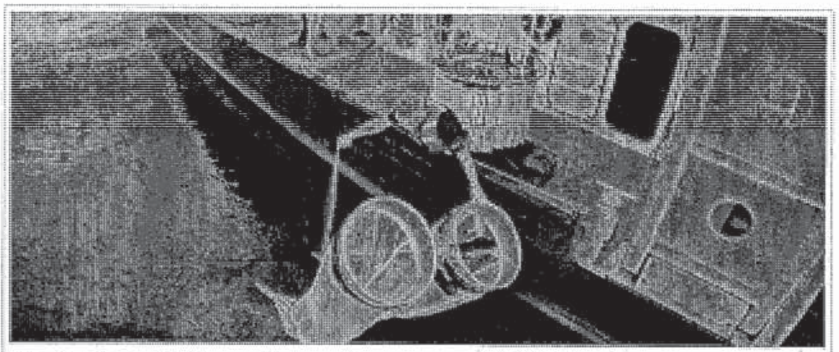
California's Fish Populations Are Declining

Two independent data sets show changing ocean conditions adversely impact fish off California

Oct 29, 2015

Media Contact: (http://scripps.ucsd.edu/news/contact-us) Mario Aguilera |

Phone: 858-534-3624 | Email: scrippsnews@ucsd.edu (mailto:scrippsnews@ucsd.edu)



Credit: James Wilkinson/Scripps Oceanography CalCOFI.

The California Current is home to many marine animals, including marine fishes, which are the most diverse vertebrates on Earth and critical to marine ecology. Two independent long-term time series now reveal strikingly similar trends of wide-ranging declines in fish populations in the California Current.

Tony Koslow and John McGowan, researchers from Scripps Institution of Oceanography at UC San Diego, and Eric Miller of MBC Applied Environmental Sciences of Costa Mesa, compared two independently collected data sets from the California Cooperative Oceanic Fisheries Investigations (CalCOFI) (http://www.calcofi.org/) and power plant cooling water intakes (PPI) from five sites along the California coastline.

The data show that fish abundance from both studies has declined sharply since 1970, with a 72 percent decline in overall larval fish abundance in the CalCOFI data set and a 78 percent decline in fishes from the PPI sampling. Although there was limited overlap in species between the nearshore PPI samples and the more offshore CalCOFI sampling, the correlation between the two time series was about 0.85. The study was published (http://www.int-res.com/abstracts/meps/v538/p221-227/) in

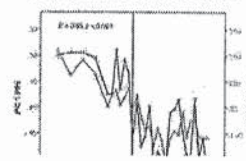
Videos

CalCOFI 15...

Climate th...

Image Galleries

California Fish Decline



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"It is notable that these two very distinct data sets tell us that the larval fish populations collected by CalCOFI and near shore fish species observed by PPI data are both declining at nearly the same rates," said Scripps researcher John McGowan.

CalCOFI was formed 70 years ago. Originally designed to study the ecology of the west coast sardine population, the ongoing CalCOFI surveys of the physical and biological oceanography and fisheries off California is today the longest-serving multi-disciplinary ocean observation program in the world. CalCOFI is a unique partnership led by Scripps Oceanography, NOAA Fisheries Service, and the California Department of Fish & Wildlife.

"The similarity in trends between the two data sets is amazing given the differences in life history strategies monitored by the two programs. While the CalCOFI program samples larval fish, several of the species integral to the PPI data set were surfperch, fishes that do not have a larval stage," said Eric Miller of MBC.

These results also dispel previous speculation that commercial fishing or seawater intakes are always primary causes of fish population declines. The PPI data do not include many commercial fish species but do include species with no larval stage that could not be captured during CalCOFI surveys. The CalCOFI time series shows a decline in both commercial and non-commercial fish species. These facts point to a more basal cross-cutting factor, or factors, forcing the observed changes in fish populations.

"The CalCOFI data were originally used to track sardines and now track the larval abundance of a broad range of fish species in the California Current system. Larval fish abundance is a strong indicator of adult fish populations, and the regular CalCOFI sampling indicates decreased abundance primarily for cool-water species," said Koslow, a Scripps researcher and first author of the paper.

The study concludes that changes in the California Current ecosystem are the likely cause of this decline in fish abundance. Overall, fishes with an affinity for cool-water conditions, such as northern anchovy, Pacific hake, and several rockfish and midwater fish species are among the most abundant in the ecosystem. Over the thirty-year period, these have declined most dramatically off southern California. However, whether this is due to a movement of cool-water species northward or an overall decline throughout the California Current is a key question for future investigation.

"Changes in temperature, current, or other factors do not cause day-to- day changes in fish populations, but over a period of time, these changes are observed and reinforce the hypothesis that the California Current is changing," said McGowan.

"The fish populations in the California Current have declined for four decades with no signs of reversal. This reflects large-scale change in environmental conditions, potentially including the transport of the California Current, salinity, zooplankton productivity, and other factors," said Koslow.

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3 Comments Scripps Institution of Oceanography Login

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sayonara kitty • 16 days ago

taking into account the billion gallons of sewage that mike before me speaks of...i am curious if possibly anyone there has considered the 400 tons of highly radioactive water that has been hemorrhaging into the ocean each day for over five years, from fukushima daiichi? also, is "fish abundance decline" the same as a species collapse, and if so, has anyone checked the numbers from 2011 thru the present?

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Scripps Inst. of Oceanography Mod sayonara kitty • 3 days ago

Scripps Oceanography helps monitor the marine environment off the coast of California though California Cooperative Oceanic Fisheries Investigations (CalCOFI) in cooperation with California Department of Fish & Wildlife and NOAA Fisheries Service. Among other samples, water collected during quarterly CalCOFI cruises and at Scripps Pier are sent to Ken Buesseler at Woods Hole Oceanographic Institution for analysis, with the results posted at http://ourradioactiveocean.org....

An update posted in December noted that "levels of contamination remain well below government-established safety limits for human health or to marine life."

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Mike Beanan • 5 months ago

Around one billion gallons of secondary sewage is discharged each day into Southern California ocean waters. Offshore islands create the Gulf of Santa Catalina so sewage is retained in local gyres to elevate water temps. If we love the ocean and want fish to survive, maybe we should stop dumping sewage into the sea.

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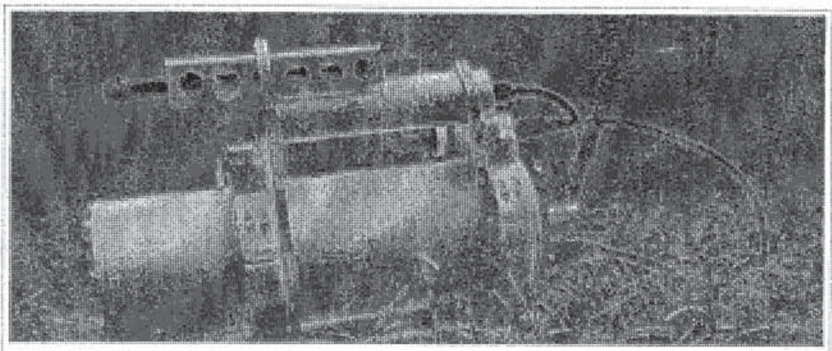
Leading Ocean Scientists Recommend Immediate, Coordinated Action Plan to Combat Changes to West Coast Seawater Chemistry

Scientific panel including Scripps Oceanography geochemist warns on accelerating rate of ocean acidification along West Coast

Apr 06, 2016

Media Contact: (http://scripps.ucsd.edu/news/contact-us) Robert Monroe |

Phone: 858-534-3624 | Email: scrippsnews@ucsd.edu (mailto:scrippsnews@ucsd.edu)



SeapHOx instruments developed by Scripps scientist Todd Martz observe conditions related to ocean acidification

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Global carbon dioxide emissions are triggering permanent changes to ocean chemistry along the North American West Coast that require immediate, decisive action to combat.

That action includes development of a coordinated regional management strategy, concluded a panel of scientific experts including Andrew Dickson, a professor of marine chemistry at Scripps Institution of Oceanography at UC San Diego.

A failure to adequately respond to this fundamental change in seawater chemistry, known as ocean acidification, is anticipated to have devastating ecological consequences for the West Coast in the decades to come, the 20-member West Coast Ocean Acidification and Hypoxia Science Panel warned in a comprehensive report unveiled April 4.

"Increases in atmospheric carbon dioxide emissions from human activities are not just responsible for global climate change; these emissions also are being absorbed by the world's oceans," said Alexandria Boehm, co-chair of the Panel and a professor of Civil and Environmental Engineering at Stanford University. "Our work is a catalyst for management actions that can address the impacts of ocean acidification we're seeing today and to get ahead of what's predicted as ocean chemistry continues to change."

Because of the way the Pacific Ocean circulates, the North American West Coast is exposed to disproportionately high volumes of seawater at elevated acidity levels. Already, West Coast marine shelled organisms are having difficulty forming their protective outer shells, and the West Coast shellfish industry is seeing high mortality rates during early life stages when shell formation is critical. The acidity of the world's oceans is anticipated to continue to accelerate in lockstep with rising atmospheric carbon dioxide emissions.

Dickson said the regional focus of the report sets it apart from other analyses of the risks of ocean acidification that have traditionally considered the problem at either a local scale or global scale. The report is also significant in accounting for the complexity of the issue. In particular, it recognizes the likely interactions between multiple simultaneous stresses acting on marine ecosystems, he said.

"This can be viewed at once a problem and a benefit," said Dickson. "The problem is there is no single fix for marine ecosystems; the benefit, that although reducing atmospheric CO_2 levels may seem a distant goal, reducing stresses of any type, and especially local contamination that increases CO_2 or reduces O_2 levels, can benefit marine ecosystems and may help them to be more resilient to those stresses that remain, including the longer-term threat of anthropogenic ocean acidification."

The panel was convened in 2013 to explore how West Coast government agencies could work together with scientists to combat the effects of ocean acidification and a related phenomenon known as hypoxia, or low dissolved oxygen levels.

The panel's final report, titled "Major Findings, Recommendations and Actions," summarizes the state of the science around this pressing environmental issue and outlines a series of potential management actions that the governments of the states of California, Oregon, and Washington, and the province of British Columbia, can immediately begin implementing to offset and mitigate the economic and ecological impacts of ocean acidification.

The panel is urging ocean management and natural resource agencies to develop highly coordinated, comprehensive multi-agency solutions, including:

- Exploring approaches that involve the use of seagrass to remove carbon dioxide from seawater.
- Supporting wholesale revisions to water-quality criteria that are used as benchmarks for improving water quality, as existing water-quality criteria were not written to protect marine organisms from the damaging effects of ocean acidification.

- Identifying strategies for reducing the amounts of land-based pollution entering coastal waters, as this pollution can exacerbate the intensity of acidification in some locations.
- Enhancing a West Coast-wide monitoring network that provides information toward development of coastal ecosystem management plans.
- Supporting approaches that enhance the adaptive capacity of marine organisms to cope with ocean acidification.

Although ocean acidification is a global problem that will require global solutions, the panel deliberately focused its recommendations around what West Coast ocean management and natural resource agencies can do collectively to combat the challenge at the regional level.

"One of the most exciting aspects of the panel's work is that it scales a challenging, global problem down to a local and regional level, providing a roadmap to guide measurable and meaningful progress immediately," said Deborah Halberstadt, executive director of the California Ocean Protection Council, a government agency that served as the impetus for the panel's formation.

West Coast policymakers will use the panel's recommendations to continue to advance management actions aimed at combatting ocean acidification and hypoxia. This work will be coordinated through the Pacific Coast Collaborative, a coalition of policy leads from the offices of the governors of California, Oregon, Washington, and the premier of British Columbia, which have been working together on West Coast ocean acidification since 2013. The Pacific Coast Collaborative has been engaging state and federal agencies across multiple jurisdictions to elevate the need for action along the West Coast.

The panel, which was convened for a three-year period that ended in February 2016, also has recommended the formation of a West Coast Science Task Force to continue to advance the scientific foundation for comprehensive, managerially relevant solutions to West Coast ocean acidification.

"Communities around the country are increasingly vulnerable to ocean acidification and long-term environmental changes," said NOAA Chief Scientist Richard Spinrad. "It is crucial that we comprehend how ocean chemistry is changing in different places, so we applaud the steps the West Coast Ocean Acidification and Hypoxia Science Panel has put forward in understanding and addressing this issue. We continue to look to the West Coast as a leader on understanding ocean acidification."

****

History of the Panel

In September 2012, the California Ocean Protection Council (OPC), a state agency charged with protecting California's ocean and coastal ecosystems, requested that the nonprofit California Ocean Science Trust (OST) convene a science advisory panel to recommend a long-term management strategy for combatting the effects of ocean acidification and hypoxia. The State of California then joined forces with the States of Oregon and Washington and the Province of British Columbia to broaden the panel's focus to include the entire North American West Coast, a region that is particularly vulnerable to ocean acidification. As a result, panel membership was expanded to reflect the depth of expertise from across the region, and surveys were conducted at the state, regional, and federal levels to understand decision-makers' science needs. These surveys, and the work of the Washington State Blue Ribbon Panel on Ocean Acidification, formed the foundation for the work of what then became the West Coast Ocean Acidification and Hypoxia Science Panel. Over a three-year period, the 20-member panel examined the full range of impacts related to changing ocean conditions, going beyond ocean acidification and hypoxia to include related stressors and impacts. Its final report, "Major Findings, Recommendations, and Actions," is supported by a series of lengthier panel technical guidance documents aimed at providing more detailed information for water-quality and natural resource managers and their scientific staffs. Although the panel's term ended in February 2016, the OPC is taking the lead in advancing its findings on behalf of partners in Oregon, Washington and British Columbia. For more information about the Panel, go to http://westcoastoah.org (http://westcoastoah.org).

About the California Ocean Protection Council

The Ocean Protection Council is a state agency whose mission is to ensure that California maintains healthy, resilient, and productive ocean and coastal ecosystems for the benefit of current and future generations. The Council was created pursuant to the California Ocean Protection Act, which was signed into law in 2004 by Governor Arnold Schwarzenegger. For more information, visit www.opc.ca.gov (http://www.opc.ca.gov).

About the California Ocean Science Trust

The California Ocean Science Trust is a nonprofit organization established by the State of California to build trust and understanding in ocean and coastal science. Serving as a liaison between governments, scientists, and citizens, the Ocean Science Trust supports decision-makers with sound, independent science. For more information, go to www.oceansciencetrust.org (http://www.oceansciencetrust.org).

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List of Documents Provided

NRDC Heal the Bay letter to EPA Opposing NPDES Permit N301(h) waiver for Pt. Loma WWTP, Jan 28, 2009.

CCC Federal Consistency Certification, City of San Diego, Secondary Treatment Waiver,Oct 7, 2009.

-Heal the Bay/NRDC Comment Letter, Oct 2 2009

West Coast Ocean Acidification and Hypoxia Science Panel, April 2016.

Ocean Outfall Study, Final Report, Department of Environmental Engineering Sciences for Florida Dept. of Environmental Protection, April 2006.

"The Effects of Sewage on Aquatic Ecosystems", Cambell, Kirstin. Web article science.opposing views.com

Electrocoagulation Report, Removal of Metals, Micro Algae and Phosphates,

10th Annual International Cleaning Technology Exposition, Conference March 3-5, 2003.

Removal of 6 Estrogenic Endocrine -Disrupting Compounds (EDCs) from Municipal Wastewater using Alumininum Electrocoagulation

Letter USF, Bench Test Removals of pathogens and viruses using electrocoagulation, August 2010.

"More Drinking Water for San Diego" by David Schubert. San Diego Union Tribune, September 12, 2008.

"Tijuana River Sewage Raises Ocean Pollution Levels" by Aleksandra Konstantinovic, Dec 2014. City New Service.

California Ocean Wastewater Discharge, Report and Inventory, Prepared by Heal the Ocean, March 2010.

California Fish Populations are Declining, Scrippts Institute of Oceanography. October 29, 2015.

Leading Ocean Scientist Recommend Immediate, Coordinated Action Plan to Combat Changes to West Coast Seawater Chemistry. Scrippts Scientific Panel, April 6, 2016.

1988/89 Grand Jury Reports, Water for the City of San Diego.

Cooperative Agreement with CSD for Non-opposition to CWA 301(h) Waiver, Jan 29, 2009.

Marco Gonzalez, Coast Law Group, LLP for Surfrider, San Diego Chapter, and San Diego Coastkeeper.

S.E.A.'s copy of comments

Additional Electronic Documents

FAQS on Sewage Sludge/Biosolids Annual Reporting - 2014

http://www.waterencyclopedia.com/Po-Re/Pollution-of-the-Ocean-by-Sewage-Nutrients-and-Chemicals.html

https://www3.epa.gov/npdes/pubs/primer.pdf

https://www.epa.gov/npdes/municipal-wastewater

http://vtdigger.org/2015/12/08/state-secures-funds-for-sewage-plant-upgrades/

https://www.epa.gov/eg https://www.epa.gov/biosolids

http://noc.ac.uk/science-technology/seas-under-threat/marine-pollution/sewage

http://www.seaweb.org/resources/briefings/toxic.php

http://wwf.panda.org/about_our_earth/blue_planet/problems/pollution/

http://blog.nature.org/conservancy/2011/09/16/what-a-waste-why-human-sewage-is-laying-waste-to-coral-reefs-globally/

http://www.motherjones.com/politics/2006/03/marine-pollution-how-ocean-became-toxic-waste-dump

Pew: http://www.fws.gov/southeast/grants/pdf/oceans_summary.pdf

http://issues.org/21-1/safina-3/

GREAT One: http://www.iatp.org/files/Marine_Pollution_in_the_United_States.htm

http://library.cqpress.com/cqresearcher/document.php?id=cqrglobal2007100000

http://library.cqpress.com/cqresearcher/document.php?id=cqresrre2005110400

http://oceana.org/our-campaigns/stop_ocean_pollution/campaign

http://www.seashepherd.org/commentary-and-editorials/2015/04/03/the-dilemma-of-toxic-cultures-on-a-toxic-planet-698

ewg Environmental Working Group
http://www.ewg.org/research/water-treatment-contaminants

Water Board
http://www.swrcb.ca.gov/water_issues/programs/owts/docs/disinfection.pdf

STATE OF CALIFORNIA -- NATURAL RESOURCES AGENCY

CALIFORNIA COASTAL COMMISSION
45 FREMONT STREET, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE AND TDD (415) 904-5200

ARNOLD SCHWARZENEGGER, *Governor*

W21a

ADDENDUM TO COMMISSION PACKET

FOR

ENERGY, OCEAN RESOURCES AND

FEDERAL CONSISTENCY DIVISION

For Wednesday, October 7, 2009

This addendum contains correspondence for Item No. W 21a

Correspondence and ex parte disclosure forms

Consistency Certification CC-056-09

City of San Diego, Secondary Treatment Waiver

RECEIVED
OCT 0 5 2009
CALIFORNIA COASTAL COMMISSION

FORM FOR DISCLOSURE OF EX PARTE COMMUNICATIONS

Name or description of project, LPC, etc.: San Diego Waiver (Wed)

Date and time of receipt of communication: 10/2/09 @ 9:15am

Location of communication: La Jolla, Calif.

Type of communication (letter, facsimile, etc.): meeting

Person(s) initiating communication: Bruce Reznik, Lisa Borat, Dave Grubb

Detailed substantive description of content of communication:
(Attach a copy of the complete text of any written material received.)

Discussed the history of this item and their surprise at the last hearing on this item. They are interested in working with the city and improving water reclamation by working together on this project.

Date 10/2/09

Signature of Commissioner

If the communication was provided at the same time to staff as it was provided to a Commissioner, the communication is not ex parte and this form does not need to be filled out.

If communication occurred seven or more days in advance of the Commission hearing on the item that was the subject of the communication, complete this form and transmit it to the Executive Director within seven days of the communication. If it is reasonable to believe that the completed form will not arrive by U.S. mail at the Commission's main office prior to the commencement of the meeting, other means of delivery should be used, such as facsimile, overnight mail, or personal delivery by the Commissioner to the Executive Director at the meeting prior to the time that the hearing on the matter commences.

If communication occurred within seven days of the hearing, complete this form, provide the information orally on the record of the proceeding and provide the Executive Director with a copy of any written material that was part of the communication.

Form for Disclosure of Ex Parte Communication

Date and time of communication: September 25, 2009, 10:00 AM

Location of communication: Hill Street Cafe, 524 S Coast Hwy, Oceanside, CA 92054-4009

Person(s) initiating communication: Bruce Reznik

Speaking on behalf of: San Diego Coastkeeper

Person(s) receiving communication: Esther Sanchez

Name and descripion of project:

Agenda Item 21.a., October 7, 2009
CC-056-09 (City of San Diego Secondary Treatment Waiver, San Diego) Resubmitted Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance, under Section 301(h) of the Clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit) for Point Loma Wastewater Treatment Plant Discharges offshore of San Diego, San Diego County. (MPD-SF)

Detailed substantive description of content of communication:

Discussed San Diego Coastkeeper's agreement with City of San Diego to study long term treatment of sewage to potable water instead of simply treating to secondary at Point Loma Outfall. Also discussed Commission possibly crafting conditions of approval for consistency determination.

Date

Signature of Commissioner

Commissioner Name (please print)

Coastal Commission Fax: 415.904.5400

DISCLOSURE OF EX PARTE COMMUNICATIONS

Name or description of project:
CC-056-09 (City of San Diego Secondary Treatment Waiver, San Diego) Resubmitted Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance, under Section 301(h) of the Clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit) for Point Loma Wastewater Treatment Plant Discharges offshore of San Diego, San Diego County.

Date and time of receipt of communication:
September 21, 2009 at 11:00 am

Location of communication:
Oceanside City Hall

Type of communication:
In person meeting

Person(s) in attendance at time of communication:
Brent Eidson, Jim Barrett, Alan Langworthy, Susan McCabe

Person(s) receiving communication:
Esther Sanchez

Detailed substantive description of the content of communication:
(Attach a copy of the complete text of any written material received.)
I received a briefing from the project representatives in which they described the City of San Diego's secondary treatment waiver request and provided background on the history of the permitting process to date. The representatives described their efforts to work with staff and to respond to concerns raised at the August hearing. They explained the City's extensive and on-going monitoring efforts and informed me that wastewater discharges have been proven to comply with secondary treatment waiver requirements and California Ocean Plan standards, which contain policies comparable to the marine resource, fishing, and recreation protection policies of the Coastal Act. The City has also upgraded its facilities, improved wastewater reclamation facilities, and maintained mass emission levels below the levels initially recommended by the Commission and required by the RWQCB. The results of an additional water reclamation study discussed by opponents are pending. The City anticipates a positive staff recommendation and support from Surfider and Coastkeeper.

Date:

Signature of Commissioner: ______________________________

Heal the Bay
1444 9th Street
Santa Monica CA 90401
ph 310 451 1550
fax 310 496 1902
info@healthebay.org
www.healthebay.org

October 2, 2009

Chairperson Neely and Commissioners
California Coastal Commission
45 Fremont Street Suite 2000
San Francisco, CA 94105-2219

Sent via Email [mdelaplaine@coastal.ca.gov]

Re: Comments on Consistency Certification No. CC-056-09 ***Reissuance of CWA Section 301(h) Secondary Treatment Waiver for Point Loma Wastewater Treatment Plant Discharges offshore of San Diego*** **dated September 16, 2009.**

Dear Chairperson Neely and Commissioners,

On behalf of Heal the Bay and the Natural Resources Defense Council ("NRDC"), we appreciate the opportunity to provide the following comments on the above referenced Consistency Certification. Heal the Bay is an environmental organization with over 13,000 members dedicated to improving water quality in Santa Monica Bay and Southern California coastal waters for people and marine life. NRDC is a national environmental organization which has 1.2 million members and activists, 250,000 of whom are Californians.

We are extremely disappointed to see that this Consistency Certification is being reheard by the Coastal Commission after an August 13, 2009 unanimous vote by the Commission to deny consistency. We agreed with the Commissioners who spoke against the waiver at the August 13th hearing and believe that all of these points are still valid. As there is no significant new information being presented in the Staff Report dated September 16, 2009, it is unclear why this item is being reheard. Bringing an item back for a re-vote only a month later sets a horrible precedent and sends a message to the public that this is a political decision, especially considering that there is no new information. The Commission requires six months to elapse before allowing a permit resubmission. By allowing a resubmission so soon after a decision, the Commission sends the message to the regulated community – if at first you don't succeed, just try again. We urge the Commission to stand firm on the well-grounded technical and policy concerns they articulated in August.

Regardless, we submit these comments in opposition to the Consistency Certification for the reissuance of a waiver of Clean Water Act standards for the E.W. Blom Point Loma Metropolitan Wastewater Treatment Plant and Ocean Outfall ("Plant" or "PLOO"). Our

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comments include some new insights since our last letter dated August 11th on additional issues that clearly demonstrate that the Plant has not met its burden of proof to obtain another 301(h) waiver under the Clean Water Act or the California Coastal Act.

The Plant is one of the largest sewage treatment plants in California, dumping nearly 200 million gallons of wastewater into the Pacific Ocean every day. Despite the fact that publicly owned treatment works were required to upgrade to secondary treatment standards over 30 years ago, the Plant continues to operate under a waiver from these federal standards. As mentioned in the Staff Report, "in California, the City of San Diego is the only municipal ocean discharger that has not either achieved or committed to implementing full secondary treatment." Staff Report at 2. From a technical standpoint, every other municipal POTW in California has proven upgrading to secondary treatment is entirely feasible. As a policy matter, allowing one major discharger to continue to treat our oceans as a dumping ground for minimally-treated sewage is unjustified and unacceptable, especially at a time when water recycling is a critical part of the solution to California's water crisis. A minimum of secondary treatment is essential for any water recycling effort. As a legal matter, the Plant has failed to meet its burden of proof to obtain another 301(h) waiver under the Clean Water Act and has failed to comply with Sections 30230 and 30231 of the California Coastal Act. The Coastal Commission Staff recommendation to concur with the City of San Diego's consistency certification is thus unsupported by evidence and inappropriate.

Applicable Legal Standards

As discussed in NRDC and Heal the Bay's January 28, 2009 letter to USEPA, the Plant has not met its burden of proof to obtain another 301(h) waiver under the Clean Water Act. To be eligible to receive a 301(h) waiver, the applicant must demonstrate that it can meet the "environmentally stringent criteria" under the Clean Water Act.[1] For many similar reasons, the discharge is also not consistent with applicable sections of the California Coastal Act. Specifically, we disagree with Staff's statement that the City's discharges under the renewal of the waiver from secondary treatment requirements would be consistent with the water quality and marine resources policies of the Coastal Act (Sections 30230, 30231). Staff Report at 3.

Section 30230 states,

"Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine

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[1] *In re Mayaguez Regional Sewage Treatment Plant Puerto Rico Aqueduct and Sewer Authority*, 4 E.A.D. 772 (1993); 33 U.S.C. § 1311(h).

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organisms adequate for long-term commercial, recreational, scientific, and educational purposes."

Section 30231 states,

"The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface waterflow, **encouraging waste water reclamation**, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams. [Emphasis added]"

The practice of dumping minimally treated sewage in the ocean is not consistent with these sections of the California Coastal Act, as it does not lead to maintenance, enhancement, or restoration of marine resources. Also as discussed in further detail below, current water reclamation efforts are inadequate and the monitoring program is insufficient as it does not adequately capture the movement of the plume and hence characterize the influence of the outfall on areas of special biological significance.

Water Reclamation

As cited above, the California Coastal Act looks towards water reclamation as a key component in protecting coastal waters and habitats. The Point Loma Plant must upgrade to at least full secondary treatment to create much needed water recycling opportunities in San Diego. The region has aggressively moved forward on a controversial desalination plant at Carlsbad with considerable environmental impacts and extensive financial and energy costs, so clearly San Diego has already expressed an interest in finding new, reliable sources of local water. Upgrading the Plant is a smart way for San Diego to create this reliable source of local water, yet San Diego refuses to embrace water recycling as a solution to significantly augment their increasingly scarce water supplies.

San Diego's neighbors to the north have redoubled their water recycling efforts—Orange County Water District, Los Angeles County Sanitation Districts, and West Basin Municipal Water District produce nearly 150 MGD of recycled wastewater, and recently the LA County Sanitation Districts agreed to a long term goal in the recently updated Santa Monica Bay Restoration Plan of over 200 MGD from their secondary treatment plant in Carson. Meanwhile, Pt. Loma continues to operate at primary treatment and San Diego continues to have a poor record on water recycling.

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Earlier this year, the State Water Resources Control Board passed a comprehensive policy to increase water recycling statewide to combat California's increasing water scarcity due to climate change, growth, and recent water rights court decisions. The state made water recycling easier and set a goal of an additional one million acre feet per year of recycled water statewide by 2020 and 2 million acre feet by 2030. The use of water recycling has never been more important to augment local water supplies and to move California to sustainable water management.

Unfortunately, San Diego has provided no water recycling goals or milestones for the coming years. The commitment that has apparently been reached by certain stakeholders and the City to go forward on a recycled water study is much different than an actual *commitment* to recycle a certain volume of water by a date certain. In light of the California water crisis and the recently approved State water recycling policy, commitments to doing studies are not enough.

The City projects that the total suspended solids loadings from the WTP will be capped at 15,000 MT/yr for the life of the permit. Further the BOD loading is expected to be greater than that of a secondary treatment plant with BOD removal not less than 58%. As the WTP has been discharging to the ocean for over 45 years, this is a significant loading of pollutants. Thus at a minimum, San Diego should commit to recycling enough water within 5 to 10 years so that the BOD loadings from Point Loma are the same as the projected BOD loadings if the POTW went to full secondary treatment. Upstream water recycling is a way to get the loadings to a full secondary treatment equivalent level. In addition, TSS reduction to 30 mg/l can be reached at the plant through advanced primary treatments. This commitment would be a creative way to comply with the requirements of the Clean Water Act and increase the use of a precious resource.

For instance, the approximate current TSS and BOD loadings are 21.6 million lbs/yr[2] and 61.1 million lbs/yr[3], respectively. Thus, this equates to an additional loading of 2.5 million lbs/yr TSS and 42 million lbs/yr BOD compared to the loading if the 30 mg/l TSS and 30 mg/l BOD requirements for secondary treatment were in place. This extra loading must be addressed, in order to protect the marine environment.

Although we strongly oppose a consistency determination by the Commission, in the event that the Commission changes their mind and determines that San Diego's application deserves a consistency determination, please adopt the following condition:

[2] Assume average TSS of 34 mg/l and flow of 208 MGD.
[3] Assume average BOD of 96 mg/l and flow of 208 MGD.

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By 2020, San Diego shall reduce the pollutant loadings of BOD from the Point Loma discharge to a loading equivalent of reaching full secondary treatment at 208 MGD. Also by 2020, Point Loma shall reduce TSS concentrations to 30 mg/l.

This condition provides an incentive for increased water recycling in the region and greatly enhanced primary treatment at the Point Loma POTW.

Discharge Impacts

New Disinfection Facilities

As stated in the USEPA's Tentative Decision, "[p]rototype effluent disinfection facilities have been installed at the Point Loma WTP to allow the discharge to comply with recreational body-contact bacteriological standards throughout the water column (ocean surface to ocean bottom) in all State regulated waters (within three nautical miles of the coast)." EPA Decision at 14. The City began adding sodium hypochlorite to the effluent discharge on September 3, 2008, after exceedances of single sample maximum and geometric mean bacterial objectives at shoreline stations. EPA Decision at 79.

We are concerned about disinfection byproducts formed by Point Loma WTP's new chlorination practices. As you know, sewage has high concentrations of organic matter, nitrates, nitrites and ammonia. Chlorination of sewage forms chloramines very quickly, and it also likely forms a wide variety of chlorinated organics. The formation of chlorinated petroleum based organics, furanones, fulvics and other non-volatile organics are of great concern. A major disinfection byproduct is the potent carcinogen N-nitrosodimethylamine (NDMA). Specifically, NDMA, an emerging disinfection byproduct from the use of chloramines as disinfectant, has been linked to the occurrence of gastric cancer[4]. As there is no de-chlorination, any residual chlorine or free chlorine available by the time the effluent hits ocean water may lead to the formation of a wide variety of brominated organics. These byproducts are toxic in the marine environment. Although additional monitoring is proposed, we are concerned that some of these toxic byproducts will, in fact, be formed and discharged to the marine environment, leading to marine impacts. Also, chlorinated effluent is far more toxic than effluent without disinfection. There is simply not enough information known about the potential impacts of this new process in preparation for the upcoming permit cycle.

There is no discussion of toxicity or water quality data for effluent post chlorination within the Staff Report. This is concerning because monitoring pre-chlorination gives a gross underestimate

[4] D Pobel, et al. (1995 Feb) Nitrosamine, nitrate and nitrite in relation to gastric cancer: a case-control study in Marseille, France. European Journal of Epidemiology.;11 (1):67-73

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of the concentrations and loadings of disinfection byproducts and the effluent toxicity. The loading of disinfection byproducts is enormous, especially from primary treated effluent. The lack of analysis of disinfection impacts and increased disinfection byproduct loadings is yet another example of San Diego failing to meet the burden of proof to earn a waiver.

Benthic Macrofauna Impacts

In order to meet its burden to obtain a 301(h) waiver under the CWA, the discharger must demonstrate that there is a balanced indigenous population of organisms outside the zone of initial dilution of discharge. The EPA decision document includes an assessment of the health of the benthic macrofauna community off of the discharge.

Although the EPA determined that the City met its burden to obtain a waiver under the Clean Water Act, the benthic marcofauna data nevertheless demonstrated that the biologically sensitive species – *Amphiodia* (brittle stars) are reducing in density in the area near the outfall, but outside the ZID. For example – brittle star densities at E-14 and E-11 were significantly different than reference conditions. Also, the *Amphiodia* densities decreased by over 75% at E-14 from the pre discharge time period (1991-1993) to the period 10-15 years later (2001-2005). Meanwhile, brittlestar densities at the reference areas remained stable or increased during this same time period. This is a typical ecological response that is seen in areas of high organic enrichment. The Point Loma discharge is clearly degrading the benthic macrofauna community with the pollution sensitive *Amphiodia*'s density reduction as a clear example.

A similar, but more dramatic occurrence occurred near the Los Angeles County Sanitation Districts outfall at White Point in Palos Verdes. As the most sensitive taxa to pollution, brittlestar populations were reduced dramatically, but other echinoderms such as sea urchins, sea stars and sea cucumbers were also reduced in numbers. The EPA decision document did not provide an analysis of these other sensitive species.

The pollutant tolerant taxa tell a similar story. When sewage discharges impair benthic soft bottomed communities, certain species of invertebrates like *Euphilomedes* crustaceans, *Capitella* worms and *Parvilucina tenuisculpta* (a bivalve) often increase in densities in areas of high organic enrichment. The case at Point Loma is no different. Reference locations had significantly lower densities of the crustacean and bivalve than sites close to the ZID. *Euphilomedes* densities at the E-14 site near the discharge increased dramatically from the pre-discharge time period to 10 to 15 years later. At the same time, densities of *Euphilomedes* actually decreased at the reference location B-9. The densities of the crustacean were significantly different higher at the near discharge sites compared to the reference locations.

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Again, this biological response is typical for benthic communities impacted by high organic enrichment such as primary treated sewage. The same trend is seen for *Parvilucina* bivalves and *Capitella* worms. The *Capitella* story is particularly dramatic. These polychaete worms are rarely seen in healthy soft bottomed communities in the San Diego portion of the Southern California Bight. In fact, none of the pollution tolerant worms were found in the monitored area prior to the discharge. Now the area near the outfall has densities of up to 17.5 per 0.1 m^2 while the reference locations are still only at 0.1 worms per 0.1 m^2. This is a dramatic difference that demonstrates that Point Loma's discharge is negatively impacting the benthic community structure.

Although EPA focused on numerous other metrics to determine if the discharger met the heavy burden of demonstrating that there is a BIP outside the ZID, there is no question that the data demonstrates that sewage discharges are having significant negative impacts on sensitive species (*Amphiodia)* and increasing the densities of pollutant tolerant taxa at sites near the ZID. The discharger has failed to meet the biological requirements of 301(h) and the Coastal Act. Further, EPA's reliance on biological indices to grant the waiver misses an very important point. Indices rely on a wide variety of metrics for numerous species. An endangered species could go extinct in an area and still get a decent score on an index. It is far more appropriate to focus on species of concern and pollution sensitive and pollution tolerant species. As such, the City has not met its burden to obtain yet another five year waiver from the secondary treatment requirements.

Emerging Contaminants

A recent study confirms that emerging contaminants can be an even greater risk from lower-treatment WWTPs. Ramirez et al. found that, "the degree and nature of treatment processes has a substantial influence over the removal efficiency of pharmaceuticals from wastewater discharge. As a result, exposure, and consequently tissue accumulation, would be expectedly higher in organisms residing in water resources receiving discharge from WWTPs employing less advanced versus more advanced treatment." (p. 26.)[5]

The study explained that, "[t]he most significant entry route for human pharmaceuticals into the aquatic environment is the point-source release from wastewater treatment plants (WWTPs)." The study continues: "Although WWTPs are capable of removing a large proportion of pharmaceuticals through various treatment processes, not all compounds are eliminated completely, with removal efficiencies varying according to the wastewater treatment processes employed at individual facilities, resulting in potential discharge to receiving waters." Thus, the study found that "[s]ites with more advanced wastewater treatment . . . tended to demonstrate

[5] Ramirez AJ at al. *Pharmaceuticals and Personal Care Products in the Environment.* Occurrence of Pharmaceuticals and Personal Care Products in Fish: Results of a National Pilot Study in the United States (unformatted, but citable, manuscript, 2009 Society of Environmental Toxicology and Chemistry)

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fewer detections, at lower concentrations and lower frequencies than sites with less advanced treatment" (p. 20.)

This study confirms that the risks to marine life exposed to the Plant's primary-treated effluent are at a higher risk for exposure to pharmaceuticals and personal care products than those in the zone of higher-treated effluent.

Two national-scale reconnaissance studies recently conducted by the USGS collected baseline information on the occurrence of pharmaceuticals and personal-care products (PPCPs), detergents, flame retardants, naturally occurring sterols, and other organic contaminants in ground water and untreated sources of drinking water in the United States. The results of these studies show the presence of these contaminants in 80% of the 139 streams tested across 30 states.[6] These contaminants are commonly derived from municipal, agricultural, and industrial wastewater sources and pathways[7].

Emerging contaminants exist in the environment in small amounts, but even these small amounts, alone or via the synergistic effects of multiple contaminants, can have significant effects on beneficial uses. Studies demonstrate that a number of these substances pose a threat to human health, marine ecosystems, and other wildlife.

Research demonstrates that pharmaceuticals and personal care products (PPCPs) are very important contributors to toxicity in wastewater[8]. Significant amounts of PPCPs enter the environment from various inputs, including animal feedlots, land application of organic materials, and wastewater treatment plants that treat residential, commercial, and/or industrial wastewater[9]. In addition disinfection byproduct such as NDMA and halogenated organics are also CECs. Numerous studies have shown detrimental impacts of PPCPs on wildlife. For example, studies have shown that certain synthetic musks found in fragrances (commonly found in perfumes, shampoos, and lotions) have been found to cause mutation in lab rats[10], and to inhibit the toxin defense system of certain marine mussels[11]. In addition, N-

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[6] Barnes, K. et al. (2002). Water-Quality Data for Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000 Iowa City, Iowa. USGS http://toxics.usgs.gov/pubs/OFR-02-94/index.html#abstract Accessed Nov 4, 2008.
[7] Daughton, C.G. (2004). Non-regulated water contaminants: emerging research. Environmental Impact Assessment Review 24 711– 732. U.S. EPA.
[8] Munoz, I. et al. (2008) Ranking potential impacts of priority and emerging pollutants in urban wastewater through life cycle impact assessment. posted Science Direct. Oct. 2008.
[9] Daughton, T. (1999). Pharmaceuticals and personal care products in the environment: agents of subtle change? Environmental Health Perspectives, December 1999, Vol. 107.
[10] Ibid.
[11] Luckenbach, Epel (2005). Nitromusk and Polycyclic Musk Compounds as Long-Term Inhibitors of Cellular Xenobiotic Defense Systems Mediated by Multidrug Transporters. Environmental Health Perspectives. Jan 2005. Vol 113, No. 1, p. 17-24.

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nitrosodimethylamine (NDMA), an emerging disinfection byproduct from the use of chloramines as disinfectant, has been linked to the occurrence of gastric cancer[12].

As for pharmaceuticals, the state of California has already taken action to reduce the incidence of them in the environment by passing Senate Bill 966, a bill aimed to prevent the flushing of unused medical prescriptions down the toilet. These constituents are often found in treated wastewater because they are continually input, are sometimes recalcitrant, and require high level treatment methods for removal.[13] The State's action demonstrates the recognition by California that regulatory actions are appropriate at this time to protect public health.

Studies performed in California have demonstrated evidence of exposure and effects of emerging contaminants on marine life on a local basis. According to study performed by the Pacific Estuarine Ecosystem Indicator Research Consortium (PEEIR), reproductive abnormalities and endocrine disruption is evident in longjawed mudsucker (*Gillichthys mirabilis),* a salt marsh fish considered a sentinel species, at five wetland sites along California's coast where runoff and sewage treatment effluent are discharged[14]. In addition studies in southern California have revealed hormone alterations, and reproductive abnormalities in coastal flatfish near treatment plant outfalls due to exposure to emerging contaminants. Gender ratios of the hornyhead turbot (*Pleuronichthys verticalis*) showed a trend toward masculinization at the Orange County Sanitation District outfall.[15] Furthermore, endocrine disruption was potentially evident at this site as male fish were shown to have equivalent concentrations of blood egg yolk protein as those observed in female fish[16]. These are merely a few examples of the studied impacts of emerging contaminants on the environment. There are a multitude of concerns, given existing research demonstrates how marine life is already being impacted by these contaminants. Human health may be at risk as we directly consume affected species, irrigate crops with water containing harmful levels of PPCPs, perpetuate environmental bacteria developing a resistance to antibiotics that make their way into waterways, or even drink water containing traces of these constituents.

Due to the increased risk of CEC discharge from primary treatment plants and the potential marine life and human health impacts, this provides yet another case where the Plant has not demonstrated that it can meet the "environmentally stringent criteria" under the Clean Water Act.

[12] D Pobel, et al. (1995 Feb) Nitrosamine, nitrate and nitrite in relation to gastric cancer: a case-control study in Marseille, France. European Journal of Epidemiology.;11 (1):67-73
[13] Ibid.
[14] PEEIR: Pacific Estuarine Ecosystem Indicator Research Consortium. Reproductive Impairment of a Salt Marsh Fish as an Indicator of Pollutant Effects Brochure.
http://www.bml.ucdavis.edu/PEEIR/Brochures/Fish_Reproductive_Impairment.pdf Accessed Nov. 5, 2008
[15] Rempel, M. et al. (2006) Evaluation of relationships between reproductive metrics, gender and vitellogenin expression in demersal flatfish collected near the municipal wastewater outfall of Orange County, California, USA. Aquatic toxicology 2006, vol. 77, no.3, pp. 241-249
[16] Schlenk, D. (2006). Environmental Monitoring and Assessment of Environmental Estrogens in Marine. UC Marine Council. Coastal Environmental Quality Initiative.

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Monitoring Program

In order to ensure that marine resources are maintained as required by the California Coastal Act, an adequate monitoring program is necessary. Although Commission staff members have stated that the monitoring program has improved since the last waiver in 2002, we have yet to see these improvements. In fact at least three reports demonstrate that, among other deficiencies, the Plant's monitoring program is inadequate and therefore the Plant is unable to assure compliance with water quality standards, the protection and propagation of a balanced indigenous population, or compliance with the Ocean Plan.

- Scripps Institute of Oceanography Report (2004)
- Assessment of Water Conditions at Cabrillo National Monument (2006)
- University of California, San Diego Report (2007)

Scripps Institute of Oceanography Report (2004)

After being hired by the City of San Diego to assess the adequacy of the Plant's monitoring program, Scripps Institute of Oceanography released its findings in 2004. Among other findings, Scripps bluntly concluded, "We don't know where the water goes, or where the plume goes."[17] Scripps described a number of other inadequacies in the Plant's monitoring program:

- "The City does not adequately monitor or understand the physical circulation of the coastal waters relevant to the Point Loma Ocean Outfall in terms of spatial and temporal variability and synoptic patterns (e.g., seasonal variability or in response to episodic events), or the geographic extent of the 'receiving waters.'"

- "The location, movement, and dispersal of the plume from the outfall is also inadequately monitored and understood."

- "Because of the lack of knowledge of the plume's location, its impact on the planktonic community is unclear. The spatial and temporal resolution, and the types of measurements currently made are inadequate to quantify the effects of chronic nutrient loading on the plankton relative to natural nutrient sources and other anthropogenic sources."

- "Understanding the impact of the outfall on the benthic environment requires modification of the existing monitoring program, primarily to provide more appropriate control stations.

17 Scripps Institute of Oceanography, "Point Loma Outfall Project" (Sep. 2004), at 26.

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Currently the control sites, because they are substantially different in the character of their sediments from the other monitoring sites, and because they may be contaminated from sources other than Point Loma, do not provide a basis for evaluating benthic impacts with confidence."

- "Present monitoring does not include integration of littoral transport cells. Therefore, it is possible that contaminated sediments are accumulating downslope from the shelf, and because this area is not monitored, there is presently no way to know if the effects of the PLOO or other sources of contaminants are accumulating in these areas."[18]

Further, the report states that in 2004 the City was considering an increase in the Plant's daily discharge from 175 mgd to the Plant's full capacity of 240 mgd. In response, Scripps stated, "A major conclusion of this review is that there is currently insufficient information to determine how the projected increase in the discharge at Point Loma would affect water quality ...."[19] According to the Staff Report, the Plant made changes to its monitoring program (Page 5); however, the details of the changes were not provided in the staff report. Also, it is not indicated that these changes were made in light of Scripps' findings. Since the Plant has increased its daily discharge to 208 mgd for 2009, and is projected to further increase to 219 mgd for 2014,[20] it follows that the Plant's current monitoring program is inadequate to determine how its current increased discharge affects water quality. As such, San Diego has failed to meet the burden of proof laid out in Section 301(h) of the Clean Water Act.

Assessment of Water Conditions at Cabrillo National Monument (2006)

Just to the south of the Plant lies the Cabrillo National Monument, part of the National Park Service ("Cabrillo"). In 2006, scientists at the Marine Science Institute at UC Santa Barbara, and the Bodega Marina Laboratory, released a study of the water quality conditions at Point Loma for the National Park Service's Water Resources Division.[21] Like the Scripps report, this report discusses the problems that arise from insufficient information about the effluent plume:

This raises the possibility that the PLOO contributes to background concentrations of these constituents in the coastal ocean (i.e., farfield effects). Four of the analytes detected (copper, silver, cyanide and ammonia) were concentrated enough on average in effluent during 2004 to exceed EPA daily maxima or acute exposure criteria for marine life. Although the circumstances that could result in cross-shore transport of the PLOO effluent plume all the way to [Cabrillo]

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[18] Scripps Institute of Oceanography, "Point Loma Outfall Project" (Sep. 2004), at 3.
[19] *Id.* at 26 (emphasis original).
[20] EPA Tentative Decision, at 17.
[21] Engle, D. and Largier, J., "Assessment of Coastal Water Resources and Watershed Conditions at Cabrillo National Monument, California" (Aug. 2006).

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have not been described, it is possible that exposure to poorly diluted effluent could harm some biota. Such an exposure occurred in 1992 at [Cabrillo] when the outfall pipe was ruptured near shore. . . . [We] do not know if the PLOO can be reasonably ruled out as a source of these pollutants in the ocean near [Cabrillo]."[22]

University of California, San Diego Report (2007)

The City of San Diego also requested a scientific review of the impact of the Plant by the Environment and Sustainability Initiative at the University of California, San Diego. The report, which was released in 2007, did not conduct new research, but rather reviewed existing analyses and reports as requested by the City. Like in the 2004 report, the 2007 report found that the Plant's monitoring program was insufficient to track the effluent plume:

- "[T]he complexity of the oceanographic conditions in the Point Loma area demands more observations before any conclusions can be made about the transport of the plume."[23]

- "The physical oceanographic data at present is inadequate to predict with certainty either the location or the dilution rate of the plume."[24]

This report also noted that PCB levels in rockfish caught close to the outfall were "significantly higher" than PCB levels in fish north of the outfall. This may indicate an absence of a balanced indigenous population in the vicinity of the outfall. Yet due to the inadequacies of the monitoring program, there "currently is no way to know definitively whether the elevated levels" were due to the Plant or another source.[25]

Plume Study

In the latest Staff Report, the City *acknowledges* that "the behavior of the Point Loma wastewater plume (wastefield) is not well known at the present . . ." Staff Report at 10. This echoes the concerns articulated in other monitoring studies which Heal the Bay and NRDC brought to the Commission's attention in our August 11 letter and reiterated above. In this Staff Report, the City describes a study it is undertaking to learn more about the plume, but the results of this study will not be known until at least mid-2011. Staff Report at 11. This plume study is meant to "address two primary concerns of operating the ocean outfall in its current configuration: (1) possible effects to beach and near-surface water quality and (2) its risk to the coastal marine environment. This study addresses beach and surface water quality concerns by

[22] *Id.* at 141.
[23] Environment and Sustainability Initiative, University of California, San Diego, "Final Report: Point Loma Outfall Review" (Oct. 1, 2007), at 4.
[24] *Id.* at 16.
[25] *Id.* at 9.

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determining whether the wastewater plume surfaces and encroaches upon beaches, and if so, the frequency of such behavior." (*Id.*)

Thus, this discussion in the latest Staff Report confirms that insufficient information is known at this time about the plume and its impacts in order for the City to meet its burden under the Clean Water Act. Further as the study will not be completed until at least mid-2011, the extent of impacts from the discharge is unknown for the upcoming permit cycle.

In sum, Point Loma WTP has not met its burden of proof to obtain another 301(h) waiver under the Clean Water Act or the Coastal Act. Lack of adequate information about the fate of the Plant's effluent plume, increased loadings, the discharge of disinfection byproducts and emerging contaminants, and the creation of benthic macrofauna impacts are just a few of the reasons why consistency should be denied. Further, the gaps in monitoring do not provide a complete picture of the impacts of the primary discharge. Thus, we urge the Commission to concur with the original, unanimous decision to deny consistency.

Thank you for the opportunity to comment. If you have any questions, please contact us at 310-451-1500.

Sincerely,

Mark Gold

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President, Heal the Bay

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PLEASE DISTRIBUTE TO THE MEMBERS OF THE COMMISION

Oct. 3, 2009

Dear Commissioners and Staff of the Coastal Commission:

On Aug. 13, in San Francisco, the Coastal Commission refused "consistency" determination to the San Diego sewage waiver.

Purely based on instinct, San Diego continue to struggle to retain their waiver to avoid (at the least) full secondary treatment standards for sewage before it's dumped onto the Ocean. But really, why are we wasting water dumping it into the Ocean at all?

The Commission has given San Diego a chance to re-evaluate its position, and realize that the only sensible desalination is reclaiming wastewater; and that their big problem is the high cost of MWD water.

Expensive seawater desalting schemes, even if subsidies push off some of the cost onto more prudent Californians, are not going to supply the water we need. Barring some sort of divine water intervention, San Diego's water supply future is bleak, unless recycling of wastewater is contemplated.

Orange County has proven that it can be done, and done without hugely higher cost. San Diego has challenges, such as a lack of an aquifer, and Tijuana's sewage; but obstacles are made to be conquered, not avoided.

SAN DIEGO: THE LAST WAIVER.

San Diego is the very last, outside of small fishing communities, the last sewage waiver. What makes us think it's OK for San Diego to dump poorly treated sewage, while other places go to great lengths to treat the sewage? Well, San Diego HATES to install infrastructure, from fire stations to water, needed for the huge growth that fueled the wealth of the top honchos running the city.

So there really hasn't been much in the way of sewage investment at San Diego, it's pretty much all ***DEFERRED MAINTENANCE.*** But San Diego might feel picked-upon, because even if they cleaned up their sewage, Tijuana would still be dumping on them.

So the Coastal Commission has been asked to hear the item again, this time in Oceanside, Item 21 a, CC-056-09 (City of San Diego Secondary Treatment Waiver, San Diego) Resubmitted Consistency Certification by City of San Diego for secondary treatment waiver http://documents.coastal.ca.gov/reports/2009/10/W21a-10-2009.pdf

The STAFF is recommending to approve the waiver.
There are two problems with the staff report, and two issues to consider, as well as a synthesis of both sides and a pathway to resolution.

1. On page two, Staff fundamentally misrepresents the process of ***ENDING*** a waiver; the report states, erroneously, that even after a POTW gives up the waiver, "interim waivers" may be needed. However, the distinction is between GIVING UP THE WAIVER and retaining it.

If a POTW discharger decides to give up the waiver, and if the process will take longer than 5 years, a "Settlement Agreement" is reached, which gives the discharger a permit WITHOUT the waiver, but suspends enforcement of penalties for the period -- which may be 10, 15 or even 25 years, or more -- so long as a schedule to upgrade is followed.

But the point is, the discharger agrees to bring the sewage up to at least secondary standards; often, they want to do much more, as Orange County or Morro Bay, because, after all, water is scarce and not getting any cheaper.

It's not an immediate process at all; OCSD, for example, gave up the waiver in 2002, but received 10 years, longer than it needed, to come into compliance. There is NO SUCH THING as an "interim waiver", and Staff misrepresents the legal situation, muddying the basic idea.

The important thing is to come into compliance and avoid a waiver (which the EPA likes to call a "variance", but it's still dumping sewage!).

2. The Staff Report spends a lot of time regurgitating the "studies" purporting to prove that the sewage is actually good, or at least doing no harm. These are needed to prove that the sewage waiver is legal under the Clean Water Act, which otherwise would require secondary standards.

It's a big DIVERSION to waste time arguing that paid-off researchers are only going to find what you want them to find.

But wait a minute.

Isn't this just a ... diversion?? We're not looking to find it legal under the Clean Water Act, the Coastal Commission is doing a CONSISTENCY DETERMINATION, which is an entirely different piece of legal machinery.

The Commission is acting under authority of the 1972 Coastal Zone Management Act ("CZMA"), which extends and empowers the Coastal Act as a piece of federal legal machinery, giving the Commission the power to determine if an activity is in accordance with the enforceable policies of the ***COASTAL ACT***, with the force of federal law.

There is no bar from the Commission using the CZMA to invalidate the sewage waiver; and no argument that the sewage dumping is in accordance with the 1976 amendments to the Clean Water Act can be used to overturn such a finding by the Coastal Commission, unless there's some provision that sewage is immune from the Coastal Act.

Basically, the Commission has the power to determine if the dumping is in accordance with the "enforceable policies" of the Coastal Act. These are, to avoid damage to the recreational, habitat and other values of the near-shore Ocean. Sewage dumping can't be good for the reputation, if nothing else. "We're the last sewage beach on the Coast...".

It's true that, under Sect. 307, the Secretary of Commerce has the power to over-ride; and it's true that there is federal pre-emption for federal agencies, which are just charged with avoiding impacts and not violating local law "as much as possible".

But there's no exemption for City of San Diego, at least not without appeal; and good luck on that one, asking special permission to dump sewage into the Ocean.

The Commission should make its ruling, which it presaged in San Francisco, that the sewage waiver is outlandish, shameful, anachronistic, and not in accordance, not "consistent", with the Coastal Act.

Thus, if this is right, all Staff's arguments that the Waiver is in conformity with the Clean Water Act's 301(h) provision is not relevant to its status under the Coastal Act. If they dare, let Commerce reverse the facts and argue for the sewage.

3. A third point is that everyone, even those arguing for the Waiver, admits that water recycling is needed; some of the sewage dumpers even want to pay for seawater desalination schemes. San Diego is at "the end of the [MWD] pipe" and pays the highest rate for fresh water; yet dumps about 200 million gallons per day of wastewater instead of recycling it.

Of course, it's easier to cleanse the water ***BEFORE*** it's mixed in with the seawater, because in waste materials processing, source control is the name of the game. Trying to unpack biological waste and industrial waste, for example, is, well, just a plain waste of resources; much easier to control it before it's mixed.

Poseidon resources
http://www.youtube.com/watch?v=GVjVwfw_gGk
ran into trouble in Tampa Bay, their one running project, because they hadn't considered the fecundity of the
Ocean. The Reverse Osmosis filters become clogged with sea-life, which actually grows on the membrane. This requires constant backflushing, and treatment with expensive chemicals. On one occasion, during the recent Florida water crisis, they reported that the plant could only operate at two-thirds capacity, presumably because a third of the membranes needs flushing at all times, and cannot be in constant service.

Desalting sewage, or briny aquifers, might make sense, but desalting sewage mixed in the Ocean is like unpacking the puzzle after it's waterlogged. Much better to solve it the right way, cleanse the sewage first.

So the REAL issue is whether a CERTAIN, CONCRETE AGREEMENT should replace San Diego's VAGUE and INDEFINITE wish to recycle the water. And do it in accordance with a time-frame to make bringing San Diego's wastewater treatment into the modern age more than a pipe-dream and fantasy.

4. For those objecting to the cost, wait a minute!! This is JUST the sort of thing that Congress funded, back in 1972, when it passed the original Clean Water Act; but even if San Diego has to fund it all, where does the money go, other than into local businesses and the local economy??

It's not like we're asking the Japanese or Russians to treat our sewage; it's not like sending billions to buy oil that funds terrorists, leaving us only pollution.

It's funds that stay ***RIGHT HERE***, in the local community. It's hiring local firms to implement a long-term plan for sewage improvement, hiring locally and providing ***GOOD, LONG-TERM JOBS*** building plant to recycle the water.

Makes common sense. If San Diego needs federal funding to help treat Tijuana's sewage, let's lobby for it. But let's get started now, and start healing the Ocean.

A PATH TO AGREEMENT. All those concerned agree that water is valuable, and that the sewage will have to be recycled, not just dumped into the Ocean; for one thing, if desalination is to be used, it's a lot easier to do on sewage before it's dumped into seawater. So, really, the only issue is when, and how.

IF WE CAN UNDERSTAND THE PROCESS OF GIVING UP A WAIVER, that it's not instantaneous, it involves a commitment to improve sewage facilities in a real way during a specified time, we should all agree on giving up the waiver in exchange for a decade-or-more period of fixing the problem and implementing water recycling.

After all, San Diego agrees it's going to need more water, anyway; Mayor Sanders appears on a video segment extolling the virtues of desalination.

Holding on to the waiver while promising to upgrade is like crossing your fingers when testifying.

It can't be both ways.

The Coastal Commission should insist on ending the waiver, based on the Coastal Act, not the Clean Water Act, and San Diego should agree cheerfully. All should agree we need to work to retrieve the huge amounts of wastewater currently -- well, currently "wasted".

Doug Korthof
Director, Ocean Outfall Group
1020 Mar Vista
Seal Beach, CA 90740-5842
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714-496-1567

DIANNE JACOB

SUPERVISOR, SECOND DISTRICT
SAN DIEGO COUNTY BOARD OF SUPERVISORS

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Agenda Item: W21a
Consistency Certification CC-056-09
County of San Diego
In Support

September 30, 2009

California Coastal Commission
Chairperson Neely
45 Fremont Street, Suite 2000
San Francisco, CA 94105

Attention: Mark Delaplaine

SUBJECT: Coastal Commission Meeting, Wednesday October 7, 2009

Item W21a. Consistency Certification CC-056-09 (City of San Diego) Re-submitted Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance, under Section 301(h) of the Clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit) for Point Loma Wastewater Treatment Plant Discharges offshore of San Diego, San Diego County. (MPD-SF)

Dear Commissioners:

On behalf of the San Diego County Board of Supervisors, I support the reissuance of the 301(h) modified NPDES permit for the City of San Diego's E.W. Blom Point Loma Wastewater Treatment Plant.

The Point Loma Plant is a major component of the Metropolitan Sewerage System operated by the City of San Diego, with the participation of fifteen other municipalities and agencies, including the County of San Diego. Nearly one third of the total flow to the system originates from these participating agencies. As a participating agency, the County has a unique interest in decisions that affect the operation of the Metro system.

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250 E. Main Street, Suite 169 • El Cajon, California 92020-3941
www.diannejacob.com

The County feels strongly that the combination of chemically assisted primary treatment, the deep ocean outfall, located 320 feed deep and 4.5 miles from the shoreline, and the City of San Diego's exemplary record of compliance with the State Ocean Plan during the last 15 years have proven to be protective of the public health and environment in the local area. Also, comprehensive ocean monitoring over the past 15 years, along with scientific analysis, has not revealed any harmful impacts to the ocean environment.

The County of San Diego strongly supports the U.S. Environmental Protection Agency's Approval Decision, as well as the San Diego Regional Water Quality Control Board's unanimous decision to approve the modified permit, because it continues to protect the environment while being fiscally prudent with public resources.

Without the Waiver of secondary treatment, costs to County ratepayers are estimated to go from $10 million a year to approximately $17.7 million a year. A nearly double rate increase would be extremely burdensome on ratepayers when there is no valid reason to do so.

Therefore, I urge the California Coastal Commission to make the finding that San Diego's modified waiver complies with the California Coastal Management Program and that it will be conducted in a manner consistent with this program.

Sincerely,

Dianne Jacob

DIANNE JACOB
Chairwoman

DJ:nc

DON HIGGINSON, Mayor
CARL KRUSE, Deputy Mayor
MERRILEE BOYACK, Councilmember
JIM CUNNINGHAM, Councilmember
BETTY REXFORD, Councilmember

CITY OF POWAY

Agenda Item: W21a
Consistency Certification CC-056-09
City of Poway
In Support

September 29, 2009

California Coastal Commission
Chairperson Neely
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Attention: Mark Delaplaine

Subject: Coastal Commission Meeting, Wednesday, October 7, 2009

Item W21a. Consistency Certification CC-056-09 (City of San Diego)
Resubmitted Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance under Section 301(h) of the Clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit) for Point Loma Wastewater Treatment Plant Discharges offshore of San Diego, San Diego County. (MPD-SF)

Dear Commissioners:

The City of Poway would like to express its full support for the reissuance of the 301(h) modified NPDES permit for the City of San Diego's E. W. Blom Point Loma Wastewater Treatment Plant.

The Point Loma Wastewater Treatment Plant is a major component of the Metropolitan (Metro) Sewerage System, which is operated by the City of San Diego with the participation of fifteen other municipalities and agencies. Nearly one-third of the total flow to the Metro system originates from these participating agencies, and as a participating agency, the City of Poway has a unique interest in decisions that affect the operation of the system. Additionally, as a member of the greater San Diego area community, we are also concerned that the public health and environment of our local waters are protected.

The City of Poway has been actively involved in all the secondary waiver processes at Point Loma, and our elected officials are educated in this subject. We believe strongly that the combination of chemically assisted primary treatment, the deep ocean outfall (located 320 feet deep and 4.5 miles from the shoreline), and the City of San Diego's exemplary record of compliance with the State Ocean Plan during the last 15 years have proven to be protective of the public health and environment in the local area. Additionally, the comprehensive ocean monitoring over the past 15 years, along with scientific analysis, has not revealed any harmful impacts to the ocean environment. The City of Poway supports the U.S. Environmental Protection Agency's Approval Decision, as well as the San Diego Regional Water Quality Control Board's unanimous decision to approve the modified permit, because this decision continues to protect the environment while being fiscally prudent with public resources.

Therefore, the City of Poway urges the California Coastal Commission to make the finding that San Diego's modified waiver complies with the California Coastal Management Program and that it will be conducted in a manner consistent with this program.

Very truly yours,

Don Higginson

Don Higginson
Mayor

City of Imperial Beach, California

www.cityofib.com

OFFICE OF THE MAYOR

September 24, 2009

Chairperson Neely and Commissioners
California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Subject: Reissuance of the Permit for the Point Loma Wastewater Treatment Plant

Dear Chairperson Neely and Commissioners,

The City Council of Imperial Beach supports the City of San Diego's request for the Coastal Commission to approve the reissuance of the secondary water treatment waiver for the Point Loma Wastewater Treatment Plant. We believe the waiver is environmentally responsible and will allow San Diego to use ratepayer funds in a prudent manner during the term of the permit. Granting the waiver will also be consistent with your staff's recommendation of August 13, 2009.

In the longer term we hope that San Diego will continue its work to enhance the region's capacity to use reclaimed water and identify future opportunities to increase recycling of water.

Our support for the use of reclaimed water should not in any way be interpreted as support for delaying or rejecting the waiver.

Please approve the Secondary Treatment Waiver for the Point Loma Wastewater Treatment Plant. Thanks in advance for moving ahead on this topic.

Sincerely,

James C. Janney
Mayor
City of Imperial Beach

cc: Diana Lilly and Commission Staff

825 Imperial Beach Blvd., Imperial Beach, CA 91932 Tel: (619) 423-8303 fax: (619) 628-1395

CALIFORNIA
NATIONAL CITY
1887
INCORPORATED

September 24, 2009

California Coastal Commission
Chairperson Neely
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Attention: Mark Delaplaine

SUBJECT: Coastal Commission Meeting, Thursday, August 13, 2009

Item 11b. Federal Consistency CC-043-09 (City of San Diego) Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance under section 301 (h) of the clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit for Point Loma Wastewater Treatment Discharges offshore of the San Diego, San Diego County. (MPD-SF)

Dear Commissioners:

The City of National City would like to express its support of the reissuance of the 301 (h) modified NPDES permit for the City of San Diego's E. W. Blom Point Loma Wastewater Treatment Plant.

The Point Loma Wastewater Treatment Plant is a major component of the Metropolitan Sewerage System, which is operated by the City of San Diego, with the participation of fifteen other municipalities and agencies. Nearly one third of the total flow to the system originates from these participating agencies. As a participating agency, the City of National City and its residents have a vested interested in any decisions that affect the operation of the Metro system.

As a participating member of the Metro JPA the City of National City has been actively involved in the secondary waiver at the Point Loma Treatment Plant. We feel that the combination of chemically assisted primary treatment, deep ocean outfall (located 320 feet deep and 4.5 miles from the shoreline) and the City of San Diego's exemplary record of compliance with the State Ocean Plan during the last 15 years have proven to be protective of the public health and environment in the local area. As well, comprehensive ocean monitoring over the past 15 years, along with scientific analysis, has not revealed any harmful impacts to the ocean's environment. The City of National City supports the U. S. Environmental Protection Agency's approval decision, as well as the San Diego Regional Water Quality Control Board's unanimous decision to approve the modified permit, because this decision continues to protect the environment while being fiscally prudent with public resources.

Therefore, the City of National City urges the California Coastal Commission to make the finding that San Diego's modified waiver complies with the California Coastal Management Program and that it will be conducted in a manner consistent with the program.

Sincerely,

Ron Morrison
Mayor

cc. City Council
City Manager
Public Works Director

Mayor Ron Morrison
1243 National City Boulevard, National City, CA 91950-4301
619/336-4233 Fax 619/336-4239 www.nationalcityca.gov

CITY OF CORONADO
OFFICE OF THE MAYOR
CASEY TANAKA

1825 STRAND WAY • CORONADO, CA 92118 • (619) 522-7320 • CTANAKA@CORONADO.CA.US

Agenda Item: W21a
Consistency Certification CC-056-09
City of Coronado
In Support

September 29, 2009

California Coastal Commission
Chairperson Neely
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Attention: Mark Delaplaine

SUBJECT: Coastal Commission Meeting, Wednesday, October 7, 2009.

Item W21a. Consistency Certification CC-056-09 (City of San Diego) Re-submitted Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance under section 301(h) of the Clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit) for Point Loma Wastewater Treatment Plant Discharges offshore of San Diego, San Diego County. (MPD-SF)

Dear Commissioners:

The City of Coronado would like to express its complete support for the reissuance of the 301(h) modified NPDES permit for the City of San Diego's E. W. Blom Point Loma Wastewater Treatment Plant.

The Point Loma Wastewater Treatment Plant is a major component of the Metropolitan Sewerage System, which is operated by the City of San Diego with the participation of fifteen other municipalities and agencies. Nearly one-third of the total flow to the system originates from these participating agencies. As a participating agency, the City of Coronado has a unique interest in decisions that affect the operation of the Metro system. As a coastal city with approximately 9.75 miles of ocean coastline, home to the world-renowned Coronado Central Beach and Hotel del Coronado, Coronado's beaches are located south of the Point Loma outfall and north of the South Bay outfall. Due to our proximity to these outfalls, our community has a heightened concern that the public health and environment of our local waters are protected.

The City of Coronado has been actively involved in all the secondary waiver processes at Point Loma, and the City Council is educated in this subject. We feel strongly that the combination of chemically-assisted primary treatment, the deep ocean outfall (located 320 feet deep and 4.5 miles from the shoreline) and the City of San Diego's exemplary record of compliance with the State Ocean Plan during the last 15 years have proven to be protective of the public health and environment in the local area. As well, comprehensive ocean monitoring over the past 15 years, along with scientific analysis, has not revealed any harmful impacts to the ocean environment. The City of Coronado supports the U. S. Environmental Protection Agency's Approval Decision, as well as the San Diego Regional Water Quality Control Board's unanimous decision to approve the modified permit, because this decision continues to protect the environment while being fiscally prudent with public resources.

Therefore, the City of Coronado urges the California Coastal Commission to make the finding that San Diego's modified waiver complies with the California Coastal Management Program and that it will be conducted in a manner consistent with this program.

Sincerely,

Casey Tanaka

Casey Tanaka
Mayor

CT/lh

METRO WASTEWATER **JPA**

www.metrojpa.org

276 Fourth Avenue Chula Vista, CA 91950 619-476-2557

Ernest Ewin, Chairman

Agenda Item: W21a
Consistency Certification CC-056-09
Metro Joint Powers Authority (JPA) San Diego
In Support

October 1, 2009

California Coastal Commission
Chairperson Neely
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Attention: Mark Delaplaine

SUBJECT: Coastal Commission Meeting, Wednesday, October 7, 2009.

Item W21a. Consistency Certification CC-056-09 (City of San Diego) Re-submitted Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance under section 301(h) of the Clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit) for Point Loma Wastewater Treatment Plant Discharges offshore of San Diego, San Diego County. (MPD-SF)

Dear Commissioners:

The Metro Wastewater Commission and JPA (together "Metro JPA") would like to express their complete support for the reissuance of the 301 (h) modified NPDES permit for the City of San Diego's E. W. Blom Point Loma Wastewater Treatment Plant.

The Point Loma Wastewater Treatment Plant is a major component of the Metropolitan Sewerage System, which is operated by the City of San Diego, with the participation of fifteen other municipalities and agencies. Nearly one third of the total flow to the system originates from these participating agencies and, therefore, the Metro JPA, the coalition of municipalities and special districts sharing in the use of the City of San Diego's regional wastewater facilities, has an interest in decisions that affect the operation of the Metro system. Additionally, with coastal communities as participating agencies, we have a concern that the public health and environment of our local waters are protected.

The Metro JPA has been actively involved in all the secondary waiver processes at Point Loma, and the elected officials of the participating agencies are educated in this subject. We feel strongly that the combination of chemically assisted primary treatment, the deep ocean outfall (located 320 feet deep and 4.5 miles from the shoreline) and the City of San Diego's exemplary record of compliance with the State Ocean Plan during the last 15 years have proven to be protective of the public health and environment in the local area. As well, comprehensive ocean monitoring over the past 15 years, along with scientific analysis, has not revealed any harmful impacts to the ocean environment. The Metro JPA supports the U. S. Environmental Protection Agency's Approval Decision, as well as the San Diego Regional Water Quality Control Board's unanimous decision to approve the modified permit, because this decision continues to protect the environment while being fiscally prudent with public resources.

Therefore, the Metro JPA urges the California Coastal Commission to make the finding that San Diego's modified waiver complies with the California Coastal Management Program and that it will be conducted in a manner consistent with this program.

Sincerely,

Ernest Ewin
Chair Metro Wastewater JPA and Metro Commission

CITY OF
CHULA VISTA
OFFICE OF THE MAYOR

CHERYL COX
MAYOR

September 25, 2009

California Coastal Commission
Chairperson Neely
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Attention: Mark Delaplaine

SUBJECT: Coastal Commission Meeting, Wednesday, October 7, 2009

Item 21a. Federal Consistency CC-056-09 (City of San Diego Secondary Treatment Waiver, San Diego) Resubmitted Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance, under Section 301(h) of the Clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit) for Point Loma Wastewater Treatment Plant Discharges offshore San Diego, San Diego County. (MPD-SF)

Dear Commissioners:

The City of Chula Vista supports the reissuance of the 301(h) modified NPDES permit for the City of San Diego's Point Loma Wastewater Treatment Plant.

The Point Loma Wastewater Treatment Plant is a major component of the Metropolitan Sewerage System, which is operated by the City of San Diego, with the participation of 15 other municipalities and agencies. Nearly one-third of the total flow to the system originates from these participating agencies. As the second largest participating agency, the City of Chula Vista has a definite interest in decisions that affect the operation of the Metro system.

As the City of Chula Vista Metro Wastewater Joint Powers Authority representative, on September 1, 2009, I provided our City Council with an update of this issue. The combination of chemically assisted primary treatment, the deep ocean outfall (located 320 feet deep and 4.5 miles from the shoreline) and the City of San Diego's exemplary record of compliance with the State Ocean Plan during the last 15 years, have protected public health and the local environment.

276 Fourth Avenue • Chula Vista • California 91910 • (619) 691-5044 • Fax (619) 476-5379
ccox@chulavistaca.gov

California Coastal Commission
September 25, 2009
Page 2

Comprehensive Ocean monitoring over the past 15 years and scientific analysis has not revealed any harmful impacts to the ocean environment. The City of Chula Vista supports the U.S. Environmental Protection Agency's approval decision and the San Diego Regional Water Quality Control Board's unanimous decision to approve the modified permit. This decision continues to protect the environment while being fiscally prudent with public resources.

The City of Chula Vista urges the California Coastal Commission to make the finding that San Diego's modified waiver complies with the California Coastal Management Program and that it will be conducted in a manner consistent with this program.

Respectfully,

Cheryl Cox

Cheryl Cox
Mayor

Cc: Scott Tulloch, Assistant City Manager
Richard Hopkins, Director of Public Works

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City of Imperial Beach, California

www.cityofib.com

OFFICE OF THE MAYOR

September 24, 2009

Chairperson Neely and Commissioners
California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Subject: Reissuance of the Permit for the Point Loma Wastewater Treatment Plant

Dear Chairperson Neely and Commissioners,

The City Council of Imperial Beach supports the City of San Diego's request for the Coastal Commission to approve the reissuance of the secondary water treatment waiver for the Point Loma Wastewater Treatment Plant. We believe the waiver is environmentally responsible and will allow San Diego to use ratepayer funds in a prudent manner during the term of the permit. Granting the waiver will also be consistent with your staff's recommendation of August 13, 2009.

In the longer term we hope that San Diego will continue its work to enhance the region's capacity to use reclaimed water and identify future opportunities to increase recycling of water.

Our support for the use of reclaimed water should not in any way be interpreted as support for delaying or rejecting the waiver.

Please approve the Secondary Treatment Waiver for the Point Loma Wastewater Treatment Plant. Thanks in advance for moving ahead on this topic.

Sincerely,

James C. Janney
Mayor
City of Imperial Beach

CITY OF LEMON GROVE

"Best Climate On Earth"

Office of the Mayor

Agenda Item: W21a
Consistency Certification CC-056-09
City of Lemon Grove
In Support

October 1, 2009

California Coastal Commission
Chairperson Neely
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Attention: Mark Delaplaine

SUBJECT: Coastal Commission Meeting, Wednesday, October 7, 2009

Item W21a. Consistency Certification CC-056-09 (City of San Diego)
Re-submitted Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance under section 301(h) of the Clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit) for Point Loma Wastewater Treatment Plant Discharges offshore of San Diego, San Diego County. (MPD-SF)

Dear Chairperson:

The City of Lemon Grove Sanitation District would like to express its full support for the reissuance of the 301 (h) modified NPDES permit for the City of San Diego's E. W. Blom Point Loma Wastewater Treatment Plant.

The Point Loma Wastewater Treatment Plant is a major component of the Metropolitan Sewerage System, which is operated by the City of San Diego, with the participation of fifteen other municipalities and agencies (including the City of Lemon Grove). Nearly one third of the total flow to the system originates from these participating agencies and, therefore, the Metro JPA, the coalition of municipalities and special districts sharing in the use of the City of San Diego's regional wastewater facilities, has an interest in decisions that affect the operation of the Metro system. Additionally, with coastal communities as participating agencies, we have a concern that the public health and environment of our local waters are protected.

The City of Lemon Grove Sanitation District has been actively involved in the secondary waiver processes at Point Loma, and our elected officials are educated in this subject. We feel strongly that the combination of chemically assisted primary treatment, the deep ocean outfall (located

320 feet deep and 4.5 miles from the shoreline) and the City of San Diego's exemplary record of compliance with the State Ocean Plan during the last 15 years have proven to be protective of the public health and environment in the local area. As well, comprehensive ocean monitoring over the past 15 years, along with scientific analysis, has not revealed any harmful impacts to the ocean environment. The City of Lemon Grove supports the U. S. Environmental Protection Agency's Approval Decision, as well as the San Diego Regional Water Quality Control Board's unanimous decision to approve the modified permit, because this decision continues to protect the environment while being fiscally prudent with public resources.

Therefore, the City of Lemon Grove urges the California Coastal Commission to make the finding that San Diego's modified waiver complies with the California Coastal Management Program and that it will be conducted in a manner consistent with this program.

Sincerely,

Mary T. Sessom

Mary T. Sessom, Chairperson
Lemon Grove Sanitation District Board of Directors

Cc: Jerry Jones, Lemon Grove Sanitation District Board Member / Metro JPA Liaison
Jerry Selby, Lemon Grove Sanitation District Board Member
Mary England, Lemon Grove Sanitation District Board Member
George Gastil, Lemon Grove Sanitation District Board Member
Graham Mitchell, Executive District Director
Patrick Lund, District Engineer

PADRE DAM
Municipal Water District

September 29, 2009

California Coastal Commission
Chairperson Neely
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Attention: Mark Delaplaine

SUBJECT: Coastal Commission Meeting, October 7, 2009
Consistency Certification No. CC-056-09 (City of San Diego)
Reissuance of the Modified Permit for the Point Loma Wastewater Treatment Plant

Dear Commissioners:

Padre Dam Municipal Water District ("Padre Dam") would like to express its complete support for the reissuance of the 301 (h) modified NPDES permit for the City of San Diego's Point Loma Wastewater Treatment Plant.

Padre Dam along with fourteen other municipalities and agencies contract for wastewater treatment services through the City of San Diego. Collectively we are responsible for approximately 35 percent of the cost associated with the Metropolitan Sewerage System and therefore have a vested interest in decisions that affect the operation of the system.

We continue to support the City in its applications efforts, not only to spare our ratepayers an unnecessary financial burden, but also because the application for a modified permit is scientifically supported and meets the requirements of the Clean Water Act.

Therefore, Padre Dam urges the California Coastal Commission to concur with the consistency certification made by the City of San Diego for the proposed waiver, finding that the waiver is consistent with the enforceable policies of the California Coastal Management Program.

Sincerely,

Douglas S. Wilson
CEO/General Manager

OFFICE 9300 FANITA PARKWAY, SANTEE CA 92071 MAIL POST OFFICE BOX 719003, SANTEE CA 92072-9003
TEL 619 448 3111 FAX 619 449 9469 WEB WWW.PADREDAM.ORG

Mark Delaplaine

From: doug korthof [doug@seal-beach.org]
Sent: Sunday, October 04, 2009 2:33 PM
To: Mark Delaplaine
Subject: Sewage and Desal: joint issue Oct. 7 in Oceanside

Hello,

It's one Ocean, and what San Diego dumps into it concerns everyone ("THE WORST, THE MOST, THEY'RE DUMPING ON OUR COAST").

San Diego should give up its shameful sewage waiver, and start recycling its wastewater -- as all should agree is the ultimate goal.

But more importantly, San Diego's reticence to end the sewage waiver is going to COST US MONEY.

Whatever San Diego decides to do with its wastewater, it affects us all, right in the pocketbook.

There's 200 million gallons of wastewater discarded every day down the sewage pipe; and San Diego is short of fresh water. Instead of reclaiming or recycling this immense waste, San Diego is planning, extolling, crowing about its commitment to POSEIDON'S SEAWATER-SEWAGE DESALTING SCHEME.

Poseidon claims that desalting the sewage after it's mixed with seawater will only cost $1100 per Acre-Foot (twice what the most expensive water now costs San Diego); but ALL OF SOUTHERN CALIFORNIA will be taxed with paying a subsidy of $250 per Acre-Foot via the Metropolitan Water District (MWD). But that's not the worst of it.

Poseidon claims that, if the project is a disaster, as I fully expect, that they will be the ones who lose out, that it won't cost the cities or Agencies a red cent. As we see, that's just not true; but it's not just the "cost shifting" that's threatening to rip-off unknowing California taxpayers.

Poseidon's cost claims are based on NO DOCUMENTATION. Poseidon brings only failure to the table; their project in Tampa Bay had to be taken over by the locals. So what are their credentials, and what is their financing? We look into it and find that there is LITTLE or NOTHING.

In reality, Poseidon has applied to the State for tax-free state bonds that would fund their proposed plant to the tune of $485,000,000 (485 M dollars). If the plant proves worthless, guess who pays for those bonds (plus interest -- it's a low interest, but does grow). We the Taxpayers, that's who.

This $485M may only be the FIRST installment, if as expected construction costs rise.

As any creditor finds, when the first tranche of money is spent by the debtor, and, like Trump, the threat is to lose it all, it's easy to throw good money after bad, instead of just admitting failure. So once Poseidon has spent the money, we will be called on to advance more, or else lose it all.

But that's not the worst of it. If, as expected, Poseidon lays down 30-year-contracts for supplying water at a fixed price, and if, on the basis of that supply, new development goes in, there's no guarantee that the cost won't rise. In the face of "force majeure", that is, inability to perform, all contracts can be VOIDED and the price adjusted to meet costs, as we see in the case of General Motors' and other companies' "promises".

Thus, the Taxpayer and Ratepayer are really on the hook for unlimited sums, untold barrels of money that Poseidon may extort from all California based on San Diego's folly in not securing adequate water supplies and not treating the sewage properly.

San Diego, overwhelmed by growth, reaches out to Poseidon like the thirsty man in the desert reaching for a beautiful mirage of unlimited, shining water. Like the desert mirage, Poseidon likely will yield only acrid dirt and empty illusions.

Instead of funding Poseidon, what if San Diego properly treated, and began recycling, its wastewater?

Perhaps desalting schemes might work, if used on tertiary-treated wastewater. Perhaps San Diego should look to success stories, such as Orange County.

To do this, all San Diego has to do is start.

By agreeing to end the sewage waiver, perhaps in 15 years, San Diego need not simply throw money at the obsolete, creaking, overloaded plant on Point Loma; for less than the ultimate cost of the Poseidon scheme, San Diego could build new, more rational sewage treatment plants, ones sited far from the Coast, ones that don't depend on flushing out the sewage after an 11-hour settling process that leaves the toxins in the discharges.

There are two paths before San Diego: one, the path of success, proven recycling of wastewater, chosen by Orange County and other places; the other, the path of failure, guided by the uncertain lantern of a firm called Poseidon, which has no track record of success, little credibility, and questionable financial resources. Are they, in fact, any more than a "three guys and a coat-rack" kind of operation?

San Diego should save us all a bundle of money, and treat its sewage. Don't put us all on the hook for Poseidon's flickering lantern. There's debt, waste and folly, not water, in that mirage.

/Doug

Oceanside City Council Chambers, 300 North Coast Hwy., Oceanside, CA 92054 WEDNESDAY, OCTOBER 7, 2009.

> The SEWAGE WAIVER is being heard as ITEM 21 a, ostensibly in the very late afternoon; but watch it, when the Commission wants to slip a fast one, they can "trail" an item to the morning, to suit the developer or polluter. They did this, for example, at Santa Barbara to cater to Hellman.

"...21. FEDERAL CONSISTENCY...
a. CC-056-09 (City of San Diego Secondary Treatment Waiver, San Diego) Resubmitted Consistency Certification by City of San Diego for secondary treatment waiver (i.e., Environmental Protection Agency (EPA) Reissuance, under Section 301(h) of the Clean Water Act, of a modified National Pollutant Discharge Elimination System (NPDES) Permit) for Point Loma Wastewater Treatment Plant Discharges offshore of San Diego, San Diego County. (MPD-SF)..." http://documents.coastal.ca.gov/reports/2009/10/W21a-10-2009.pdf

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California Coastal Commission, Voice 415-904-5200
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219
415-904-5400 (FAX)
619-767-2384 (San Diego FAX)

PLEASE DISTRIBUTE TO THE MEMBERS OF THE COMMISION

Oct. 2, 2009

Dear Commissioners and Staff of the Coastal Commission:

On Aug. 13, in San Francisco, the Coastal Commission refused "consistency" determination to the San Diego sewage waiver.

Purely based on instinct, San Diego continues to struggle to retain their waiver to avoid (at the least) full secondary treatment standards for sewage before it's dumped onto the Ocean. But really, why are we wasting water dumping it into the Ocean at all?

The Commission has given San Diego a chance to re-evaluate its position, and realize that the only sensible desalination is reclaiming wastewater; and that their big problem is the high cost of MWD water.

Expensive seawater desalting schemes, even if subsidies push off some of the cost onto more prudent Californians, are not going to supply the water we need. Barring some sort of divine water intervention, San Diego's water supply future is bleak, unless recycling of wastewater is contemplated.

Orange County has proven that it can be done, and done without hugely higher cost. San Diego has challenges, such as a lack of an aquifer, and Tijuana's sewage; but obstacles are made to be conquered, not avoided.

SAN DIEGO: THE LAST WAIVER.

San Diego is the very last, outside of small fishing communities, the last sewage waiver. What makes us think it's OK for San Diego to dump poorly treated sewage, while other places go to great lengths to treat the sewage? Well, San Diego HATES to install infrastructure, from fire stations to water, needed for the huge growth that fueled the wealth of the top honchos running the city.

So there really hasn't been much in the way of sewage investment at San Diego, it's pretty much all DEFERRED MAINTENANCE. But San Diego might feel picked-upon, because even if they cleaned up their sewage, Tijuana would still be dumping on them.

So the Coastal Commission has been asked to hear the item again, this time in Oceanside, Item 21 a, CC-056-09 (City of San Diego Secondary Treatment Waiver, San Diego) Resubmitted Consistency Certification by City of San Diego for secondary treatment waiver http://documents.coastal.ca.gov/reports/2009/10/W21a-10-2009.pdf

The STAFF is recommending to approve the waiver.
There are two problems with the staff report, and two issues to consider, as well as a synthesis of both sides and a pathway to resolution.

1. On page two, Staff fundamentally misrepresents the process of ENDING a waiver; the report states, erroneously, that even after a POTW gives up the waiver, "interim waivers" may be needed. However, the distinction is between GIVING UP THE WAIVER and retaining it.

If a POTW discharger decides to give up the waiver, and if the process will take longer than 5 years, a "Settlement Agreement" is reached, which gives the discharger a permit WITHOUT the waiver, but suspends enforcement of penalties for the period -- which may be 10, 15 or even 25 years, or more -- so long as a schedule to upgrade is followed.

But the point is, the discharger agrees to bring the sewage up to at least secondary standards; often, they want to do much more, as Orange County or Morro Bay, because, after all, water is scarce and not getting any cheaper.

It's not an immediate process at all; OCSD, for example, gave up the waiver in 2002, but received 10 years, longer than it needed, to come into compliance. There is NO SUCH THING as an "interim waiver", and Staff misrepresents the legal situation, muddying the basic idea.

The important thing is to come into compliance and avoid a waiver (which the EPA likes to call a "variance", but it's still dumping sewage!).

2. The Staff Report spends a lot of time regurgitating the "studies" purporting to prove that the sewage is actually good, or at least doing no harm. These are needed to prove that the sewage waiver is legal under the Clean Water Act, which otherwise would require secondary standards.

It's a big DIVERSION to waste time arguing that paid-off researchers are only going to find what you want them to find.

But wait a minute.

Isn't this just a ... diversion?? We're not looking to find it legal under the Clean Water Act, the Coastal Commission is doing a CONSISTENCY DETERMINATION, which is an entirely different piece of legal machinery.

The Commission is acting under authority of the 1972 Coastal Zone Management Act ("CZMA"), which extends and empowers the Coastal Act as a piece of federal legal machinery, giving the Commission the power to determine if an activity is in accordance with the enforceable policies of the COASTAL ACT, with the force of federal law.

There is no bar from the Commission using the CZMA to invalidate the sewage waiver; and no argument that the sewage dumping is in accordance with the 1976 amendments to the Clean Water Act can be used to overturn such a finding by the Coastal Commission, unless there's some provision that sewage is immune from the Coastal Act.

Basically, the Commission has the power to determine if the dumping is in accordance with the "enforceable policies" of the Coastal Act. These are, to avoid damage to the recreational, habitat and other values of the near-shore Ocean. Sewage dumping can't be good for the reputation, if nothing else. "We're the last sewage beach on the Coast...".

It's true that, under Sect. 307, the Secretary of Commerce has the power to over-ride; and it's true that there is federal pre-emption for federal agencies, which are just charged with avoiding impacts and not violating local law "as much as possible".

But there's no exemption for City of San Diego, at least not without appeal; and good luck on that one, asking special permission to dump sewage into the Ocean.

The Commission should make its ruling, which it presaged in San Francisco, that the sewage waiver is outlandish, shameful, anachronistic, and not in accordance, not "consistent", with the Coastal Act.

Thus, if this is right, all Staff's arguments that the Waiver is in conformity with the Clean Water Act's 301(h) provision is not relevant to its status under the Coastal Act. If they dare, let Commerce reverse the facts and argue for the sewage.

3. A third point is that everyone, even those arguing for the Waiver, admits that water recycling is needed; some of the sewage dumpers even want to pay for seawater desalination schemes. San Diego is at "the end of the [MWD] pipe" and pays the highest rate for fresh water; yet dumps about 200 million gallons per day of wastewater instead of recycling it.

Of course, it's easier to cleanse the water BEFORE it's mixed in with the seawater, because in waste materials processing, source control is the name of the game. Trying to unpack biological waste and industrial waste, for example, is, well, just a plain waste of resources; much easier to control it before it's mixed.

Poseidon resources
http://www.youtube.com/watch?v=GVjVwfw_gGk
ran into trouble in Tampa Bay, their one running project, because they hadn't considered the fecundity of the Ocean. The Reverse Osmosis filters become clogged with sea-life, which actually grows on the membrane. This requires constant backflushing, and treatment with expensive chemicals. On one occasion, during the recent Florida water crisis, they reported that the plant could only operate at two-thirds capacity, presumably because a third of the membranes needs flushing at all times, and cannot be in constant service.

Desalting sewage, or briny aquifers, might make sense, but desalting sewage mixed in the Ocean is like unpacking the puzzle after it's waterlogged. Much better to solve it the right way, cleanse the sewage first.

So the REAL issue is whether a CERTAIN, CONCRETE AGREEMENT should replace San Diego's VAGUE and INDEFINITE wish to recycle the water. And do it in accordance with a time-frame to make bringing San Diego's wastewater treatment into the modern age more than a pipe-dream and fantasy.

4. For those objecting to the cost, wait a minute!! This is JUST the sort of thing that Congress funded, back in 1972, when it passed the original Clean Water Act; but even if San Diego has to fund it all, where does the money go, other than into local businesses

and the local economy??

It's not like we're asking the Japanese or Russians to treat our sewage; it's not like sending billions to buy oil that funds terrorists, leaving us only pollution.

It's funds that stay RIGHT HERE, in the local community. It's hiring local firms to implement a long-term plan for sewage improvement, hiring locally and providing GOOD, LONG-TERM JOBS building plant to recycle the water.

Makes common sense. If San Diego needs federal funding to help treat Tijuana's sewage, let's lobby for it. But let's get started now, and start healing the Ocean.

A PATH TO AGREEMENT. All those concerned agree that water is valuable, and that the sewage will have to be recycled, not just dumped into the Ocean; for one thing, if desalination is to be used, it's a lot easier to do on sewage before it's dumped into seawater. So, really, the only issue is when, and how.

IF WE CAN UNDERSTAND THE PROCESS OF GIVING UP A WAIVER, that it's not instantaneous, it involves a commitment to improve sewage facilities in a real way during a specified time, we should all agree on giving up the waiver in exchange for a decade-or-more period of fixing the problem and implementing water recycling.

After all, San Diego agrees it's going to need more water, anyway; Mayor Sanders appears on a video segment extolling the virtues of desalination.

Holding on to the waiver while promising to upgrade is like crossing your fingers when testifying.

It can't be both ways.

The Coastal Commission should insist on ending the waiver, based on the Coastal Act, not the Clean Water Act, and San Diego should agree cheerfully. All should agree we need to work to retrieve the huge amounts of wastewater currently -- well, currently "wasted".

Doug Korthof
Director, Ocean Outfall Group
1020 Mar Vista
Seal Beach, CA 90740-5842
562-430-2495
714-496-1567

Mark Delaplaine

From: JonV3@aol.com

Sent: Monday, October 05, 2009 12:00 AM

To: Mark Delaplaine

Subject: Comments on San Diego Waiver Agenda Item: Wed Oct 7, Item 21a

October 4, 2009

Dear Mr. Delaplaine:

Please distribute the following comments to the Coastal Commissioners for the Wednesday October 7, 2009 meeting, agenda item W21a -10-2009. Thank you.

Jan D. Vandersloot, MD

Letter To Chair Kruer and California Coastal Commission:

California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Re: W21a-10-2009
Recommend Deny the Waiver

c/o Mark Delaplaine
mdelaplaine@coastal.ca.gov

Dear Chair Kruer and Coastal Commissioners:

This is a request that you uphold your decision on August 13, 2009 to deny the San Diego 301 (h) waiver. There is no new information that would cause you to change your decision and it is appropriate for you to vote again to deny San Diego the last 301 (h) waiver on the California coast. It is time that San Diego joined the ranks of civilized responsible sewage dischargers in coastal California and treated its sewage to full secondary before discharging into the Pacific Ocean.

The slides presented at the Coastal Commission meeting in August did indeed show harm to the ocean with a loss of biodiversity in the benthic response index by about a third, from 150 to 102, near the outfall. This means that more pollution tolerant species are living there, an adverse impact that will get worse after the volumes of discharge are increased over the next several years.

The City of San Diego need look no further than the Orange County Sanitation District on how to go about treating its sewage without a waiver. Under pressure by the citizens group Ocean Outfall Group, as well as many other opponents of the waiver, OCSD gave up its waiver in 2002, and moved towards full secondary treatment by 2012, only three years from now. OCSD is showing how to institute full secondary using limited space by installing vertical trickling filters among other innovative strategies to achieve full secondary treatment without a waiver. By doing so, it is supplying the Orange County Water District clean enough wastewater to be run through the GWRS water reclamation system.. These trickling filters are stacked vertically and simulate natural conditions to clean the sewage.

Vertical trickling filters are one of the technologies that exist for implementation of secondary treatment by San Diego. Although vertical trickling filters could be located on the limited space available at Point Loma, in reality, these trickling filters and other secondary treatment methods should be located inland from the Point Loma treatment plant. The Point Loma treatment plant itself is obsolete, run down, and an embarrassment to society. San Diego should be ashamed for the sorry condition of the plant located on the side of a cliff. Perhaps photographs of the treatment plant facilities are not allowed because they don't want the public to know how bad it is. The City of San Diego should not be rewarded for the shabby condition of the plant by giving it another waiver. Instead, denial of the waiver will force the city to upgrade its facilities to the 21st century. Ultimately, this plant on the cliff should be dismantled and the sewage treated to full secondary at inland locations where the wastewater can be reclaimed in a process similar to GWRS in Orange County.

Feasible technology exists for full secondary if San Diego is required to give up the waiver. Otherwise, there is no sure way that they will ultimately follow the rules that the rest of California has to follow and treat its sewage to full secondary, a necessary step to go to full reclamation of wastewater.

In this day and age, water is increasingly a scarce resource. Reclaiming wastewater like Orange County is the wave of the future. Denying the waiver for San Diego and requiring full secondary treatment of wastewater will allow this resource to be used for reclamation.

San Diego has no excuses to avoid proper full secondary treatment. You should not be led down the primrose path by promises of further studies on recycling water and promises on studies on plume behavior, etc. If San Diego were serious about these promises, the studies would have been done ago. Denying the waiver ensures that the city will have to go beyond mere promises and actually take concrete action to solve its wastewater problem, which in turn leads to a solution for its water supply problems as well.

Thank you for your past action in denying the waiver. Please ratify your decision and vote again to deny the waiver on Wednesday.

Sincerely,

Jan D. Vandersloot, MD
Director, Ocean Outfall Group
2221 E 16th Street
Newport Beach, CA 92663
949-548-6326

Mark Delaplaine

From: Charlotte Pirch [dpirch@socal.rr.com]
Sent: Monday, October 05, 2009 3:15 PM
To: Mark Delaplaine
Subject: Agenda Item W 21a-10-2009. Oppose San Diego Waiver

October 5, 2009

California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Re: W21a-10-2009
Recommend Deny the Waiver

c/o Mark Delaplaine
mdelaplaine@coastal.ca.gov <mailto:mdelaplaine@coastal.ca.gov>

Dear Chair Kruer and Coastal Commissioners:

This is a request that you uphold your decision on August 13, 2009 to deny the San Diego 301 (h) waiver. There is no new information that would cause you to change your decision and it is appropriate for you to vote again to deny San Diego the last 301 (h) waiver on the California coast. It is time that San Diego joined the ranks of civilized responsible sewage dischargers in coastal California and treated its sewage to full secondary before discharging into the Pacific Ocean.

The slides presented at the Coastal Commission meeting in August did indeed show harm to the ocean with a loss of biodiversity in the benthic response index by about a third, from 150 to 102, near the outfall. This means that more pollution tolerant species are living there, an adverse impact that will get worse after the volumes of discharge are increased over the next several years.

The City of San Diego need look no further than the Orange County Sanitation District on how to go about treating its sewage without a waiver. Under pressure by the citizens group Ocean Outfall Group, as well as many other opponents of the waiver, OCSD gave up its waiver in 2002, and moved towards full secondary treatment by 2012, only three years from now. OCSD is showing how to institute full secondary using limited space by installing vertical trickling filters among other innovative strategies to achieve full secondary treatment without a waiver. By doing so, it is supplying the Orange County Water District clean enough wastewater to be run through the GWRS water reclamation system.. These trickling filters are stacked vertically and simulate natural conditions to clean the sewage.

Vertical trickling filters are one of the technologies that exist for implementation of secondary treatment by San Diego. Although vertical trickling filters could be located on the limited space available at Point Loma, in reality, these trickling filters and other secondary treatment methods should be located inland from the Point Loma treatment plant. The Point Loma treatment plant itself is obsolete, run down, and an embarrassment to society. San Diego should be ashamed for the sorry condition of the plant located on the side of a cliff. Perhaps photographs of the treatment plant facilities are not allowed because they don't want the public to know how bad it is. The City of San Diego should not be rewarded for the shabby condition of the plant by giving it another waiver. Instead, denial of the waiver will force the city to upgrade its facilities to the 21st century. Ultimately, this plant on the cliff should be dismantled and the sewage treated to full secondary at inland locations where the wastewater can be reclaimed in a process similar to GWRS in Orange County.

Feasible technology exists for full secondary if San Diego is required to give up the waiver. Otherwise, there is no sure way that they will ultimately follow the rules that the rest of California has to follow and treat its sewage to full secondary, a necessary step to go to full reclamation of wastewater.

In this day and age, water is increasingly a scarce resource. Reclaiming wastewater like Orange County is the wave of the future. Denying the waiver for San Diego and requiring full secondary treatment of wastewater will allow this resource to be used for reclamation.

San Diego has no excuses to avoid proper full secondary treatment. You should not be led down the primrose path by promises of further studies on recycling water and promises on studies on plume behavior, etc. If San Diego were serious about these promises, the studies would have been done ago. Denying the waiver ensures that the city will have to go beyond mere promises and actually take concrete action to solve its wastewater problem, which in turn leads to a solution for its water supply problems as well.

Thank you for your past action in denying the waiver. Please ratify your decision and vote again to deny the waiver on Wednesday.

Sincerely,
Charlotte Sumrow-Pirch
9826 Lewis Avenue, Fountain Valley
714-968-5634

Mark Delaplaine

From: Donald Schulz [surfdad@hotmail.com]

Sent: Monday, October 05, 2009 1:50 PM

To: Mark Delaplaine

Subject: San Diego 301(h) waiver (oppose).

Dear Chair Kruer and Coastal Commissioners:

This is a request that you uphold your decision on August 13, 2009 to deny the San Diego 301 (h) waiver. There is no new information that would cause you to change your decision and it is appropriate for you to vote again to deny San Diego the last 301 (h) waiver on the California coast. It is time that San Diego joined the ranks of civilized responsible sewage dischargers in coastal California and treated its sewage to full secondary before discharging into the Pacific Ocean.

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Thank you for your past action in denying the waiver. Please ratify your decision and vote again to deny the waiver on Wednesday.

Sincerely,
Don Schulz
Senior Member, Surfrider Foundation

Mark Delaplaine

From: Welsh, Terry [Terry.Welsh@ahmchealth.com]
Sent: Monday, October 05, 2009 10:26 AM
To: Mark Delaplaine
Subject: No Full Treatment Waiver for San Diego

No Full Treatment Waiver for San Diego, please

Terry Welsh,

Costa Mesa, CA
714-432-1385

mdelaplaine@coastal.ca.gov

mdelaplaine@coastal.ca.gov Please modify your contacts with my new e-mail address. It is Terry.Welsh@ahmchealth.com

Thank you

Mark Delaplaine

From: Iryne Black [ayeblack@sbcglobal.net]
Sent: Monday, October 05, 2009 10:26 AM
To: Mark Delaplaine
Subject: San Diego request for 301h waiver

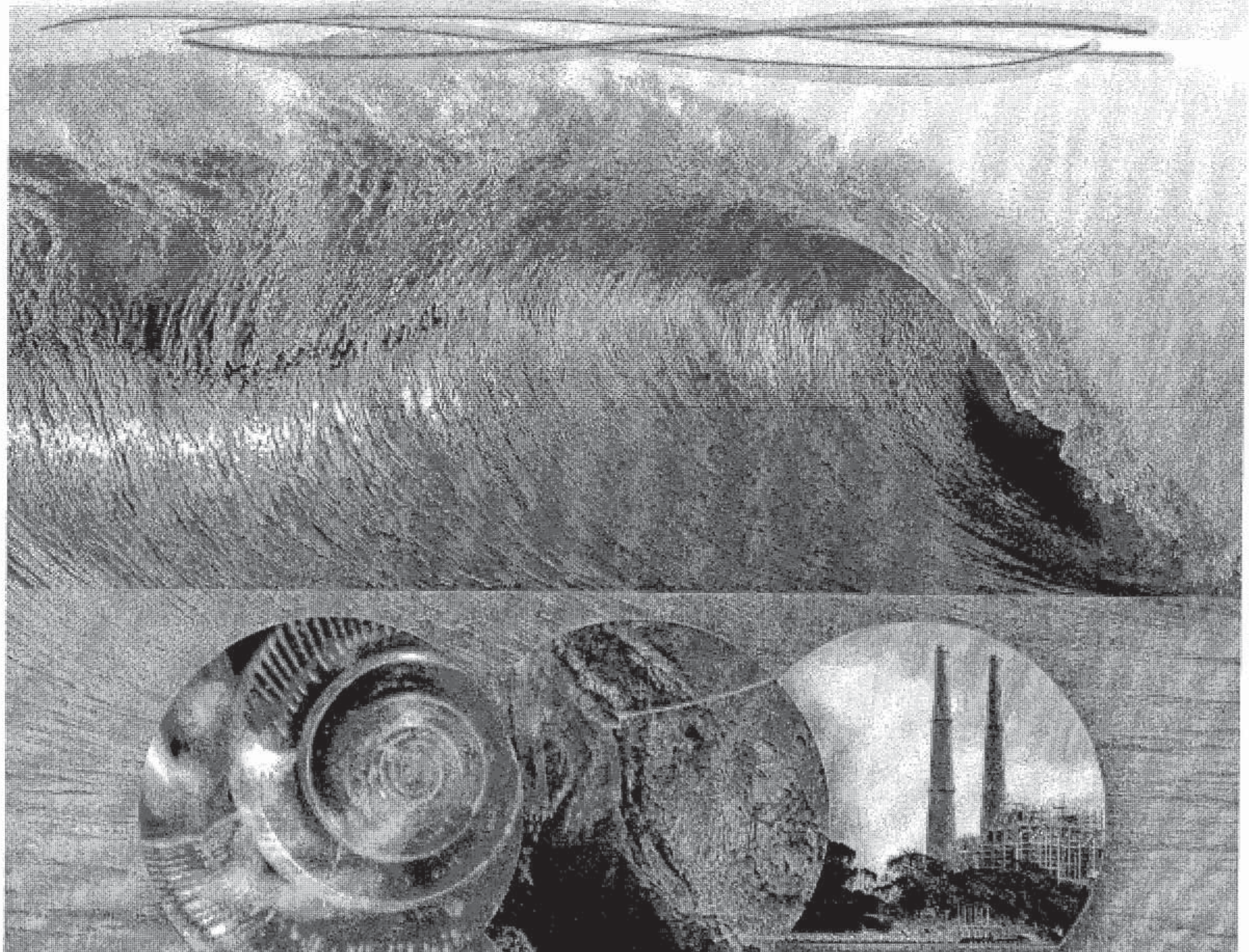
To Members of the California Coastal Commission

Please reassert your denial of a 301 H Waiver to the City of San Diego. There are other means to meet the problem without placing the health of our oceans in jeopardy.

Thank you. Iryne Black
1646 Irvine Ave. Newport Beach 92660

The West Coast Ocean Acidification and Hypoxia Science Panel

MAJOR FINDINGS, RECOMMENDATIONS, AND ACTIONS



APRIL 2016

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CALIFORNIA OCEAN SCIENCE TRUST

CALIFORNIA OCEAN PROTECTION COUNCIL

INSTITUTE FOR NATURAL RESOURCES

This report was produced by the West Coast Ocean Acidification and Hypoxia Science Panel (the Panel), working in partnership with the California Ocean Science Trust. The Panel was convened by the Ocean Science Trust at the request of the California Ocean Protection Council in 2013, working in collaboration with ocean management counterparts in Oregon, Washington, and British Columbia. Ocean Science Trust and the Oregon Institute for Natural Resources served as the link between the Panel and government decision-makers. The information provided reflects the best scientific thinking of the Panel. More information on the Panel can be found at www.westcoastOAH.org.

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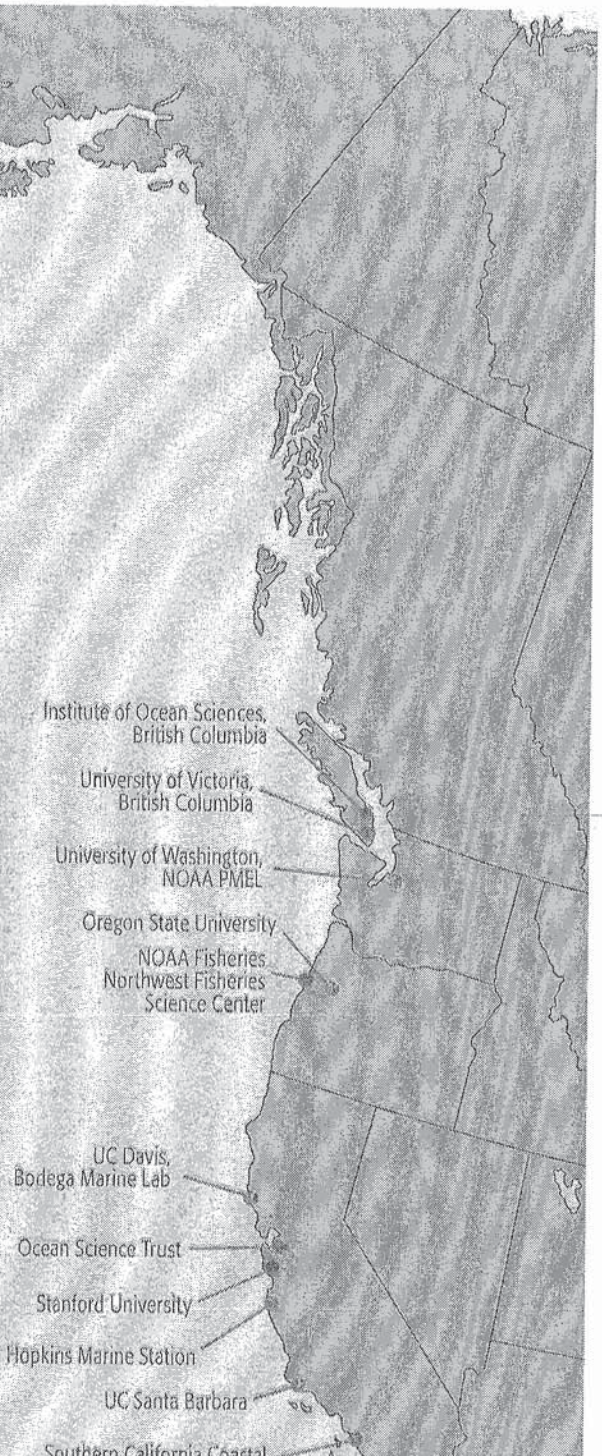
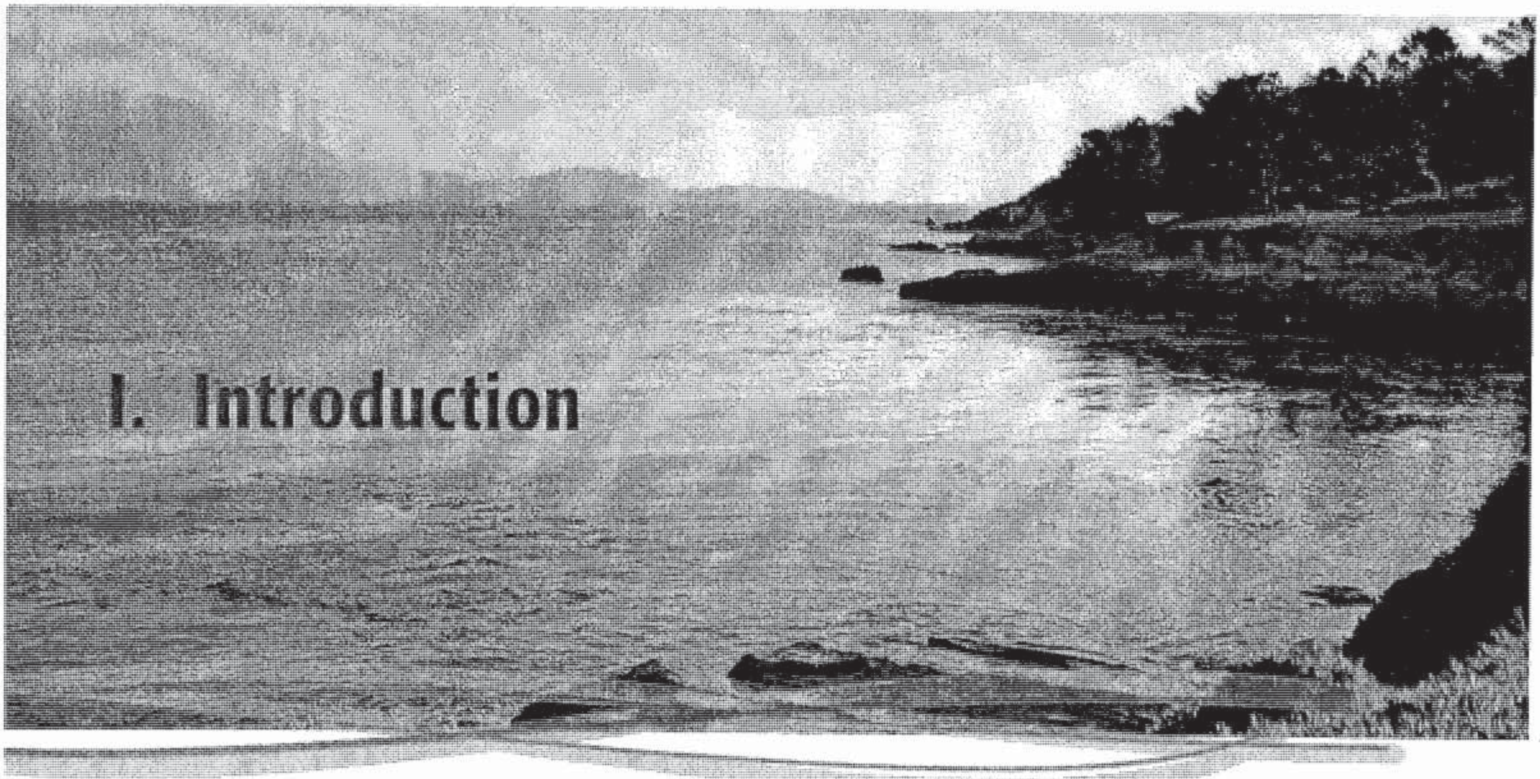




I. Introduction

Global carbon dioxide (CO_2) emissions over the past two centuries have altered the chemistry of the world's oceans, threatening the health of coastal ecosystems and industries that depend on the marine environment. This fundamental chemical alteration is known as ocean acidification (OA), a phenomenon driven by the oceans absorbing approximately one-third of atmospheric CO_2 generated through human activities. Scientists initially observed the impacts of OA on calcifying marine organisms that were having difficulty forming their shells, but additional evidence now indicates that growth, survival and behavioral effects linked to OA extend throughout food webs, threatening coastal ecosystems, and marine-dependent industries and human communities (see Appendix A).

Although OA is a global phenomenon, emerging research indicates that, among coastal zones around the world, the West Coast of North America will face some of the earliest, most severe changes in ocean carbon chemistry. The threats posed by OA's progression will be further compounded by other dimensions of global climate change, such as the intensification and expansion of low dissolved oxygen – or hypoxic – zones. In the coming decades, the impacts of ocean acidification and hypoxia (OAH), which are already being felt across West Coast systems, are projected to grow rapidly in intensity and extent. Even if atmospheric CO_2 emissions are stabilized today, many of the ongoing chemical changes to the ocean are already "locked in" and will continue to occur for the next several decades. Given these challenges, decision-makers must act decisively and in concert now.

In an effort to develop the scientific foundation necessary for West Coast managers to take informed action, the California Ocean Protection Council in 2013 asked the California Ocean Science Trust to establish and coordinate a scientific advisory panel in collaboration with California's ocean management counterparts in Oregon, Washington and British Columbia. The resulting West Coast Ocean Acidification and Hypoxia Science Panel, comprised of 20 leading scientific experts (see V. The Panelists, page 32), was charged with summarizing the current state of knowledge and developing scientific consensus about available management options to address OAH on the West Coast.

This document, "**Major Findings, Recommendations, and Actions**" of the Panel, summarizes the Panel's work and presents **Actions** that can be taken now to address OAH. The appendices to this document contain a series of two-page synopses that provide more detail on many of the key concepts that are mentioned in the main body. In addition to this document, the Panel has produced a number of longer supporting documents intended for agency program managers and technical audiences (see VI. Additional Panel Products Supporting the "Major Findings, Recommendations, and Actions," page 36).

Why ocean acidification AND hypoxia?

OA and hypoxia refer to distinct phenomena that trigger a wide range of marine ecosystem impacts. The Panel considered them together because they frequently co-occur and present a collective West Coast challenge. In particular, OA and hypoxia share a common set of drivers – increased atmospheric CO_2 levels and local nutrient and organic carbon inputs. Consequently, OA and hypoxia can be managed synergistically via an overlapping set of management strategies.

The Panel's products are more focused on OA because our understanding of the effects of OA and its interaction with hypoxia is only beginning to grow. In contrast, scientists have built a sizeable body of research on hypoxia, so its impacts on marine environments are better understood. Note that when the Panel uses the term OAH, it is a deliberate reference to both phenomena collectively; the terms OA, hypoxia and OAH cannot, however, always be used interchangeably.

II. Major Findings

The Panel's scientific experts reached consensus on six **Major Findings**:

1. **OAH will have severe environmental, ecological and economic consequences for the West Coast, and requires a concerted regional management focus.**

   OAH is a problem that is expected to grow in intensity with far greater impacts to come, particularly along the West Coast, where regional ocean circulation patterns dramatically heighten the potentially devastating effects of OAH. Local governments alone do not have the capability to halt fundamental, widespread changes to the chemistry of coastal waters. Decision-makers need a common core of scientific information that will enable them to use limited resources in a strategic, coordinated, regional fashion to best serve the ecological and socioeconomic needs of the entire West Coast region. Appendix B provides more detail about the trajectory of OAH-triggered change, and why the West Coast is more vulnerable than other coastal regions.

2. **Global carbon emissions are the dominant cause of OA.**

   Although this document is focused on how the West Coast is impacted by OA and the associated intensification of hypoxia, OA is a global problem that will require global solutions. Given that the dominant cause of OA is global carbon dioxide emissions, the Panel stands firmly behind multinational efforts to reduce atmospheric carbon dioxide emissions worldwide; humankind's ability to reduce the levels of CO_2 being absorbed by the world's oceans will be the single most important, effective strategy for mitigating OA. To that end, the Panel encourages West Coast leadership to develop a regional carbon management strategy, expanding on initiatives such as California's AB 32 and Washington's Climate Action Team.

3. **There are actions we can take to lessen exposure to OA.**

   Although local actions cannot wholly undo the global impacts of OA, West Coast managers can take action to improve local conditions by managing local factors that contribute to declining water quality. In particular, opportunities exist to implement better controls on nutrients and organic matter pollution that flow from land into coastal waters, as these chemicals provide nourishment for algae and bacteria that, in turn, can trigger hypoxia and exacerbate acidification. In selecting specific areas in which to implement these controls, managers should work closely with scientists, as these actions are typically costly and will not be equally effective everywhere; monitoring and modeling results can be used to inform best options.

4. **We can enhance the ability of ecosystems and organisms to cope with OA.**

   West Coast managers are not limited to mitigating OA; they also can take actions to reduce the negative biological and ecological impacts from OA. Fostering ecosystem resilience – that is, taking management actions intended to support an ecosystem's ability to withstand the impacts of OA – offers a near-term strategy for maintaining functional ecosystems along the West Coast as the environment changes. Managing for resilience can be achieved by expanding and adjusting approaches already in place along the West Coast, including the use of protected areas, ecosystem approaches to fisheries management, and integrated coastal management techniques. The concept of enhancing resilience is more thoroughly explored in Appendix C.

5. **Accelerating OA science will expand the management options available.**

   The state of knowledge about OA and its interaction with hypoxia is rapidly evolving, but is still limited and thus able to inform only a limited suite of management options to date. West Coast managers should be looking for opportunities to foster rigorous, managerially relevant research, develop coordinated cost-effective monitoring programs that continue to provide information about the projected trajectories of OAH, and integrate knowledge from multiple domains into decision-making. As scientific understanding of OAH grows, so will the options available for devising effective, fiscally prudent management strategies.

6. **Inaction now will reduce options and impose higher costs later.**

   It is becoming increasingly clear that OA will cause significant ecosystem changes, with widespread negative consequences that diminish valuable ecosystem benefits and services. Over time, OA conditions will intensify, diminishing opportunities for managers and West Coast communities to adapt to the changing marine environment. Delaying action now could render future management interventions far less effective (detailed further in Appendix D). Actions taken now based on best available science offer the possibility of forestalling at least some of the negative consequences for ecosystems and society.

III. Panel Recommendations

Consistent with these **Major Findings**, the Panel has formulated eight **Recommendations** to guide management responses. These **Recommendations** are divided among three themes:

1. Address local factors that can reduce OAH exposure;
2. Enhance the ability of biota to cope with OAH stress; and,
3. Expand and integrate knowledge about OAH.

For each **Recommendation**, the Panel provides specific **Actions** that can be implemented immediately and largely accomplished within a one-year timespan. The Panel's **Recommendations** and **Actions** highlight avenues where new science can quickly catalyze management options for addressing OAH.

By The Numbers

THREE THEMES

Eight Recommendations

Fourteen Actions

THEME 1
ADDRESS LOCAL FACTORS THAT CAN REDUCE OAH EXPOSURE

Recommendation	Actions
RECOMMENDATION 1 Reduce local pollutant inputs that exacerbate OAH	Action 1.1: Generate an inventory of areas where local pollutant inputs are likely to exacerbate OA. Action 1.2: Develop robust predictive models of OAH. Action 1.3: Develop an incentive-based strategy for reducing pollutant inputs.
RECOMMENDATION 2 Advance approaches that remove CO_2 from seawater	Action 2.1: Use demonstration projects to evaluate which locations are optimal for implementing CO_2 removal strategies. Action 2.2: Generate an inventory of locations where conservation or restoration of aquatic vegetated habitats can be successfully applied to mitigate OA. Action 2.3: Consider CO_2 removal during the habitat restoration planning process.
RECOMMENDATION 3 Revise water quality criteria	Action 3.1: Agree on parameters that will be part of OAH criteria.

THEME 2
ENHANCE THE ABILITY OF BIOTA TO COPE WITH OAH STRESS

Recommendation	Actions
RECOMMENDATION 4 Reduce co-occurring stressors on ecosystems	Action 4.1: Integrate OA effects into the management of ocean and coastal ecosystems and biological resources.
RECOMMENDATION 5 Advance the adaptive capacity of marine species and ecosystems	Action 5.1: Inventory the co-location of protected areas and areas vulnerable to OAH. Action 5.2: Evaluate the benefits and risks to active enhancement of adaptive capacity.

THEME 3
EXPAND AND INTEGRATE KNOWLEDGE ABOUT OAH

Recommendation	Actions
RECOMMENDATION 6 Establish a coordinated research strategy	Action 6.1: Create agreement among the multiple organizations that fund OAH research to establish joint research priorities.
RECOMMENDATION 7 Build out and sustain a West Coast monitoring program that meets management needs	Action 7.1: Define gaps between monitoring efforts and management needs. Action 7.2: Enhance comparability of and access to OAH data.
RECOMMENDATION 8 Expand scientific engagement to meet evolving management needs	Action 8.1: Create a science task force.

THEME 1: ADDRESS LOCAL FACTORS THAT CAN REDUCE OAH EXPOSURE

Recommendation 1: Reduce local pollutant inputs that exacerbate OAH.

While elevated atmospheric CO_2 levels are a major driver of OA, local discharge of organic carbon and nutrients can exacerbate OA. Upon discharge, organic carbon is broken down by bacteria, which consume dissolved oxygen during the decomposition process, triggering hypoxic conditions, increasing CO_2 levels and lowering pH. When nutrients such as nitrogen and phosphorus are introduced to coastal waters, they can trigger proliferation of algae that, following their death, are decomposed by bacteria that further decrease dissolved-oxygen levels and increase acidity. The Panel's recommendation to reduce local inputs is tempered by the recognition that scientists do not yet have adequate information to precisely identify locations where reductions in local inputs can meaningfully mitigate OAH effects. In general, the effectiveness of local actions will be greatest in semi-enclosed water bodies, such as estuaries, where local processes dominate over oceanic forcing. Site-specific evaluations are needed to determine which local input(s) (wastewater discharges vs. non-point source pollution in river discharge or atmospheric deposition) should be the targets of nutrient reduction efforts. Because of uncertainties concerning which local-control strategies will be most effective in reducing OA, West Coast managers may find it advantageous to pursue more than a purely regulatory enforcement strategy. For example, upgrades to wastewater treatment plants or investment in water reuse could be incentivized to design facilities that reduce nutrient discharges. Regardless of whether incentive-based or regulation-based approaches are used to achieve desired outcomes, managers can support the expedited development of predictive OA models that will guide decisions about how to best implement local source controls.

- **Action 1.1: Generate an inventory of areas where local pollutant inputs are likely to exacerbate OA.**

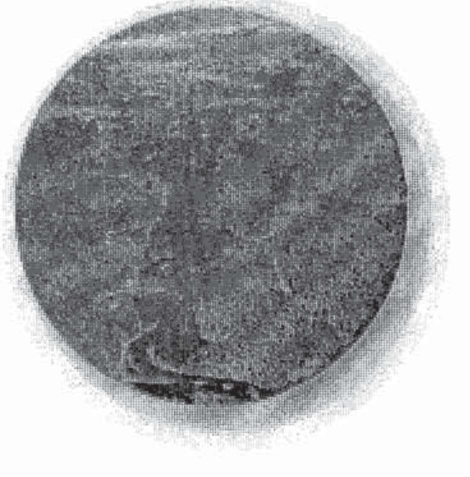
  While local nutrient- or other discharge-related control programs will not be effective everywhere, there are a number of locations where local nutrient inputs are thought to exacerbate OA. West Coast managers should compile an inventory of those locations to focus their initial management efforts, as these locations can serve as testing grounds for understanding the relative successes that can be achieved by reducing local inputs.

- **Action 1.2: Develop robust predictive models of OAH.**

  One method to determine where reduction of local inputs will result in the greatest gains in water quality is through use of coupled physical-biogeochemical models. These models quantify to what degree various nutrient, carbon, and CO_2 inputs influence OAH, and project how these inputs will exacerbate OAH. Several research groups on the West Coast are in various stages of developing such models, but before they can be used to support OAH-related management decisions, further investment is required to enhance and coordinate modeling efforts, and to link them to managerially relevant endpoints. A more thorough discussion of how West Coast managers can enhance the usefulness of these modeling efforts appears in Appendix E. Once models are operational, model outputs should be made accessible for comparisons among models and with monitoring data.

- **Action 1.3: Develop an incentive-based strategy for reducing pollutant inputs.**

  West Coast managers can develop grants, loans and other programs to create financial incentives for both the public and private sector to work proactively toward reducing local inputs that can exacerbate OAH, as well as promote reductions in atmospheric CO_2 emissions.



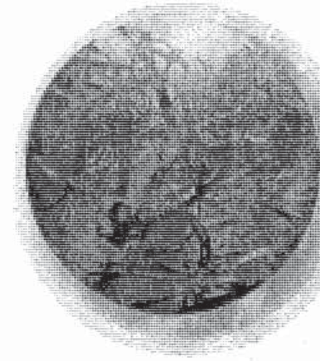
In general, the effectiveness of local actions will be greatest in semi-enclosed water bodies, such as estuaries, where local processes dominate over oceanic forcings.

Recommendation 2: Advance approaches that remove CO_2 from seawater.

Seagrass and kelp beds remove CO_2 from seawater as they grow. This removal of CO_2 has the potential to offset the reductions in pH from OA. Emerging research suggests that conservation or restoration of aquatic vegetation habitats may indeed act to measurably lessen the severity of OA exposure. However, important uncertainties remain about when, where and how broadly local habitat conservation and restoration will mitigate OA exposure (see Appendix F). West Coast managers should actively explore the utility of this mitigation approach.

- **Action 2.1: Use demonstration projects to evaluate which locations are optimal for implementing CO_2 removal strategies.**

  Scientists have conducted research that demonstrates substantive positive benefits from coastal aquatic vegetation on CO_2 removal from seawater. The next step is to transition from these small-scale and short-term research efforts to larger-scale proof of concept demonstration studies across a range of habitats, providing managers with the opportunity to explicitly evaluate under which conditions protection and restoration of vegetated habitats will sufficiently remove CO_2 to meaningfully mitigate OA. These demonstration projects should be accompanied by rigorous monitoring, and physical and biogeochemical modeling to evaluate efficacy of such measures in reducing exposure to OA stress.



Emerging research suggests that conservation or restoration of aquatic vegetated habitats may indeed act to measurably lessen the severity of OA exposure.

- **Action 2.2: Generate an inventory of locations where conservation or restoration of aquatic vegetation habitats can be successfully applied to mitigate OA.**

  The knowledge gained from demonstration projects in Action 2.1 can be used to identify and inventory locations across the West Coast where CO_2 removal strategies can be applied. This inventory can inform comprehensive planning for how local CO_2 removal approaches can be applied relative to other Actions to reduce local inputs of CO_2, non-OA stressors, and enhance ability of biota to cope with stressors.

- **Action 2.3: Consider CO_2 removal during the habitat restoration planning process.**

  A number of investments have already been made to promote aquatic habitat restoration. Carbon offset protocols are also under development in some instances to value the co-benefits from long-term carbon storage of such restoration. However, they do not incorporate the potential benefits of local reductions in OA stress. Accounting for this local ecosystem benefit will assist in better accounting for the full societal value of habitat restoration and management.

Recommendation 3: Revise water quality criteria.

Water quality criteria serve as the foundation for many management activities, providing managers with thresholds to objectively determine the condition of a water body and to set targets for clean-up efforts. As such, they are an initiation point for both planning and implementation activities. However, existing water quality criteria, which were created four decades ago, are not scientifically appropriate for assessing OA conditions. Even when existing water quality criteria for seawater pH are met, a wide range of severe biological impacts of OA are observed. New criteria are needed. The Panel further recommends that OA water quality criteria be expanded to include other acidification parameters, as pH is only one of several possible parameters for describing the carbonate system. One such alternative, aragonite saturation state, has been found to be biologically relevant to a number of calcifying organisms. Appendix G provides additional insight about the need for revised water quality criteria.

- **Action 3.1: Agree on parameters that will be part of OAH criteria.**

  Water quality agencies should lead efforts among water quality and acidification experts to develop scientific consensus about which parameters are most appropriate for inclusion in new water quality criteria. In the immediate future, a scientific workshop is needed to identify appropriate biologically relevant indicators and thresholds to assess OA, and prioritize short-term research needs to support criteria development.

THEME 2: ENHANCE THE ABILITY OF BIOTA TO COPE WITH OAH STRESS

Recommendation 4: Reduce co-occurring stressors on ecosystems.

The ability of marine organisms to grow, survive, and reproduce in the face of OAH is partly dependent on the number, intensity, and interactions of other, non-OAH stresses they encounter, such as physical disturbances to nearshore habitats, warming temperatures, toxic contaminants, biological invasion, and harvest. Thus, it is important for West Coast managers to consider management plans and actions in the context of these multi-stressor effects. For example, the growing adoption of ecosystem approaches to fisheries management offers opportunities to consider the potential regional effects of OAH within the context of other ecological stressors as fisheries management plans are updated.

- **Action 4.1: Integrate OA effects into the management of ocean and coastal ecosystems and biological resources.**

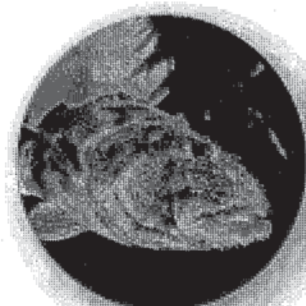
  OA is likely to influence ecosystems along the West Coast via impacts on fish behavior, impaired calcification of shelled organisms, and fundamental changes in food web dynamics. Managers should work to understand and incorporate the probable impacts of OA into management plans for marine managed areas and fisheries. In some instances, this will require bilateral collaboration, for example, between the U.S. and Canada. For fisheries, the most promising avenue for advancing ecosystem-based fishery management along the West Coast is the Fishery Ecosystem Plan (FEP), adopted by the Pacific Fishery Management Council in 2013. The FEP is intended to improve and coordinate fishery management within the California Current Ecosystem by informing decisions made under each individual Fishery Management Plan with broader considerations about the ecosystem. Future updates of the FEP will provide an important opportunity to integrate improved OA knowledge into fishery management decisions, including ways that individual fisheries can be better managed to enhance ecosystem resilience and adaptive capacity under OA.

Recommendation 5: Advance the adaptive capacity of marine species and ecosystems.

Marine species and ecosystems have, to varying degrees, the ability to adjust and persist in the face of changing environmental conditions, a concept known as adaptive capacity. West Coast managers can support their adaptive capacity through relatively passive measures, such as use of protected areas. Managers can also undertake more proactive approaches, such as selective breeding, translocation of organisms that have shown adaptive capacity, and direct modification of genetic material. Genetic intervention efforts are already being explored as a means to improve the adaptive capacity of marine species to OA. The Panel recognizes that these more proactive approaches raise important concerns regarding their potential unintended consequences. Thus, such strategies should only be considered when other means of maintaining and promoting genetic adaptation are infeasible, and only when safety concerns have been addressed.

- **Action 5.1: Inventory the co-location of protected areas and areas vulnerable to OAH.**

  The West Coast includes five National Marine Sanctuaries, five National Estuarine Research Reserves, 15 National Wildlife Refuges, two Canadian marine protected areas, two Canadian Areas of Interest, multiple Essential Fish Habitat conservation areas created by the Pacific Fishery Management Council, 34 Areas of Special Biological Significance established by State of California, and numerous state-managed protected areas. Most protected areas, however, were designed and are being managed without regard to their vulnerability to OAH impacts, because little was known about OAH processes or impacts when most of the areas were established. Nevertheless, some of these protected areas could serve to promote adaptive capacity to OAH. Enhanced diversity and productivity of fish and invertebrate populations and preservation of ecological function within protected areas can strengthen the ability of populations and communities to cope with future OAH impacts. This may be particularly beneficial in instances where protected areas overlap with locations that are likely to face moderated exposure to OAH stress. In contrast, protected areas that are co-located with OAH hotspots offer an environment where biota that develop genetic tolerances to OAH are preserved. Both environments are important to maintaining adaptive capacity. West Coast managers should inventory the co-location of protected areas and areas vulnerable to OAH to assess the number of locations they presently have in the two categories.

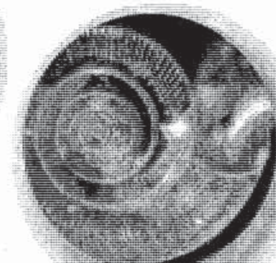


...protected areas that are co-located with OAH hotspots offer an environment where biota that develop genetic tolerances to OAH are preserved.

- **Action 5.2: Evaluate the benefits and risks to active enhancement of adaptive capacity.**

  West Coast managers should facilitate the establishment of a working group of scientists and managers from relevant sectors to engage in joint fact-finding about the potential risks, benefits, and costs of active genetic intervention, such as through the selection, manipulation, and/or translocation of genetic varieties as a strategy for enhancing the persistence of species in mariculture settings and in natural ecosystems under intensifying OAH. Such intervention-based options are already being explored for OA but are occurring in the absence of deliberative guidance from the scientific and management communities. Historically, introductions of new genetic varieties and species on land and in the oceans have caused unintended harmful ecological or economic consequences that outweighed their benefits. The establishment of an active genetic intervention working group will set the stage for assessing the policy context for evaluating and regulating planned genetic interventions.

THEME 3: EXPAND AND INTEGRATE KNOWLEDGE ABOUT OAH



Recommendation 6: Establish a coordinated research strategy.

OA research is still in its infancy, with 75% of all acidification science studies published in the last five years, and only a handful of studies to date that have addressed the combined effects of OA and hypoxia, or OA and temperature, or OA and any other stressor. These constraints limit the ability to formulate options for effective management actions grounded in sound science. Generating more options will require further investment in directed research on OAH and its impacts on marine ecosystems. The research should be driven by management needs and should focus on evaluating the breadth of responses available to management, including scale and cost. The Panel has developed a comprehensive set of recommendations about which research topics are most likely to yield the greatest expansion of management options (see Appendix H), and Appendix H is supported by a separate and more extensive technical document outlining recommendations for research priorities ("*Ocean Acidification and Hypoxia Research Priorities to Inform Decisions and Develop Solutions*").

- **Action 6.1: Create agreement among the multiple organizations that fund OAH research to establish joint research priorities.**

  OAH research is taking place at multiple levels – across a range of federal, state, provincial, local and nonprofit funding sources. West Coast leadership should develop a coordinated long-term vision and funding plan to achieve a sustained, leveraged OAH research strategy for the region. West Coast managers should meet with funding entities to help unify their research around focused management goals and ensure that research efforts are effectively coordinated.

Recommendation 7: Build out and sustain a West Coast monitoring program that meets management needs.

Monitoring is a cornerstone of effective environmental management, highlighting spatial differences in OAH condition, and revealing the trajectory of conditions and providing a means for assessing effectiveness of management actions. OAH monitoring programs have often focused on measuring chemical parameters – such as pH and dissolved oxygen – but managers need a comprehensive program that assesses an array of interrelated physical oceanographic, chemical and biological variables and indices. Moreover, most West Coast monitoring is focused on addressing local issues, but these can readily be coordinated to achieve a regional-level program that addresses management needs coast-wide. A more thorough description about the need and opportunities for enhanced monitoring appears in Appendix I and in a supporting Panel technical document that describes a desired monitoring framework ("*Ocean Acidification and Hypoxia Monitoring Network: Tracking the Impacts of Changing Ocean Chemistry to Inform Decisions*").

...research should be driven by management needs and should focus on evaluating the breadth of responses available to management, including scale and cost.

- **Action 7.1: Define gaps between monitoring efforts and management needs.**

  West Coast managers should cultivate partnerships between monitoring practitioners and decision-makers to better define OAH information needs across ecosystem types and for diverse uses. First, they should build on existing efforts to complete a comprehensive inventory of existing oceanographic and ecological monitoring programs on the West Coast; the goal being to identify what monitoring is being conducted, what management questions these efforts address, what synergies and enhancements could be achieved, what measurements are missing, and what geographic areas have inadequate coverage to meet management needs.

- **Action 7.2: Enhance comparability of and access to OAH data.**

  Data comparability among disparate programs is necessary to achieve an understanding of OAH. West Coast managers should facilitate training and quality assurance procedures that will enhance comparability among programs. Furthermore, managers should work toward a consistent level of data discoverability, ensuring that the OAH community can make effective use of OAH data. Development of centralized portals for OAH monitoring data will allow this key information to be linked and shared, ensuring that monitoring can be used effectively to inform further research and ultimately management actions. This portal can also be used to access OAH model outputs.

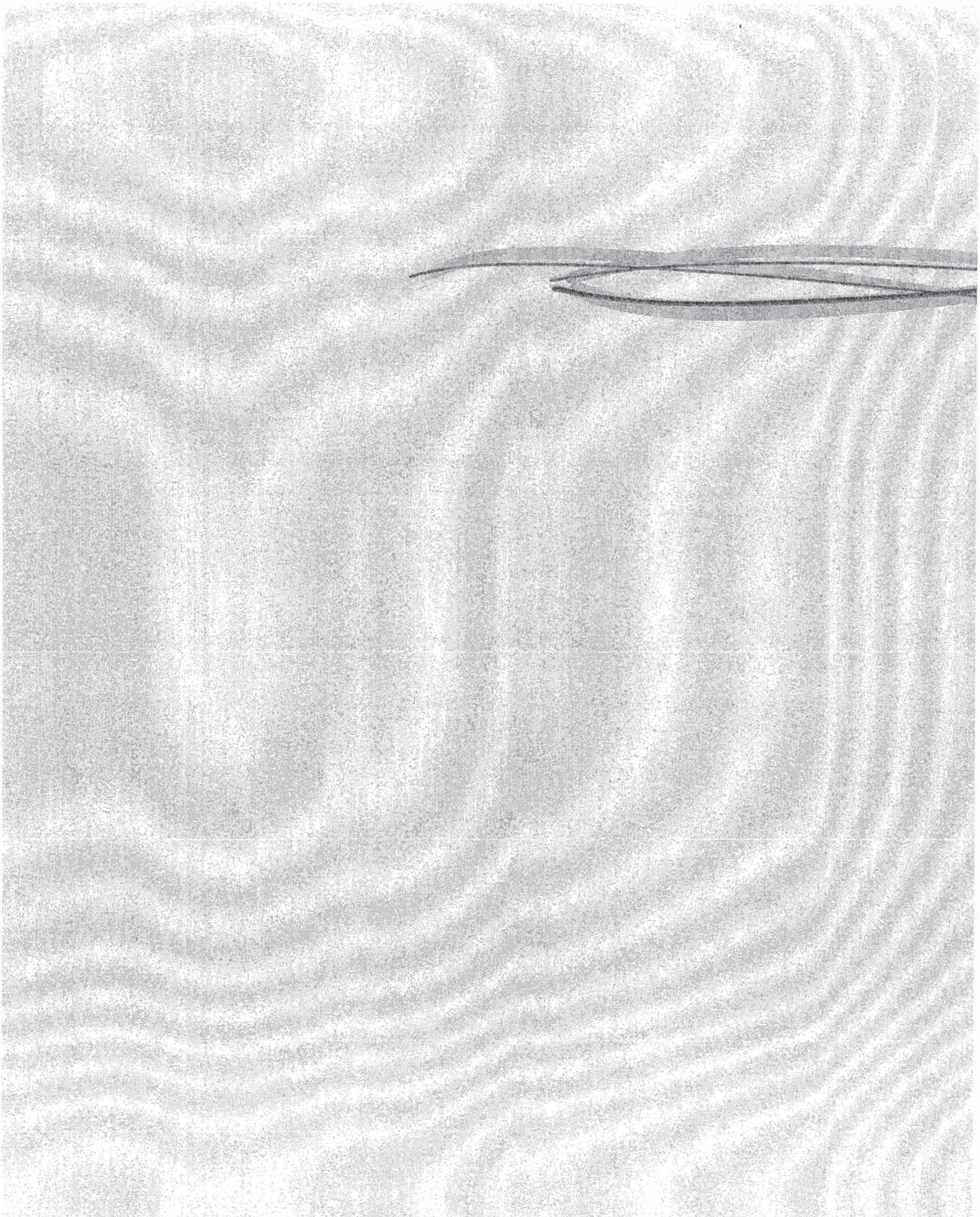
Recommendation 8: Expand scientific engagement to meet evolving management needs.

Over the past two years, the Panel has not only created a set of written products outlining its "**Major Findings, Recommendations, and Actions**," but has also taken advantage of an unprecedented opportunity to network, convey relevant scientific perspectives, and build a community within a relatively nascent research area. Going forward, the region will benefit from this continued thoughtful interaction among scientists that is simultaneously focused and region-wide, and enhanced dialogue between scientists and managers. This is a rapidly evolving field, so cross-boundary communication is crucial to ensuring that new science products developed from research initiatives are appropriately vetted and communicated for use by the management community.

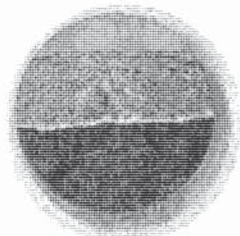
- **Action 8.1: Create a science task force.**

  West Coast managers will need a highly qualified body of scientists to advise them as new science develops in this rapidly evolving field. Given our West Coast-wide scientific commitment, investment, and momentum, this should remain a West Coast regional body with representation from California, Oregon, Washington, British Columbia, Alaska and Mexico as this issue will transcend state and federal geographic boundaries. The task force can evolve from the existing OAH Panel, but it should be refined to focus expertise on topic areas that align with management needs. A West Coast science task force will ensure that managers and legislators continue to be equipped with the most up-to-date information to make important decisions to protect the West Coast.

A West Coast science task force will ensure that managers and legislators continue to be equipped with the most up-to-date information to make important decisions to protect the West Coast.



IV. Appendices



APPENDIX A:
Why West Coast managers should care about ocean acidification

APPENDIX B:
Why the West Coast is vulnerable to ocean acidification - and what we can learn from it

APPENDIX C:
Managing for resilience to address ocean acidification and hypoxia

APPENDIX D:
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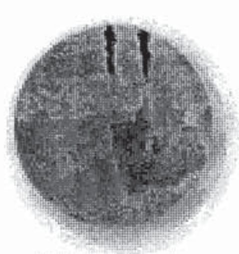
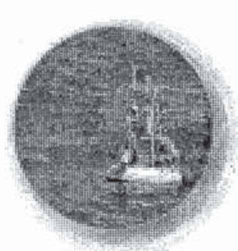
APPENDIX E:
Using modeling to enhance understanding

APPENDIX F:
Approaches to reduce CO_2 in seawater

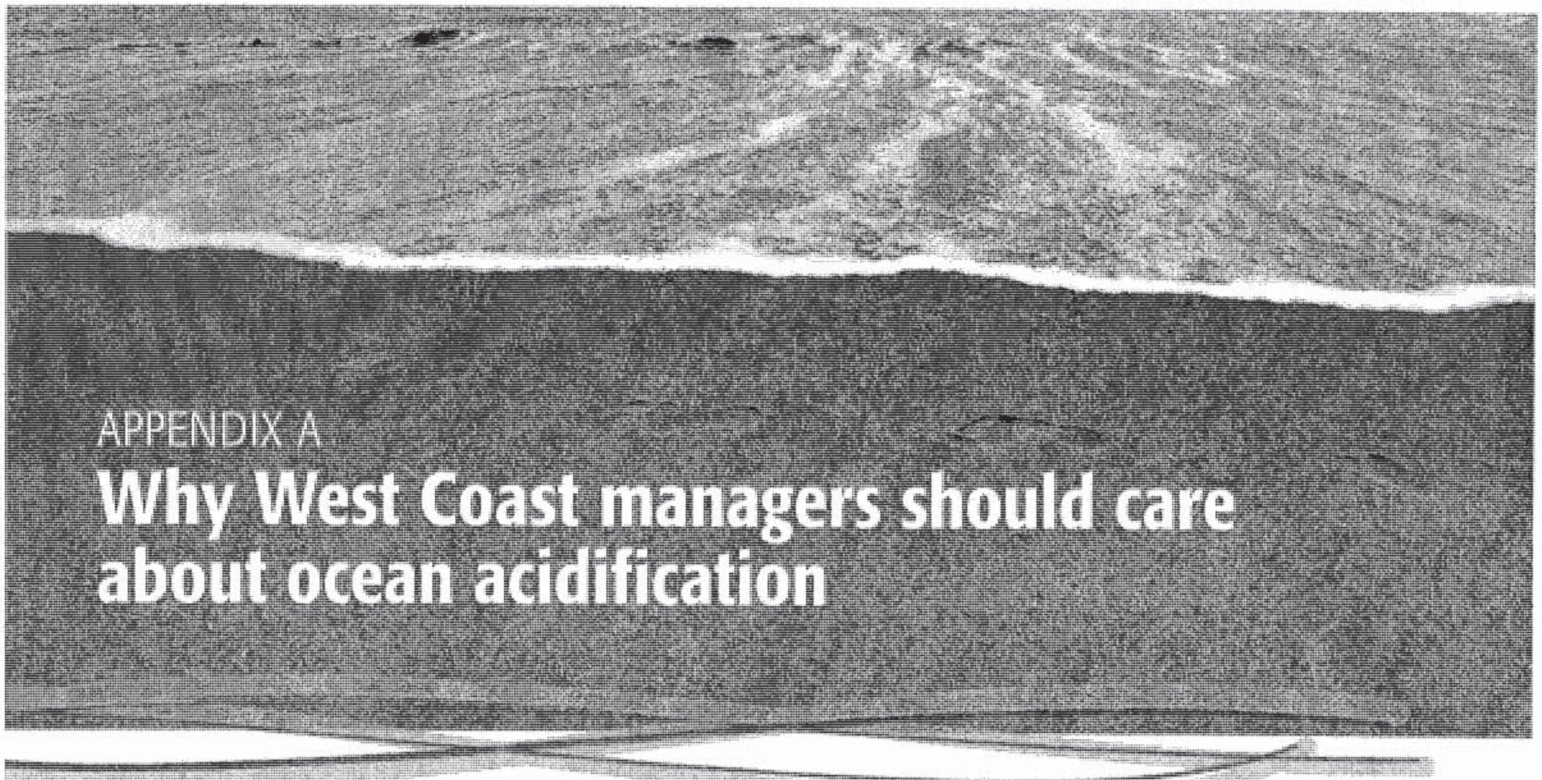


APPENDIX G:
Existing water quality criteria are inadequate to protect marine ecosystems

APPENDIX H:
Establishing ocean acidification and hypoxia research priorities



APPENDIX I:
Tracking changing ocean chemistry through an ocean acidification and hypoxia monitoring network



APPENDIX A

Why West Coast managers should care about ocean acidification

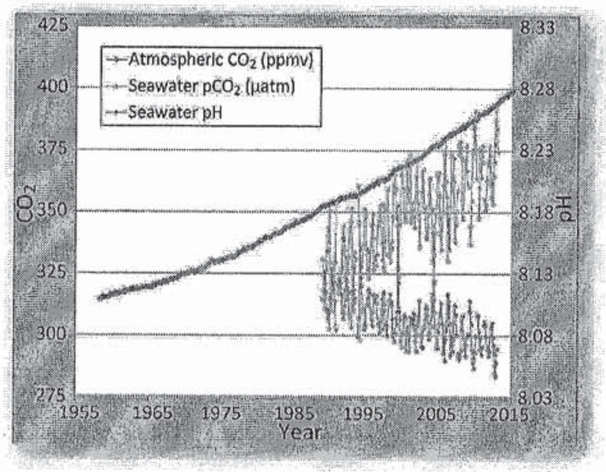
Ocean acidification is already posing a substantial threat, even if it's just beginning to enter the public consciousness.

In the same way that legacy pollutants in the marine environment inspired a generation of environmental activism in the 1970s and 80s, ocean acidification (OA) will define West Coast environmental management in the coming decades. OA endangers not only the biological health of marine organisms but also the numerous economic and societal benefits that stem from the West Coast's dependence on its coastal waters. The Panel unanimously and vigorously affirms that acidification of coastal waters is an undeniable, pervasive issue whose impacts have only begun to be felt.

1. Ocean chemistry is changing at an alarming rate, with no projected end or slowdown in sight.

- **Rapid change:** The fundamental alteration of the ocean's chemistry from continued absorption of atmospheric CO_2 is indisputable. At the current rate of global CO_2 emissions, the average acidity of the surface ocean is expected to double over pre-industrial levels by the end of this century.
- **Consequential change:** Seemingly small changes in ocean pH – which serves as a measure of acidification – are anything but small, as pH is expressed on a logarithmic scale. The 0.1 pH units of change that the ocean has recently experienced is equivalent to a 30% increase in acidity. For some organisms, this can be the difference between being able to grow a shell and having their shell dissolved.

...the average acidity of the surface ocean is expected to double over pre-industrial levels by the end of this century.



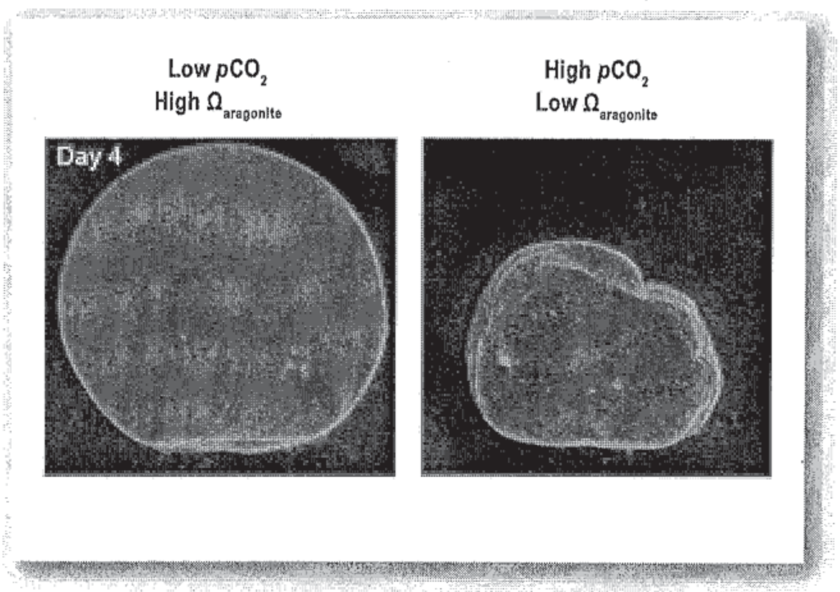
Credit: Modified after R.A. Feely, Bulletin of the Meteorological Society, July 2008.

2. West Coast ecosystems are already facing the pervasive impacts of OA.

- **Shell-forming abilities crippled:** Even small increases in acidity of the local water can dramatically reduce the ability of marine organisms to properly grow shell or skeletal structures. Shellfisheries are particularly vulnerable. Oyster hatcheries are seeing high mortality rates during early life stages when shell formation is critical. In 2007, hatchery managers began to experience a severe loss of oyster seed stock as a consequence of OA, which led to acute shortages available to oyster growers up and down the West Coast.
- **Reverberation through food webs:** Microscopic algae and zooplankton that form carbonate structures during their life cycle are at risk, resulting in consequences for marine food webs. For example, swimming sea snails known as pteropods, serve as an important food source for many West Coast fisheries species, including herring, mackerel and salmon. In some locations, more than 50% of these sea snails are already showing signs of shell dissolution. The evidence is compelling, with studies demonstrating that the percentage of pteropods affected by shell dissolution corresponds with local acidity levels.
- **Effects extend beyond shelled organisms:** Rising CO_2 in seawater has been found to disrupt basic neural function and sensitive skeleton structure in marine fishes. These disruptions adversely affect critical behaviors such as orientation, distinguishing predators from prey, finding food, and identifying appropriate habitats. Scientists' understanding of how OA impacts organisms and ecosystems continuously expands, so effects will likely extend beyond those described here.

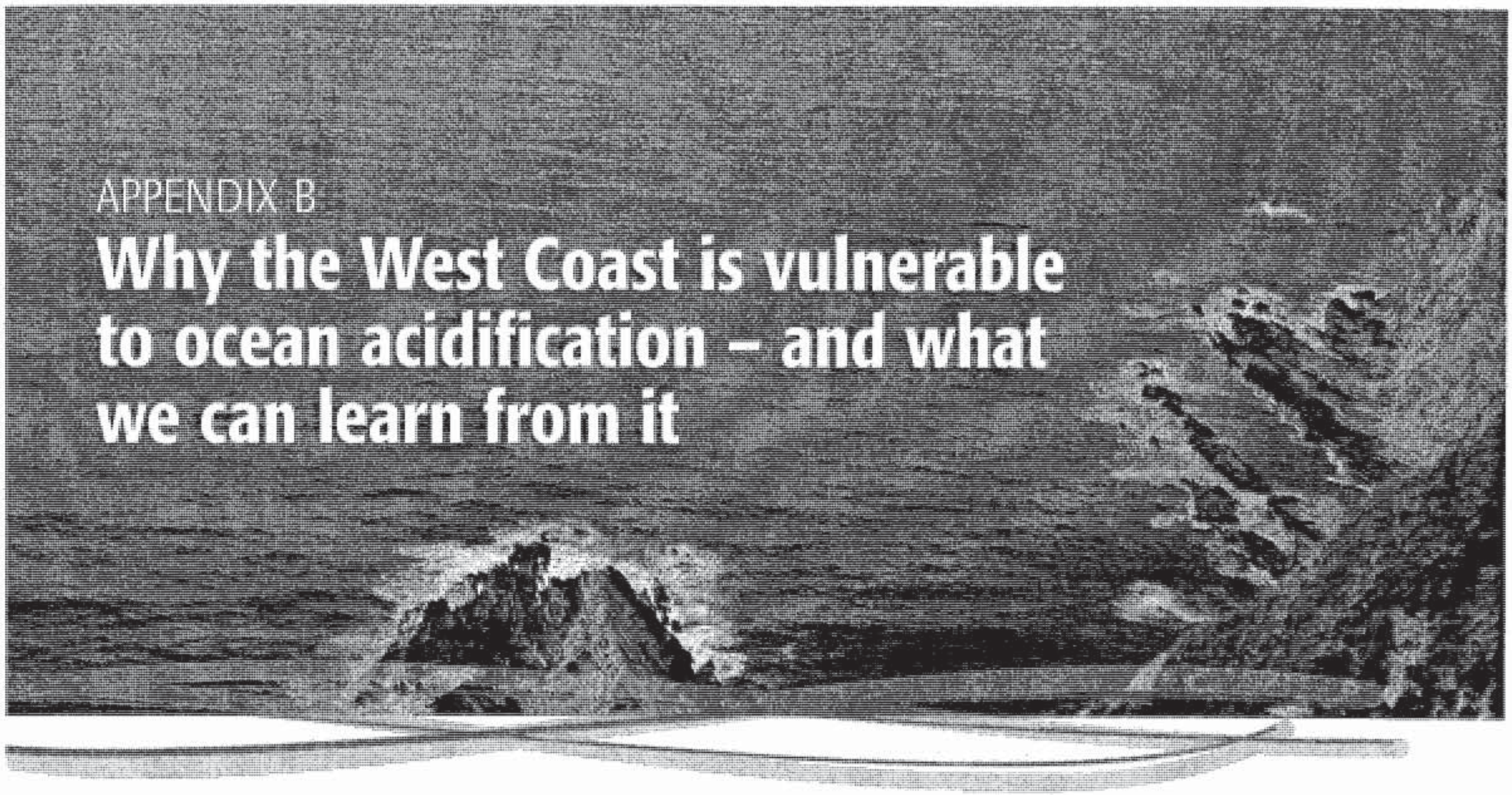
3. The consequences of OA are affecting ocean industries, with effects projected to worsen over time.

- **Operational disruption:** A West Coast shellfish farmer has relocated his hatchery to Hawaii, where exposure to low-pH marine waters is less than along the West Coast. Other hatcheries have invested in building expensive monitoring and water conditioning systems as necessary to maintain their West Coast operations.
- **Economic loss:** Oyster production in the Pacific Northwest declined 22% between 2005 and 2009 (13% decline in gross sales). In Washington and Oregon alone, two of the three major West Coast oyster seed hatcheries experienced production declines of up to 80% from 2006 to 2009. A Canadian company reported that it lost $10 million during its scallop harvest in 2014 in part due to OA. As the OA trajectory continues, a range of shellfish industries, including those for oysters, mussels and crabs, will be subject to economically devastating losses.
- **Domino effects of job losses:** Washington State's commercial and recreational fishing industries generate $8 billion in sales and 65,000 in jobs annually. In Oregon, the commercial and recreational fishing industries generate $1.5 billion in sales, and 19,000 jobs annually. Lastly, sales generated by the commercial and recreational fishing industries in California are $25.7 billion, and 158,000 jobs generated annually. As these industries endure future increases in acidification, the impacts could set off a domino effect of job losses throughout coastal communities, particularly in places where the fishing industry and coastal tourism provide the economic base.



Even small increases in acidity of the local water can dramatically reduce the ability of marine organisms to properly grow shell or skeletal structures.

Figure. Pacific oyster larvae from the same spawn, raised by the Taylor Shellfish Hatchery in natural waters of Dabob Bay, WA having favorable (left, $pCO_2 = 403$ ppm, $\Omega_{aragonite} = 1.64$, and pH (total) = 8.00) and unfavorable (right column, $pCO_2 = 1418$ ppm, $\Omega_{aragonite} = 0.47$, and pH (total) = 7.49) carbonate chemistry during the spawning period.
Photo credit: Brunner/Waldbusser.



APPENDIX B

Why the West Coast is vulnerable to ocean acidification – and what we can learn from it

Ocean acidification (OA) is a global problem triggered by the world's oceans absorbing society's CO_2 emissions from the atmosphere, but the effects of OA will manifest unevenly in different regions of the world. The West Coast of North America – among the first and most prominent regions being impacted by OA – is especially vulnerable because of a confluence of factors affecting this ecologically and economically significant region. However, as OA's global impacts intensify, other regions of North America – from the fisheries-dependent Gulf Coast to the slow-flowing embayments of New England – also will be altered by OA. Thus, the West Coast can and should serve both as a harbinger of OA's impacts worldwide and as a case study on how to develop a highly effective, region-specific science strategy for reducing the threat of OA on the West Coast and other regions of North America.

A confluence of factors makes the West Coast particularly vulnerable to ocean acidification; a regional, coordinated science approach is the best strategy to mitigate impacts.

A confluence of factors makes the West Coast especially vulnerable to OA

OA along the West Coast is being driven by a confluence of conditions that will create increasingly severe impacts over the foreseeable future. There are two primary natural phenomena that work in concert to heighten the region's vulnerability to global CO_2 emissions:

1. **Ocean currents:** Acidification of West Coast waters originates with oceanic currents that transport waters across the northern Pacific Ocean from Asia to the West Coast. The journey for these waters – which takes about 30 years but can be as long as 50 years – begins off the coast of Japan, where surface waters absorb atmospheric CO_2 produced through global human activity and then sink hundreds of feet beneath the ocean's surface. As these subsurface waters move toward the West Coast, CO_2 levels rise even more as natural respiration processes break down sinking organic matter (and deplete dissolved oxygen). Because these deep waters are naturally enriched in CO_2, the added CO_2 from atmospheric emissions has a disproportionately large impact on ocean chemistry.

2. **Coastal upwelling:** Along the West Coast, winds that blow southward push surface waters away from the coastline. As surface waters are displaced, the deep waters rich in CO_2 and poor in dissolved oxygen (DO) are pulled to the surface in a process known as upwelling. Upwelling spreads CO_2-enriched waters across the entire continental shelf, pushing chemical conditions past biological thresholds for harm in many coastal zones.

Because these physical and biogeochemical processes play out over a multi-decade timeframe, the effects of West Coast OA are projected to become increasingly severe over time. Three decades ago, atmospheric CO_2 levels were about 16% lower than they are today. Thus, the waters already in transit to the West Coast will carry an increasingly heavy anthropogenic CO_2 burden as they arrive on West Coast shores. In fact, even if atmospheric CO_2 emissions could immediately be stabilized, the West Coast would still be grappling with increasingly CO_2-rich waters for at least the next three decades.

Compounding these challenges is global climate change, which is also triggered by rising CO_2 emissions. As the world's oceans warm, seawater will become less able to hold DO, and the difference in temperatures between surface waters and deeper waters will grow bigger, reducing the oxygen resupply to deeper waters. Both trends will result in larger and more severe low oxygen, or hypoxic zones. Meanwhile, West Coast upwelling is projected to intensify as the winds that drive upwelling strengthen in response to global warming. Because upwelled waters are also depleted in DO, the progression of OA in many parts of the West Coast will take place against a backdrop of increasing risk of hypoxia events. This co-occurrence of hypoxia poses further challenges for organisms already subject to OA stress, increasing the vulnerability of the West Coast region to the effects of rising CO_2 emissions.

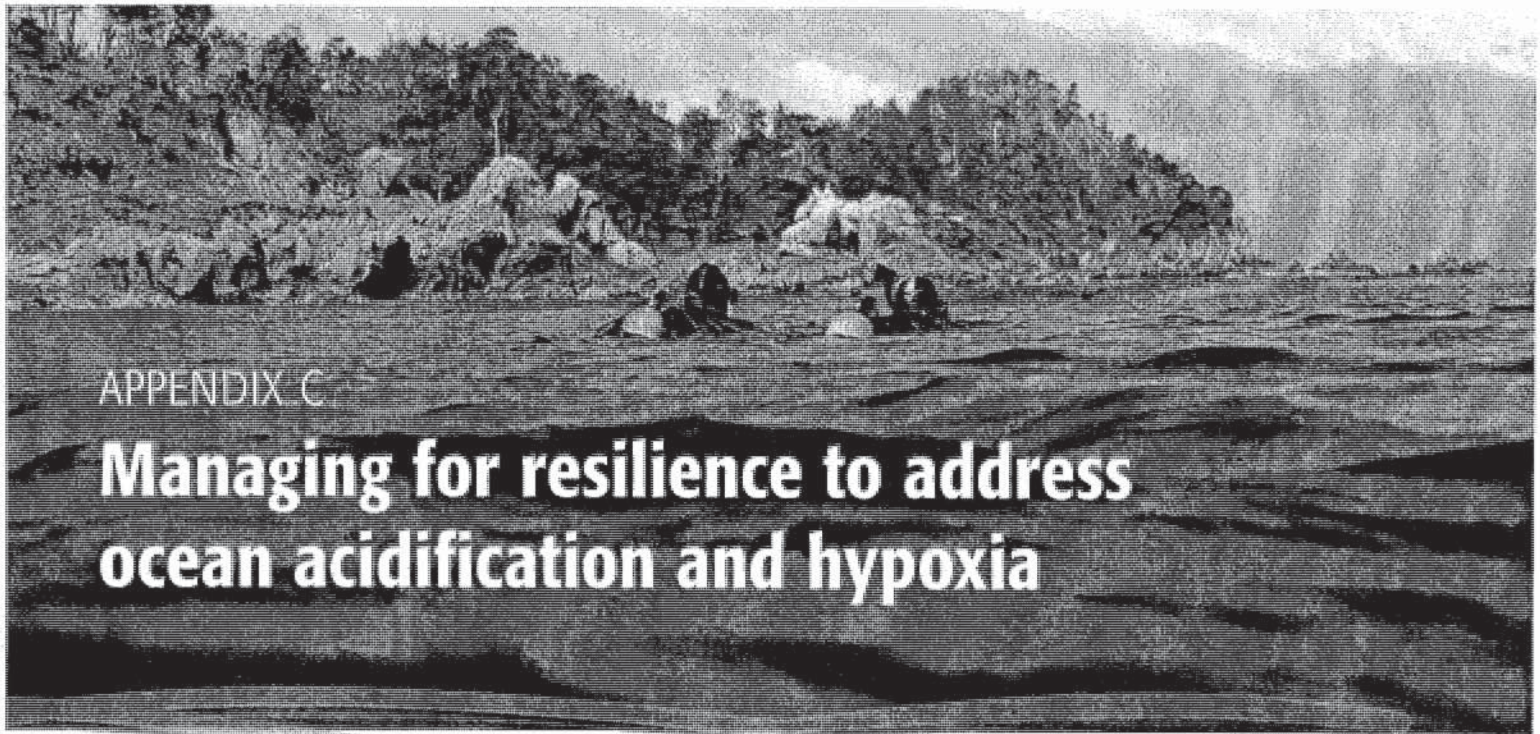
The most effective way to reduce West Coast vulnerability is through coordinated science

Because OA is a regional problem for the West Coast, the best way to mitigate OA's impacts is a regionally coordinated scientific research and monitoring strategy. Scientists and managers from across the West Coast can work together toward reducing OA's impacts on coastal ecosystems. A coordinated approach can take advantage of scientific commonalities that link the geographically and ecologically disparate areas that make up the West Coast region. For example, while Southern California's highly urbanized coastline may bear little resemblance to the minimally developed outer coast of Washington, they share many species of marine life in common. In fact, many important fishery species such as hake, tuna, and sardines move readily across state and national borders. Even for bottom-dwelling invertebrates such as Dungeness crabs, clams, and mussels, local populations can be genetically connected over large distances by the dispersal of planktonic young on ocean currents. Insights into biological vulnerability gained from one region can thus quickly inform information needs in another. Likewise, projections of ocean chemistry changes in any local ecosystem will require input from coast-wide models that set the stage for broader-scale patterns and trends in exposure. The development of such crucial coast-wide models is already underway and offers another avenue to accelerate access to knowledge needed across the region.

While local modeling and monitoring efforts are critical, they can have tremendous added value when they are linked together in a region-wide context that matches the regional scope of West Coast OA. By forming collaborative partnerships that leverage regional expertise and resources, and reduce redundancies, the West Coast can take advantage of economies of scale to mount a strong defense against this intensifying region-wide problem. OA knows no political boundaries and cannot be managed within defined jurisdictional borders, underscoring the value of highly coordinated, leveraged science.

The West Coast can serve as a proving grounds for strategic OA management

The West Coast will be a harbinger for the types of OA impacts that will be widely felt across coastal North America in the coming decades. By working in a coordinated fashion, scientists can provide managers with useable knowledge and information that informs and supports their OA management decisions. Just as importantly, the West Coast can serve as a proving ground for strategic OA management in other regions of North America and the world. Even within the West Coast region, "one size fits all" approaches are unlikely to be successful, as local factors that amplify or dampen OA vulnerability will differ with geography. Consequently, the vast and varied West Coast region offers the opportunity to test and compare diverse strategies, models and guides that can be transferred to other regions of North America.



APPENDIX C

Managing for resilience to address ocean acidification and hypoxia

The term "resilience," as applied here, refers to the adaptive capacity of ecological systems to cope with and recover from the impacts of ocean acidification and hypoxia (OAH) and other stressors. Here we provide the Panel's suggestions for how the management community can support ecological resilience under conditions of intensifying OAH by undertaking targeted actions that preserve or enhance the capacity for ecological systems to cope with and recover from OAH. Managing for resilience includes adaptation measures that seek to proactively lessen the impacts of OAH, and mitigation approaches that reduce exposure to co-occurring stressors. Such actions can be applied now to address impending changes in ocean chemistry. While intensifying OAH conditions may eventually cause some ecosystems to change substantially or irreversibly, over the near-term, managing for resilience represents an important strategy for "buying time" to slow the onset and reduce the scope of harmful ecosystem changes.

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Ecological concepts that underlie managing for resilience

Resilience spans many scales of biological organization, ranging from short-term physiological adjustments that take place within individual organisms, expression of adaptive capacity through evolutionary changes in populations, to the maintenance of ecological function by species turnover at the scale of ecosystems. Despite the number and complexity of biological and ecological processes that contribute to ecological resilience, scientists have been able to identify a specific set of desired attributes of resilient systems that are well-suited for protection or enhancement via management intervention. These general attributes include diversity, redundancy, modularity, connectivity, and adaptive capacity. For example, diversity in the form of a species-rich and functionally-redundant community of aquatic vegetation can be fostered by habitat protection measures. The resilience of fish populations can be promoted through harvest regulations that maintain broad distributions in age class structure and the contribution of sub-populations to a fishery. Population connectivity and, to a lesser extent, modularity, are already central elements in the design of coastal protected area networks.

Managers can also develop solutions that foster resilience by focusing on stressors that co-occur with OAH, such as physical disturbances to nearshore habitats, warming temperatures, toxic contaminants, biological invasion, and harvest. Co-occurring stressors can diminish the ability of ecological systems to cope with OAH, but may be amenable to control through management action.

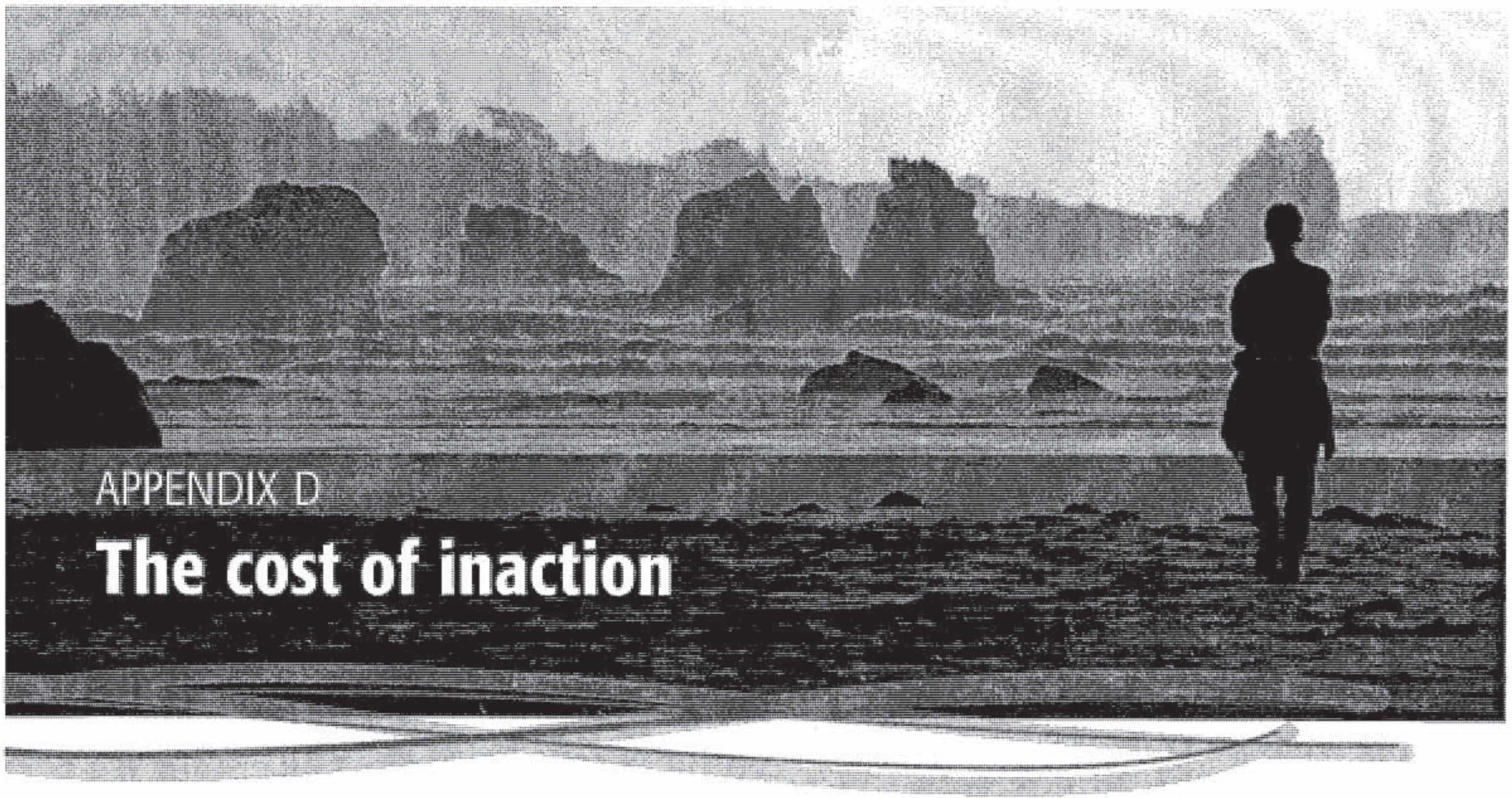
Maximizing benefits from managing for resilience

Although managing for resilience is a useful near-term management strategy for coping with OAH, the adaptive capacity of West Coast ecosystems is not limitless. Managing for resilience is likely to become less and less effective as OAH intensifies and degrades precisely the biological and ecological attributes that confer resilience to populations, communities, and ecosystems. Where and when managing for resilience is likely to be most successful is also likely to vary greatly among systems and from place to place, but understanding of this variation is poorly developed for OAH. Identifying priority candidate fisheries or systems where the development and implementation of resilience-focused management plans are most likely to be beneficial would be an important first step in managing for resilience across the region.

Resilience management can involve actions to prevent the loss of resilience from status quo conditions, or interventions that enhance the resilience of a system in the face of intensifying OAH stress. The effectiveness of either approach will depend on establishing metrics of resilience, defining targets and goals, and developing the ability to track changes in resilience and intervene adaptively if goals are not met. Because preserving and enhancing resilience to OAH are not currently explicit goals of natural resource management, metrics to quantify resilience, targets for those metrics and approaches to monitor changes in resilience have yet to be fully developed.

Increasing the capacity to hone such tools is an important opportunity to advance managing for resilience from conceptual strategy to concrete implementation. For now, managers will need to work with scientists to develop, test, and refine such approaches in real world applications.

Resilience management can involve actions to prevent the loss of resilience from status quo conditions, or interventions that enhance the resilience of a system in the face of intensifying OAH stress.



APPENDIX D

The cost of inaction

Failure to take action will reduce management options and trigger more severe ecological harm

Marine ecosystems, and the industries that depend on them, face growing risks of widespread harm that will become increasingly difficult to reverse as rising CO_2 emissions intensify ocean acidification and hypoxia (OAH). Thus, the cost of inaction on OAH, in the form of reduced management options and wider ecological changes, will rise over time. Scientists are working to understand where and when OAH's aggregate impacts will cross thresholds, or "tipping points," where ecosystems switch to significantly degraded or altered states from which recovery becomes increasingly unlikely. Scientists also are continuing to evaluate what actions West Coast managers can take now to slow the progression of OAH and mitigate its most ecologically and economically threatening impacts.

The full scope of ecological changes ahead is not yet well understood or described, and, as with any area of scientific projection, understanding will come qualified by caveats about scientific and statistical uncertainty. While skeptics might argue that West Coast managers should wait to take action until these uncertainties are resolved, the Panel strongly disagrees with that assessment. OAH science allows researchers to link various observational and modeling data to develop reasoned, informed projections that can help bound expectations about what the world might look like in 1 year, in 10 years, in 50 years. These projections will change as scientific understanding of OAH improves, but the general trends are clear.

...the cost of inaction on ocean acidification and hypoxia, in the form of reduced management options and wider ecological changes, will rise over time.

Science supports the decision to act now to start addressing OAH

The Panel's rationale for why West Coast managers should take action now includes:

1. Larger and more rapid changes in ocean chemistry lie ahead.

Continued atmospheric CO_2 emissions will alter the chemistry of coastal waters in ways that will fundamentally make it more difficult to support ecosystems and the benefits that they provide to humans today. These changes in ocean chemistry are not projected to occur in a simple incremental fashion, as non-linearities in the carbonate system amplify the impacts of future rise in seawater CO_2 content. Larger and more rapid changes can also arise from processes associated with climate change and nutrient inputs that enhance inorganic carbon loading and the intensity of ocean hypoxia.

2. The risk of crossing biological and ecological thresholds will increase as OAH stress intensifies.

In addition to non-linear changes in ocean chemistry, scientists also expect impacts on marine life populations and ecological communities will rise non-linearly as the intensification of OAH stress exceeds the physiological tolerance of an increasingly large suite of species that interact within coastal food webs.

3. Predictive power will decrease as the effects of OAH move deeper into uncharted territory.

As the West Coast moves away from presently observable states of ocean chemistry and ecology, it will become harder for scientists to predict with confidence how ecological systems will be affected by OAH. Thus, West Coast managers will benefit from slowing OAH's impacts, as it will help to preserve access to the best-constrained assessments of risks and options.

4. Degraded systems may become less resilient to OAH stress.

Emerging science suggests that as ecosystems become degraded by OAH and other stressors, they become less resilient and less able to withstand increased OAH stress going forward. This suggests that taking actions now to prevent the loss of resilience can lessen the impacts of OAH in the future.

5. Reversing OAH degradation later will involve greater effort and/or longer lag times.

Preventing declines in populations or ecosystems is often more tractable and less costly than reversing declines once they have occurred. For example, challenges in rebuilding fish populations once genetic diversity is lost, or restoring habitats once they have shifted into a less desired state, illustrate the difficulty of reversing ecological degradation. By allowing more changes to manifest before taking management action, OAH effects may become more difficult and perhaps impossible to reverse.

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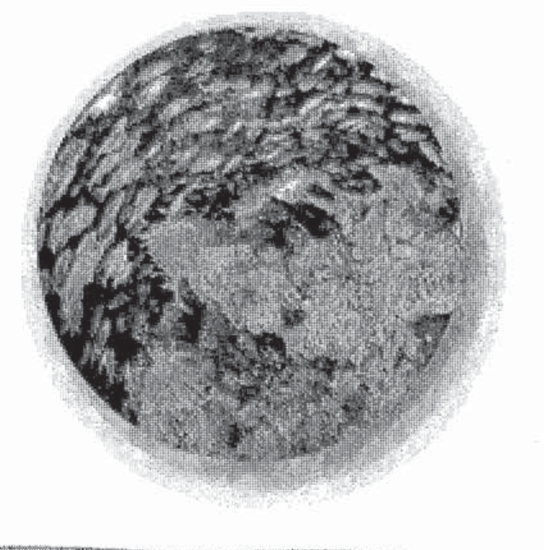
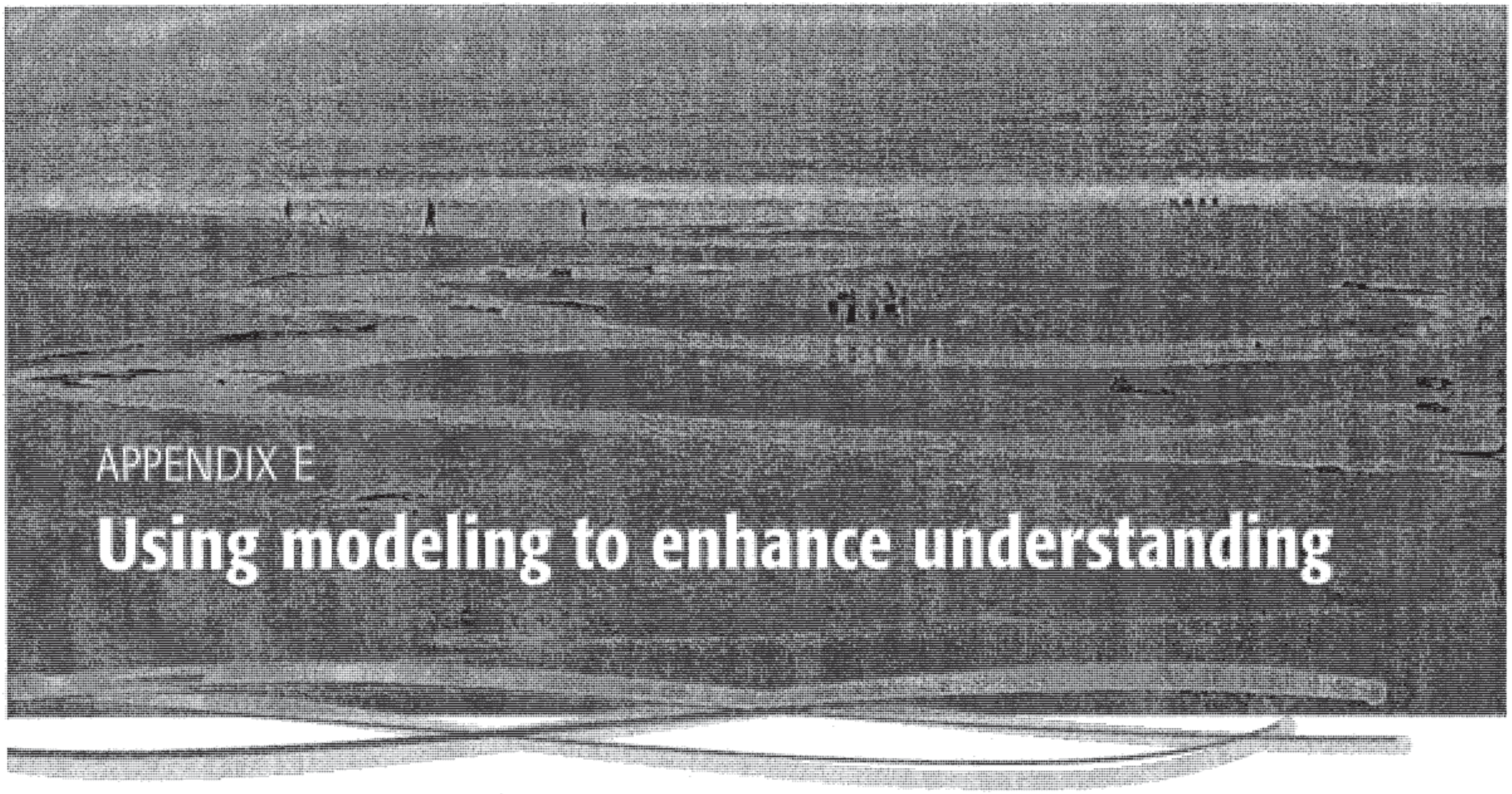




APPENDIX E

Using modeling to enhance understanding

Predictive mathematical models that provide insight into the potential ramifications of ocean acidification and hypoxia (OAH) play an instrumental role in scientists' ability to offer a suite of management options that address OAH in an informed, scientifically defensible fashion. Modeling tools allow scientists to forecast what future conditions will look like, to interpolate limited data sets to build a comprehensive picture of conditions, to evaluate likely success of potential management actions, to prioritize data gaps, and to evaluate monitoring plans.

OAH models will allow coastal managers to make better-informed decisions about implementing controls on local pollution sources that are exacerbating OAH, and to engage in ecosystem-scale resource management planning. Multiple research groups are already in various stages of developing such models, but efforts to date are limited in several respects. First, OAH model development has primarily focused on large oceanic scales, leaving important knowledge gaps in scientists' ability to predict OAH dynamics in near-coastal waters, estuaries and bays that are the primary focus of potential management action. Second, physical models that describe the movement of ocean water across space and time have not yet been systematically coupled with biogeochemical models, which describe how various environmental elements together exert collective effects on OAH chemistry, or with ecosystem models that integrate physical, biogeochemical and ecological properties to predict effects on marine life populations and whole ecosystems.

Thus, additional investments in OAH modeling work are needed to enhance, coordinate and link existing modeling efforts to OAH-related management decisions. The Panel recommends that West Coast managers and the scientific community move forward by building and improving upon both coupled physical-biogeochemical models and fishery and ecosystem models. These models should be validated with management endpoints in mind and against various settings. The modeling community would also benefit from a modeling forum to promote collaboration and interaction with managers. These recommendations are outlined in greater detail here.

OAH models will allow coastal managers to make better-informed decisions about implementing controls on local pollution sources...

OAH Modeling Recommendations

1. Invest in a suite of coupled ocean-margin physical and biogeochemical models.

Although a nested set of physical and, to a lesser extent, biogeochemical models has already been developed for the West Coast, these models have coarse resolution that inhibits their application in areas that are the focus of management concern. West Coast managers should build capacity for downscaling these physical models, extending them closer to shore, and integrating them with biogeochemical models to create high-resolution, coupled models.

2. Improve fishery and ecosystem models.

Although a broad suite of models are currently employed to inform fishery management and predictions of ecosystem changes along the West Coast, the objectives of these efforts have generally fallen outside the scope of OAH management needs. Fishery and ecosystem models will be crucial for understanding and predicting the full extent of OAH impacts. The utility of these models, however, will depend on how biological and ecological responses of OAH are parameterized, and how outputs from coupled physical-biogeochemical models are utilized. To better support marine resource decisions, scientists should prioritize research that yields parameterize-able understanding of the biological and ecological impacts of OAH, and improvement in the capability of fishery and ecosystem models to be informed by advances in coupled physical-biogeochemical models.

3. Validate the models.

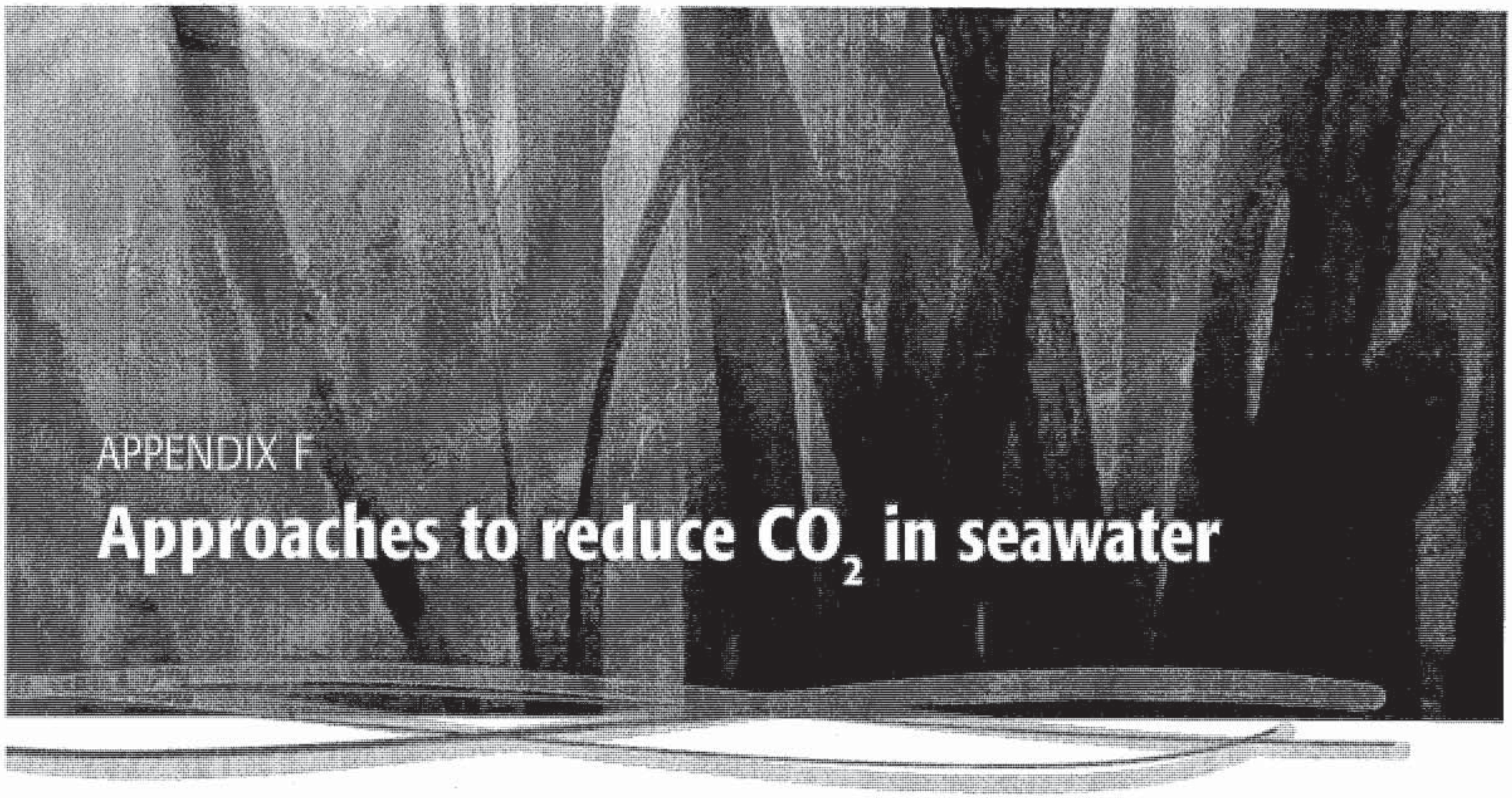
The management decisions that will be based on model outputs are likely to be costly. As such, models should be validated and improved with endpoint management decisions in mind, and with a focus on identifying knowledge gaps and quantifying uncertainty. Validation efforts should extend explicitly into near-coastal areas where temporal and spatial variability are the highest, and where a large number of management decisions are concentrated. Scientists should first seek to validate existing models using observational data for a broad range of climate and ecosystem states, with a focus on quantifying uncertainties and identifying key gaps in data and modeling infrastructure. Second, scientists should compare the outputs of multiple models to constrain uncertainty in their projections, which could ultimately pave the way for development of the next generation of models.

4. Collect data to support model development and refinement.

The ability of models to make accurate predictions of future ecosystem changes – be it aragonite saturation state, dissolved oxygen, biodiversity, or fish populations – is limited by the availability of data that can be used to parameterize those key attributes. In turn, confidence in model outputs will depend on a clear understanding of the ability of models to accurately reproduce features of the ecosystem that are of greatest management interests. This understanding will require diverse datasets that test model performance across different regions or habitats, and across different seasons and years as ocean and ecosystem conditions change. Investments in the sustained collection of integrated oceanographic and ecological data sets will be crucial for refining the performance of predictive models and their utility in informing decisions. There also should be effort to create a central repository for observational data and model output so that they are used effectively to inform further research, and ultimately management action.

5. Establish a forum to advance coastal ocean modeling.

The West Coast would benefit from creation of a forum that brings scientists and managers together to synthesize local and regional management needs, and to ensure that scientists are working in a coordinated, synergistic fashion to address those management needs. An organized community of modelers, observational researchers, and managers will serve to: (1) provide a vehicle for dialogue on management goals and scenarios, (2) encourage discussion on the use of model outputs to illustrate outcomes of management options to reach those goals, (3) facilitate discussion about the level of validation needed to use models to support management decisions, and (4) coordinate modeling products among different technical specialists. A first critical action is to convene a series of workshops to summarize key regional and local management needs, and identify the status of existing models to support those needs.



APPENDIX F

Approaches to reduce CO_2 in seawater

The impacts of rising atmospheric CO_2 concentrations on seawater carbonate chemistry can be reduced using two possible approaches. The first is biologically-based, making use of the natural ability of the ocean's photosynthetic organisms (algae and plants) to capture CO_2. For example, seagrasses, kelps and other macrophytes remove CO_2 from seawater and convert it into living tissue. This CO_2 uptake can occur at sufficiently rapid rates to significantly improve water quality for organisms sensitive to carbon chemistry changes. Although a substantial fraction of this organic carbon is released as CO_2 when plant tissue decomposes, active photosynthesis may offer a means to locally reduce CO_2 in shallow coastal environments.

There has been considerable interest along the West Coast in protecting and restoring aquatic vegetation as a means to reduce CO_2 in coastal aquatic ecosystems. Seagrass beds and kelp forests are among the world's most productive habitats, with rates of net primary production that can exceed those of tropical forests. The ability of aquatic vegetation to influence coastal chemistry is evident from estuarine monitoring data that show day to night swings in pH whose magnitude can exceed near-term declines projected from OA.

The second approach uses abiotic methods to mitigate OA exposure. Abiotic methods can be used to increase chemical buffering capacity (alkalinity) of seawater or physically remove CO_2. Synthetic base chemicals or natural base minerals can be added to seawater to increase its alkalinity. This in turn neutralizes seawater acidity and buffers against the effects of increasing CO_2 on seawater chemistry. CO_2 can be directly removed from seawater using engineered approaches such as electrochemistry, electrodialysis, vacuum extraction, and aeration with a CO_2-depleted gas.

...coastal vegetated habitats hold some of the highest concentration of organic carbon of any ecosystem on the planet, and serve as a globally important sink for carbon (i.e., blue carbon).

There are potential co-benefits of habitat protection and restoration

While one potential benefit of protecting and enhancing aquatic vegetation is reducing CO_2 in seawater, additional co-benefits may also be realized. A portion of the CO_2 converted into vegetation can be buried in sediments. This process represents the potential long-term storage or sequestration of CO_2. On an areal basis, coastal vegetated habitats hold some of the highest concentration of organic carbon of any ecosystem on the planet, and serve as a globally important sink for carbon (i.e., blue carbon). Consequently, their conservation and restoration could one day become eligible for carbon offsets in carbon trading markets, such as the one established in California, or for other funding that promotes carbon sequestration. We also note the distinction between short-term removal of CO_2 and the long-term sequestration of CO_2 by vegetated habitats. For example, kelp forests, while highly productive and active in CO_2 removal on a daily and seasonal basis, grow on hard bottom habitats where local sediment burial and the potential for long-term carbon sequestration may be minimal. In contrast, emergent marsh vegetation uses CO_2 from the atmosphere for photosynthesis and releases CO_2 to surrounding waters through root respiration. Yet, these systems can be highly effective in trapping and sequestering carbon-rich sediments, or removing nutrients that may otherwise contribute to acidification or hypoxia in downstream habitats.

Another benefit of protecting and enhancing aquatic vegetation is the creation of habitat for fish and other biota. One of the Panel's **Actions** is considering the ability of aquatic vegetation to remove CO_2 from seawater in addition to its habitat value during habitat restoration planning. Accounting for both of these ecosystem benefits will assist in better achieving the full societal value of habitat restoration and management.

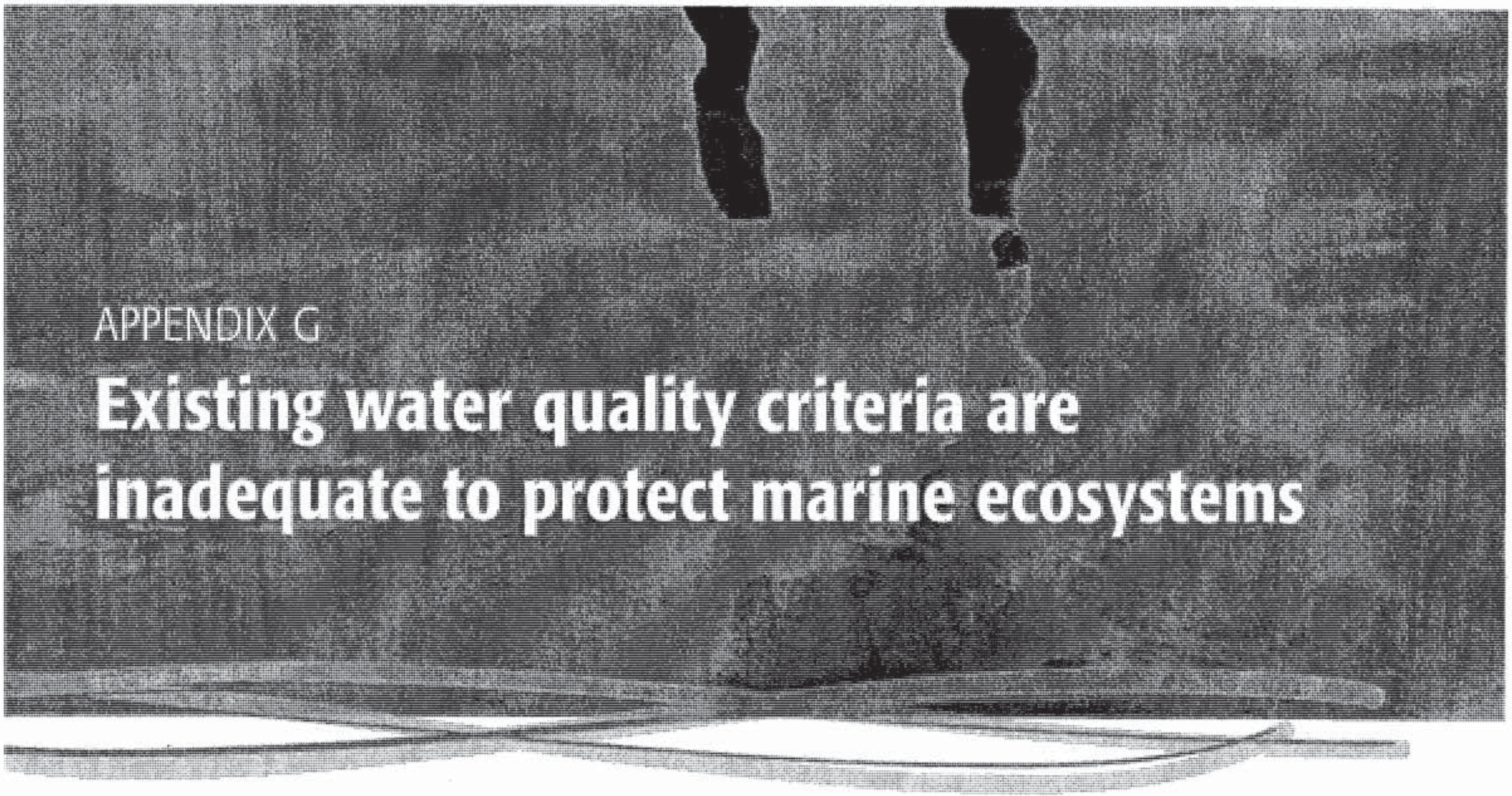
Advancing research to increase management options

Across the West Coast, researchers are actively investigating approaches for restoring aquatic vegetation, their role in locally modifying coastal seawater chemistry, and the daily to seasonal patterns of carbon uptake of these environments. In the K'ómoks Estuary on Eastern-central Vancouver Island, the transplanting of eelgrass from donor beds to previously disturbed estuaries has been successful in establishing new beds. Dive surveys have confirmed a transplant success rate of 95%. In Washington, pilot studies have reported elevated daytime pH in waters over seagrass beds relative to bare sediment habitats. In Oregon, oyster hatchery managers at Netarts Bay have begun to selectively draw seawater into the hatchery during hours when photosynthesis in the seagrass-rich system has reduced CO_2 to levels acceptable for their operations.

These examples highlight the potential applications of aquatic vegetation protection and restoration as actions to reduce CO_2 and ameliorate, if not offset, OA in local ecosystems. If successful, such actions can increase the range of options available to managers to address OA. Important questions nonetheless remain as to the effectiveness of aquatic vegetation CO_2 reduction as an OA mitigation strategy and must be answered before implementation. For example: Will the benefits of photosynthesis be offset by increases in the daily and seasonal swings in carbon chemistry? How far does the spatial "footprint" of such effects extend? What are the range of settings and locations where vegetation protection and restoration will be most successful and beneficial? Can such measures be employed in concert with other management actions to maximize conservation benefits? These questions can be addressed directly in larger-scale, proof-of-concept demonstration studies. When conducted across a range of habitats, these efforts can provide managers with new, useable knowledge of if and where protection and restoration of vegetated habitats will sufficiently remove CO_2 to meaningfully mitigate OA.

Options from engineering approaches

Human intervention to mitigate OA through engineering addition of basic materials and removal of aqueous CO_2 is still in early development. The effective scale, ecological consequences, and carbon footprint of such efforts remain uncertain but can offer important options for impacted industries. For example, shellfish growers on the West Coast have begun to use alkalinity management to offset the increase in carbonate mineral corrosivity from OA in hatchery settings. Although currently available approaches remain likely tractable only at localized scales and in controlled environments, future technological advances may broaden the applications of engineering approaches. Further research will be needed to determine the safety, cost effectiveness and potential scale of such efforts in countering the ongoing global progression of OA and its regional expression on vulnerable West Coast ecosystems.



APPENDIX G

Existing water quality criteria are inadequate to protect marine ecosystems

Water quality criteria are the management foundation of the Clean Water Act. They provide a basis for assessing water body condition, determining the level of discharge that will maintain a water body in an ecologically acceptable condition, and objectively determining when a water body is impaired. Most importantly, water quality criteria serve as targets for water body planning and mitigation projects, even outside of the regulatory framework.

Unfortunately, the existing water quality criteria for pH are not scientifically valid for application to ocean acidification (OA). They were developed 40 years ago, and the Panel has determined that they are neither based on current science nor are they ecologically relevant. Damage to ocean biological communities has been documented at thresholds that are well within the criteria's legally permissible range.

...the existing water quality criteria for pH are not scientifically valid for application to ocean acidification.

Shortcomings of existing criteria

Existing OA criteria are based on two types of pH thresholds: a requirement that pH should not fall below 6.5, and a requirement that pH should deviate no more than 0.2 pH units from natural conditions. Both types of thresholds are flawed for the purposes of application to acidification.

The minimum pH of 6.5 is inadequate because numerous studies have shown diverse biological impacts routinely manifest at pH levels well above 7.5, at which acidity (hydrogen ion concentration) is an order of magnitude higher than pH 6.5 (pH is on a logarithmic scale). The Panel's publication, "*What changes in the carbonate system, oxygen, and temperature portend for the northeastern Pacific Ocean: a physiological perspective*," provides more detail about the range of biological responses that occurs even as existing pH criteria are met.

The second part of the criteria, which calls for a deviation of no more than 0.2 pH units from natural, is flawed because it is impractical to apply. "Natural" conditions cannot be established spatially because the entire West Coast region is undergoing change due to global atmospheric inputs, and it is difficult to establish temporally because there are few long-term data sets with enough precision and accuracy to capture this level of change. This is compounded because measurement imprecision of the technology used in discharge monitoring programs is greater than 0.2 pH units, creating a margin of error that can mask ecologically relevant pH changes. Criteria inadequacies regarding establishing "natural" conditions are further described in the Panel supporting document "*Water quality criteria for acidifying oceans: Challenges and opportunities.*"

Water quality criteria should be expanded to encompass other acidification parameters

Although developing an alternative pH criteria represents an important first step, revisions to water quality criteria should be expanded to include other biologically relevant acidification parameters. pH is only one of several possible parameters for describing effects of acidification, and it is unclear if pH is even the most biologically relevant variable for many species. Aragonite saturation state, another viable candidate indicator, has been found to be more biologically relevant than pH for shell-building in calcifying organisms. Considerable scientific evidence, particularly from studies of oysters and pteropods -- a shelled zooplankton at the base of the food web – is already available for establishing both chronic and acute thresholds for aragonite saturation state. In addition, parameters such as pCO_2 have been found to be biologically relevant for fish, affecting their behavior and ability to navigate.

In developing ecologically relevant thresholds for OA parameters, managers should account for potential interactions of OA with co-occurring stressors such as hypoxia. There is a growing recognition that the most acidified regions of the ocean are also low in oxygen, with recent studies showing that dual effects of low pH and hypoxia are more severe than the predicted effects of either stressor alone. In the immediate future, a scientific workshop is needed to identify appropriate biologically relevant indicators and thresholds to assess OA, and to prioritize short-term research needs for informing criteria and threshold development.

...revisions to water quality criteria should be expanded to include other biologically relevant acidification parameters.

Development of biological criteria will improve assessment of acidification effects

The Clean Water Act provides an opportunity for assessing ocean health by examining condition of the biological communities that live within it, which has advantages over using pH or other chemical criteria alone. Traditional chemistry thresholds and associated monitoring are limited because they provide information about a relatively narrow portion of the environment at a discrete point in time. In contrast, bioassessment accounts for exposure to multiple stressors over extended time periods, and provides a more integrated reflection of aquatic ecosystem condition.

Incorporating biological criteria into a management context requires linking population and community effects with specific stressors. Effective biological criteria should provide early-warning management cues, before significant ecosystem alteration has already taken place. However, biological criteria also need to relate to effects on growth, survival, reproductive success or other metabolic functions that have repercussions at the population level, as opposed to simply quantifying exposure to a stressor. For example, pteropods might prove useful as a biologically relevant criterion for linking acidification stress to biological response, as they are an important food source for economically important fish and are among the first organisms to be affected by acidification in a marine ecosystem. Pteropods have thin aragonitic shells and narrow optimum windows for calcification, leading them to display rapid responses to corrosive waters. Acidification effects on their calcification have been studied under both field and laboratory circumstances and such indicators could offer a more integrated understanding of acidification effects.

Using ecologically relevant criteria to support OA management

Water quality criteria are typically used as regulatory tools, such as making decisions under the Clean Water Act Section 303(d) regarding whether a water body is impaired. The Panel recognizes that this is one application of water quality criteria, but the Panel also recognizes that credible water quality criteria can be effective in other decision-making contexts. For example, water quality criteria provide essential context for interpreting monitoring data or the output of model predictions about the likely effects of potential management actions. They also become part of a shared toolkit with managers from other sectors, providing a common framework for discussions about appropriate actions for fisheries and marine reserves. Additionally, scientifically-founded OA criteria can also be used to educate the public about OA and its effects on local waters.

APPENDIX H

Establishing ocean acidification and hypoxia research priorities

A strategy for aggressively expanding options for management action

To manage effectively for ocean acidification and hypoxia (OAH), West Coast managers need an arsenal of tools and options that are grounded in sound science. However, OAH research is still largely in its infancy, generally limiting the management options available. While the amount of OAH research being conducted has exploded over the past decade, many critical knowledge gaps remain. This document outlines the Panel's recommendations for aggressively expanding the breadth and depth of OAH research in order to meet the demands for management-relevant information on the West Coast and beyond. Organized around five major research areas, this research portfolio has been designed with the assessment that absent a coordinated and strategic prioritization of research foci, current research trajectories are unlikely to meet growing needs for management-relevant knowledge. To that end, scientists must go beyond answering academically stimulating questions; they also must maintain a relentless focus on providing managers with concrete, actionable options for immediately combatting the threats posed by OAH. Scientists are invested in seeing their OAH work translated into viable management options, but need help from West Coast managers in coalescing around a shared research vision and coordinating efforts for maximum impact and efficiency. The recommendations outlined in this Appendix are expanded in the Panel's more detailed document "*Research Priorities to Inform Decisions and Develop Solutions.*"

While the amount of OAH research being conducted has exploded over the past decade, many critical knowledge gaps remain.

Understand drivers of OAH

Scientists understand at a conceptual level that local nutrient and carbon inputs can exacerbate the impacts of OAH. However, management recommendations about reducing these local inputs are qualified by the lack of clear understanding about precisely where on the West Coast local inputs are sufficiently large to be meaningful relative to the global scale inputs that drive OAH. Furthermore, more clarity is needed about the relative importance among local inputs (non-point source vs. wastewater discharge vs. local atmospheric inputs) to prioritize for reduction. Thus, the Panel recommends investing in research that enhances our understanding of the relative importance of local vs. global contributions to OAH. West Coast managers should focus on developing key datasets, and coupled physical-biogeochemical models, validated with observations, that quantify the relative impacts of various nutrient, carbon and carbon dioxide sources on exacerbating OAH. Investments should also continue in developing new, accurate, cost-effective and easily deployed ocean sensors for OAH parameters. These models should be evaluated in the context of decision-making processes, and observational data should be collected to enhance model validation. As scientists learn more, they can adjust and adapt strategy options for source reduction that will maximize effectiveness and minimize cost.

Assess vulnerability to changing conditions

A key management information need is understanding how fast seawater chemistry is changing, at what locations seawater chemistry will change the most, and what levels of chemical change will trigger substantial changes in biological communities. Scientists along the West Coast are in various stages of developing coordinated monitoring programs, conducting laboratory and field experiments, and refining numerical models to address such questions. However, additional research is needed to transition these studies from individual research projects to more concerted, connected sets of research activities that address the underlying management questions. In addition, current efforts need to be expanded to downscale global models to project change along the West Coast, elucidate the biological effects of multiple stressors within the context of real-world exposure conditions and enhance the translation of physiology-scale findings to population- and ecosystem-scale projections.

Understand evolutionary response to OAH

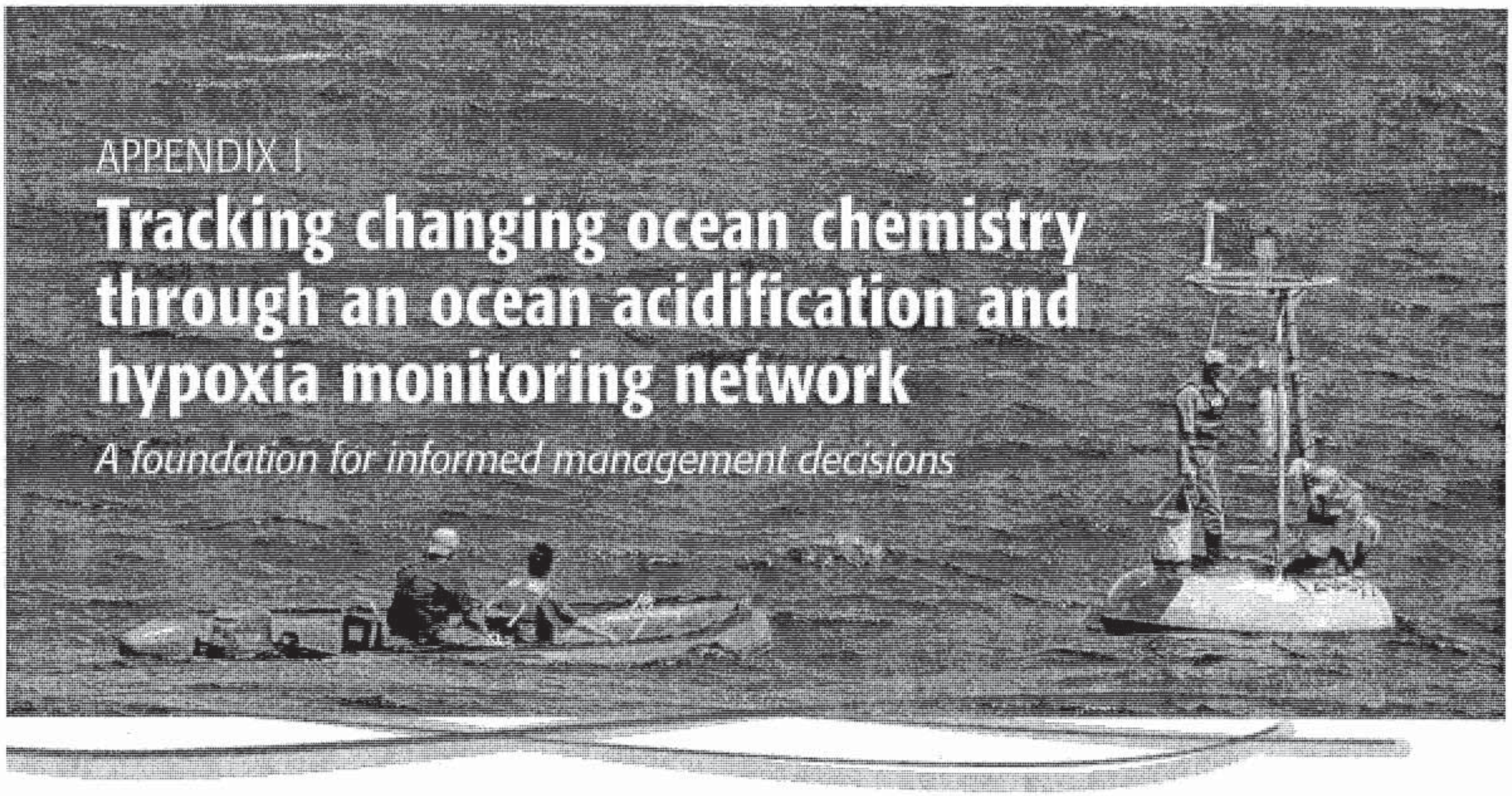
Although organisms have the potential for evolutionary adaptation to cope with OAH stress, scientists have insufficient information to predict whether, where, and how fast that genetic adaptation will occur. Thus, research is needed to understand rates of natural genetic change in response to OAH, and how evolutionary potential is distributed among taxa and localities. Moreover, West Coast managers need to understand how this potential for adaptation can best be incorporated into management strategies, such as use of refugia to protect the genetic diversity that now exists in local biota, especially those that are routinely exposed to high levels of OAH stress. Research will also allow assessment of the potential value and consequences of purposeful interventions, such as selective breeding and translocation. With sufficient knowledge, managers can determine whether and where opportunities exist to use evolutionary potential to address OAH's impacts on biological communities.

Explore sequestration and other carbon removal solutions

The acidification of seawater can be mitigated in two main ways: a) a biologically-based approach, in which seagrasses, kelp and other vegetation remove carbon dioxide from seawater and convert it into living tissues, and b) a chemically-based approach, in which the addition of base minerals such as carbonates is used to neutralize acidity. These approaches are appealing because they operate at the local level, but their applications to date have been limited and focused mostly on laboratory or small-scale settings. The Panel recommends supporting research on the type, capacity, cost-effectiveness, and safety of these removal processes as a means to determine which, if any, of these could become part of an effective marine conservation strategy.

Advance living marine resources management

Because the Panel has recommended that managers undertake actions that enhance the ability of organisms to cope with increasing OAH stress – critically important in the context of managing living marine resources such as commercial fisheries – the growing adoption of ecosystem approaches to fisheries management offers opportunities for fisheries managers to consider the potential regional effects of OAH as they update fisheries management plans. Critical to understanding OAH in an ecosystems context is that different areas are more vulnerable or resistant than others. Ecosystem models that support ecosystem-based fisheries management need to be developed and validated on local scales, and ecological risk assessments that increase understanding of fisheries vulnerabilities need to be conducted.



APPENDIX I

Tracking changing ocean chemistry through an ocean acidification and hypoxia monitoring network

A foundation for informed management decisions

Ocean acidification and hypoxia (OAH) monitoring programs dot the West Coast, as monitoring plays an invaluable role in scoping the severity of OAH-related problems, determining the trajectory of the problem (i.e., is it getting worse, and at what rate?), and assessing the effectiveness of past and planned management actions. Many monitoring programs were developed to address specific research or management needs. As a consequence, they do not adequately operate on the spatial and temporal scales over which OAH is occurring. Furthermore, traditional OAH monitoring focuses on measuring basic chemical parameters, such as pH and dissolved oxygen, rather than the full array of interrelated variables that collectively define OAH's impacts.

The Panel recommends establishment of a sustained, strategic and adaptive monitoring network that is founded on integration, coordination, and harmonization of existing efforts and their expansion in ways that will inform policy and management decisions. A regional OAH monitoring network will link decision-makers with a common pool of scientific data that will enable them to evaluate how, when, and where to act to serve the best interests of the region and society as a whole.

The monitoring network envisioned by the Panel explicitly includes physical, chemical, biological, and ecological monitoring to track change, understand impacts, and evaluate management actions. It leverages and enhances existing assets (e.g., observing systems, ecological time-series), technologies, protocols, partnerships, data systems and management frameworks (e.g., protected areas) to achieve a strategic, efficient network. The Panel's foundational requirements for a rigorous regional monitoring program are provided in a separate technical document entitled "*Ocean Acidification and Hypoxia Monitoring Network: Tracking the Impacts of Changing Ocean Chemistry to Inform Decisions.*"

A regional OAH monitoring network will link decision-makers with a common pool of scientific data that will enable them to evaluate how, when, and where to act...

Here we describe the key actions needed to achieve that desired monitoring network.

1. Define management needs from OAH monitoring.

Cultivate and enhance existing partnerships between monitoring practitioners, modelers, and decision-making users to better define OAH information needs across ecosystem types, and for diverse uses.

2. Assess how well existing monitoring efforts meet those management information needs.

Complete a comprehensive inventory of the geographic distribution, data quality, and operational status of existing monitoring programs that provide information relevant to OAH management. Use this inventory to address how well these monitoring assets are positioned to address management questions and support OAH forecast models. Use OAH model outputs to evaluate the information value of existing and proposed monitoring locations.

3. Evaluate and prioritize needs for new investment.

Enhance existing monitoring efforts to fully address management questions. Assess the feasibility of adding new measurements and analytical capacity to existing monitoring efforts. Establish regular communication and connections among managers, scientists, system operators, and end-users to iteratively assess the strength of alignment between monitoring activities and decision-making needs.

4. Enhance consistency among programs through training and quality assurance.

Many monitoring programs on the West Coast were established independently and thus have unique procedures for data procurement and management. Measurement techniques and data archiving should be harmonized among monitoring efforts. Staff involved in monitoring requires training in these procedures, and quality assurance activities should be performed to ensure reliability and comparability of data.

5. Develop a centralized portal for accessing OAH monitoring data.

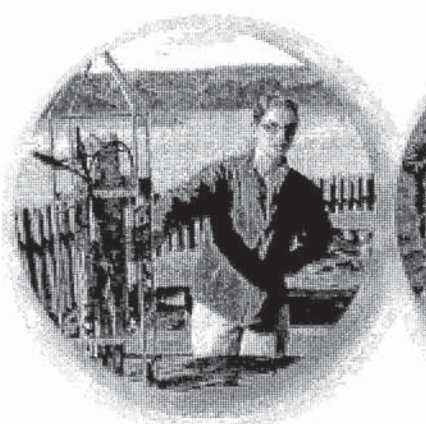
Develop a simple means for accessing diverse monitoring data sets as well as OAH model output that inform OAH management. This will allow data to be catalogued, combined, compared, and shared, ensuring that monitoring data and model output are used effectively to inform further research, and ultimately management action. Establish community protocols for submitting new data into common data portals.

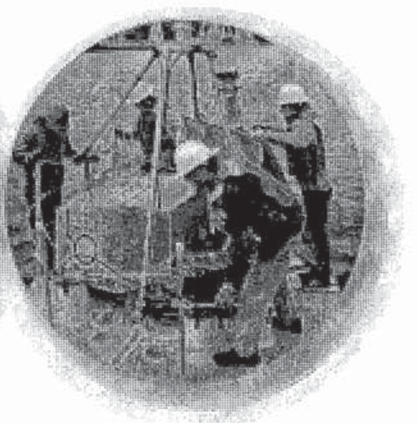
6. Develop and sustain intellectual capacity.

It is not enough to just make measurements and run models - it is also critical to maintain the intellectual capacity to interpret and communicate the findings. Investments in data analysis and data distribution are critical pieces of a monitoring network, as they will ensure the data are used to inform the management decisions the program was designed to support.

7. Communicate information widely.

Develop tools and technologies to promote greater two-way communication regarding observations and analyses, and data synthesis products. Incentivize regular information exchange activities that engage the broader user community.





Enhance existing monitoring efforts to fully address management questions.

V. The Panelists

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Dr. Alexandria Boehm is a Professor in the Department of Civil and Environmental Engineering, and a Senior Fellow of the Woods Institute for the Environment at Stanford University. Her area of expertise is coastal water quality, with a focus on knowledge that is crucial to directing new policies, and management and engineering practices that protect human and ecosystem health along the coastal margin. Dr. Boehm received her M.S., and later her Ph.D., in Environmental Engineering from University of California, Irvine.

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Dr. Elizabeth Chornesky is an Independent Consultant who assists non-profit organizations, philanthropies, and public agencies in designing science, policy, investment, and organizational strategies. Dr. Chornesky's areas of expertise include ecosystem management, sustainability, and global change, focusing on the integration of science with applied policies and practices to achieve societal goals. She earned her Ph.D. in Marine Ecology from the University of Texas at Austin.

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Dr. Andrew Dickson is a Professor of Marine Chemistry in the Marine Physical Laboratory Division at the Scripps Institution of Oceanography, University of California, San Diego. Playing a key role in providing quality control for oceanic carbon dioxide measurements, he is an expert in the chemistry of carbon dioxide in seawater, with an emphasis on ocean acidification and its effects on marine organisms. Dr. Dickson received his Ph.D. from the University of Liverpool.

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Dr. Terrie Klinger is the Director of the School of Marine and Environmental Affairs, Co-Director of the Washington Ocean Acidification Center (alongside Dr. Jan Newton), and holds the Stan and Alta Barer Endowed Professorship in Sustainability Science in Honor of Edward J. Miles. She is a marine ecologist focused on applying ecological theory to practical management solutions. Dr. Klinger received her Ph.D. in Biological Oceanography from Scripps Institution of Oceanography, University of California, San Diego.

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Dr. Thomas Pedersen is Professor of Oceanography at the University of Victoria. He is an internationally recognized authority on ocean chemistry, has published extensively in the field of paleoceanography, and has longstanding interests in climate change issues and the application of government policy to climate-change mitigation and adaptation. Dr. Pedersen holds a Ph.D. in Marine Geochemistry from the University of Edinburgh.

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Dr. George Waldbusser is an Assistant Professor of Ocean Ecology and Biogeochemistry in the College of Earth, Ocean, and Atmospheric Sciences at Oregon State University. Dr. Waldbusser's interests broadly span marine ecology and biogeochemistry. He was a key player in documenting ocean acidification impacts in oyster hatcheries in the Pacific Northwest, and continues to work closely with industry on adaptation and mitigation strategies shellfish growers can implement. He received his Ph.D. in Marine and Estuarine Environmental Science from the University of Maryland.

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Dr. Steve Weisberg is Executive Director of the Southern California Coastal Water Research Project (SCCWRP), a research agency created to provide the scientific foundation for water quality management in California. A biologist who specializes in the design of environmental monitoring programs, Dr. Weisberg's present efforts focus on the development of coordinated, integrated, cost-effective regional monitoring in the Southern California Bight. He received his Ph.D. in Biology from the University of Delaware.

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Dr. Liz Whiteman is the Program Director for the California Ocean Science Trust, a non-profit organization dedicated to advancing science-informed ocean resource management and stewardship decisions. An expert in coral reef ecology, conservation, fisheries management, and the links between science and decision-making, Dr. Whiteman has worked throughout the Caribbean and U.S. West Coast studying the effectiveness of marine protected areas and providing recommendations to policymakers from several countries. Dr. Whiteman earned her Ph.D. in Marine Evolutionary Ecology from the University of East Anglia, U.K.

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In May 2015, Skyli joined The Nature Conservancy as the Director of the North America Oceans and Coasts Program. She previously served as the Executive Director of the California Ocean Science Trust supporting California coastal and ocean resource managers by providing them with sound science to help inform decisions. She also served as the Science Advisor to the California Ocean Protection Council. In both roles, she built partnerships for science, decision-making and resource management in California.

VI. Additional Panel products supporting the "Major Findings, Recommendations, and Actions"

The Panel has produced a series of products that anchor the Panel's "**Major Findings, Recommendations, and Actions**" and attached appendices on a foundation of the best available science. The documents fall into two categories: technical guidance documents targeted for program managers, and foundational science documents targeted for subject-matter experts. For Panel products, visit www.westcoastOAH.org.

Technical guidance documents

The primary audience for Technical guidance documents is program managers who are responsible for programmatic implementation. These documents are intended to help program managers translate the "**Major Findings, Recommendations, and Actions**" into initiatives and policy.

- **Ocean Acidification and Hypoxia Monitoring Network: Tracking the Impacts of Changing Ocean Chemistry to Inform Decisions**

  The Panel has outlined a strategic framework for ocean acidification and hypoxia (OAH) related monitoring intended to provide rigorous decision-support to policymakers and managers at a West Coast-wide regional scale. This document describes key attributes of an OAH monitoring network, and recommends practical steps for implementing a West Coast network.

- **Modeling Tools: Summary of Needs to Enhance Understanding of Ocean Acidification and Hypoxia in Coastal Oceans**

  Numerous Panel discussions have underscored the need for improved modeling tools to assess the effectiveness of any potential OAH-related management action. This document outlines specific modeling needs for coupled oceanic physical and biogeochemical models as well as for ecosystem models. This document also outlines specific steps that will help build on existing infrastructure and enhance prioritization and coordination within the modeling community for meeting management needs.

- **Multiple Stressor Considerations: Ocean Acidification in a Deoxygenating Ocean and Warming Climate**

  The Panel recognizes that understanding changes to ocean chemistry is confounded by factors that may co-vary or counter-vary with OA. The outcomes of interacting environmental changes are likely to exert important compounding effects on species and ecosystems. This document describes the need for considering acidification in the context of multiple stressors to marine ecosystems.

- **Ocean Acidification and Hypoxia Research Priorities to Inform Decisions and Develop Solutions**

  This document prioritizes research initiatives focused on providing the knowledge needed to effectively manage the West Coast and oceans in the face of multiple stressors. This document is designed to help decision-makers to strategically hone in on knowledge gaps that inhibit thoughtful action on OAH.

Foundational science documents

The Panel has authored a series of in-depth scientific documents intended for subject-matter experts that summarize the state of the science on which the Panel has developed its recommendations. These documents are intended for publication as scientific journal articles, with several of them already published.

- **Ocean Acidification Science Needs for Natural Resource Managers of the North American West Coast** *(published in the journal Oceanography)*

  

  This document describes potential management actions and associated science needs that will assist managers in making decisions around whether and how best to address OA. Although decision-makers with a role to play in responding to OA come from diverse sectors, some commonalities emerge in their information needs, including a need for a comprehensive monitoring program and a range of models that identify areas that are most and least vulnerable to future OA-triggered changes.

- **What Changes in the Carbonate System, Oxygen, and Temperature Portend for the Northeastern Pacific Ocean: A Physiological Perspective** *(published in the journal BioScience)*

  

  The northeastern Pacific Ocean is undergoing changes in temperature, carbonate chemistry, and dissolved oxygen concentration. Here, the Panel examines how single- and multiple-stressor effects on physiology may drive changes in individual or species behavior, and the structure of marine ecosystems.

- **Water Quality Criteria for an Acidifying Ocean: Challenges and Opportunities** *(in press in the journal Ocean and Coastal Management)*

  When monitoring data indicate that water quality standards are not being met, management agencies have the option under Section 303(d) of the Clean Water Act to list the water body as impaired. This document describes the state of the science for making an impairment assessment in the context of this Clean Water Act process, and in cases where data needed to perform assessments are limited. The document also recommends strategies for improving monitoring programs and water quality criteria.

- **Supporting Ecosystem Resilience to Address Ocean Acidification and Hypoxia**

  

  This product provides practical guidance about the opportunities to incorporate OAH management strategies into existing ecosystem-based management frameworks – an important near-term, actionable management approach intended to ameliorate the likely impacts of OAH on marine resources and ecosystems.

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Ocean Outfall Study

FINAL REPORT

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Executive Summary

The purpose of the study was to evaluate the status and efficacy of effluent management options for the six municipal facilities in Florida's Palm Beach, Broward and Miami-Dade Counties that discharge secondarily treated wastewater through ocean outfalls. Urban water requirements in this region are rising due to rapid population growth, while water supply problems loom due to uncertainties in the time-phasing and funding of water resources projects. Southeast Florida's natural and artificial reef resources—some located near the outfalls—provide habitat and protection for marine organisms and contribute over 61,000 jobs and $1.9 billion in yearly income for residents of the three counties. An underutilized water management option in the region is water reuse, which could help Southeast Florida meet its water requirements while decreasing or eliminating reliance on ocean outfalls. The State has a reuse capacity of 1.2 BGD and expects to reclaim and reuse 65% of all domestic wastewater by 2020, up from 40% today. The study reviewed previous work describing the effects of ocean wastewater disposal on ocean biota and human health risks as well as past examples of obstacles and successes of water reuse in Florida, the U.S. and abroad. Four alternative ocean outfall strategies—involving varying degrees of reuse, nutrient removal and ocean outfall use— were considered. The alternatives were evaluated at each wastewater treatment plant according to four performance measures: 1) amount of freshwater saved relative to a base case with no reuse, 2) reduction in nitrogen and phosphorus discharged via ocean outfalls relative to the base case, 3) public acceptance, and 4) costs. Management recommendations based on these evaluations are presented.

Current and projected flows at the six wastewater treatment plants (WWTPs) are compared to their permitted capacities in Exhibit ES-1. The 2025 wastewater influent flow exceeds the 2005 permitted capacity at each WWTP; thus all of the facilities face important decisions regarding their future wastewater management options. According to current plans of the utilities, 7% of the total wastewater handled by the facilities will be reclaimed for traditional (public access) reuse in 2025, up from 4% currently.

Exhibit ES-1. Permitted, 2005, and Projected 2025 Flows at WWTPs with Ocean Outfalls

	Boynton-Delray	Boca Raton	Broward/ North	Hollywood	M-D/ North	M-D/ Central	Total
Permitted flow (MGD)	24.0	17.5	84.0	42.0	112.5	143.0	423
2005 flow (MGD)	19	16	84	40	108	129	396
2005 reuse[1] (MGD)	3.7	5.2	2.4	2.6	0.1	0	14
2005 reuse[1] (%)	19	33	3	7	< 1	0	4
2025 flow (MGD)	27	22	94	54	126	151	474
2025 reuse[1,2] (MGD)	7.5	15.9	5.3	3.6	0.1	0	32.4
2025 reuse[1,2] (%)	28	73	6	7	0.1	0	7

[1]Excluding onsite reuse for process

[2]Based on utilities' plans extending to 2025

Several studies have been made of the impacts of the outfalls on the ocean. Surfacing plumes are present at all six WWTP outfalls throughout the year. Rapid dilution in the immediate vicinity of the outfall continues for 6 to 41 miles downstream. One of the conclusions of a US EPA relative risk assessment involving deep well injection, aquifer recharge, discharge to ocean outfalls and surface waters as disposal options was that:

> Human health risks are of some concern, both within the 400-m mixing zone and outside of it, primarily because treatment of effluent prior to discharge via ocean outfalls does not include filtration to remove *Cryptosporidium* and *Giardia*. The most probable human exposure pathways include fishermen, swimmers, and boaters who venture out into the Florida Current and experience direct contact, accidental ingestion of water, or ingest fish or shellfish exposed to effluent. Otherwise, there is a very small, but not nonzero, chance for onshore or nearshore recreational or occupational users to be exposed to effluent constituents, since there is a small (10%) chance that currents will change direction to east or west.

Natural and artificial reefs near the six ocean outfalls contribute significantly to the tourist business in South Florida. Recent studies suggest that the outfall discharge at Boynton Beach may be having an adverse effect on Lynn's Reef, but did not establish a link between pollutant discharges and the relative importance of pollutant concentrations at a specific reef. A biomarker study indicates that the reefs have been impacted in some cases. Based on $\delta 15N$ analyses of macroalgae, sponges and gorgonian corals recently collected from reefs in Palm Beach and Broward counties, researchers believe that sewage nitrogen is a contributor to the nitrogen pool in the area's coastal waters. No complete report is available for this ongoing study. These recent and ongoing studies could provide valuable new insights into the extent of the cause-effect linkage between outfall discharges and impaired reefs in Southeast Florida and indicate whether or not current wastewater treatment levels are sufficient to protect water quality in general and the reefs in particular.

Spatial analysis of the consumptive permit user database in Southeast Florida indicates that large users with individual permits in Palm Beach County and northern Broward County have the highest demands for landscape irrigation. These large users are typically golf courses, parks, and other recreational areas. Miami-Dade County has the highest potential industrial demand. The Turkey Point Power Plant is an example of an industrial user not currently being supplied with reclaimed water. A case study of the area near the Broward/North WWTP indicates that reclaimed water can be cost effectively supplied to larger irrigation users within 12 metropolitan miles (measured along streets) of the reclamation facility.

Four alternative ocean outfall strategies were examined under the defined scope of this study. Under the Currently Planned Use alternative (Alt I), ocean outfalls would be used at currently planned levels. Under the Limited Use Alternative (Alt II), ocean outfall disposal would be limited to flows remaining after traditional reuse options were maximized and underground injection flows reached full 2005 permitted capacity. Under the Ocean Outfalls as Backups alternative (Alt III), ocean disposal would only be used during wet weather periods to handle flow that would otherwise go to traditional reuse. Complete elimination of ocean outfalls was considered under the No Use alternative (Alt IV). The assumption was made that permitted capacities of the ocean outfalls would be maintained at 2005 levels and that no additional ocean outfalls would be permitted. It was also assumed that Class I injection control wells for effluent disposal would be held at 2005 permitted capacities and, furthermore, that Class I injection wells for effluent disposal that were in testing or under construction during 2005 would not receive permits. Current and potential treatment requirements employed in the evaluation of ocean outfall alternatives are summarized in Exhibit ES-2

Exhibit ES-2. Current and Potential Treatment Requirements of Wastewater Management Options

Option	Treatment requirements	
	Current	**Potential**
Ocean outfalls	Secondary with basic-level disinfection	Intermediate or full nutrient control with basic-level disinfection
Class I injection wells	Secondary with no disinfection	Secondary with filtration and high-level disinfection
Traditional reuse	Secondary with filtration and high-level disinfection	
Groundwater recharge	Full treatment and disinfection	

The following conclusions and recommendations were reached from the present study:

- Water reuse (traditional and groundwater recharge) offers advantages to Southeast Florida—in terms of conserving water, augmenting available water resources, and reducing discharges to the ocean environment.
- Considering impending water shortages in Southeast Florida, continued use of ocean outfalls and deep injection wells for effluent disposal represents an unsustainable export of freshwater from the region.
- The weight of indirect evidence of reef damage by ocean outfalls is cause for concern and justification for additional actions to address these issues.
- The success of water reuse in large urban areas in the U.S. and abroad indicates that difficulties to reuse posed by the highly urbanized nature of Southeast Florida can be overcome.
- Satellite water reclamation facilities can effectively serve distant users of reclaimed water in regional wastewater systems and improve reclaimed water quality in collection systems impacted by saltwater intrusion.
- Traditional (public access) reuse for the Boynton-Delray and Boca Raton WWTPs could substantially reduce nutrient loads to the ocean. Substantial reduction of nutrient loads from the other four facilities can be achieved through groundwater recharge, since traditional reuse opportunities are more limited in these areas.
- Substantial reductions in nitrogen loads are achievable through intermediate and full nutrient removal technologies. Given the relatively low total phosphorus concentrations in effluents from the WWTPs, only full nutrient removal technology can reduce phosphorus loads. Substantial reductions in phosphorus load will require moving toward either traditional reuse or groundwater recharge.

- The average freshwater savings are essentially equal to traditional reuse volumes under alternatives I (currently planned use of ocean outfalls) and II (limited use of ocean outfalls) and range from 24 to 64% at the Boynton-Delray and Boca Raton WWTPs and from 1 to 18% at the other four facilities.
- Under alternatives III (use of ocean outfalls as backups) and IV (no use of ocean outfalls), average freshwater savings range from 64 to 87%.
- Public acceptance of traditional reuse is expected to be high at all of the facilities because the reclaimed water is used primarily for irrigation.
- Public acceptance of alternatives featuring large-scale groundwater recharge could be moderate or lower. However, public education programs and community involvement throughout the planning, implementation, and continued use of water reuse projects should help mitigate public concerns.
- Trends between costs and the average of percent freshwater savings and nutrient load reduction indicate that alternatives emphasizing traditional reuse and nutrient control technology are somewhat more cost effective than those emphasizing groundwater recharge. The ability to generate revenues from traditional reuse further increases the attractiveness of this approach.
- At the facilities with lesser densities of consumptive use permittees (Hollywood, Miami-Dade/North and Miami-Dade/Central), extensive groundwater recharge would be required to achieve a 50% average of freshwater savings and nutrient load reduction unless industries and residential users are added to the reclaimed water customer base.
- Over the period 2005–2025, the costs of liquid treatment, reuse and disposal to achieve a 50% average of freshwater savings and nutrient load reduction would range from $1.00/1,000 gal at the Boca Raton WWTP to $1.90/1,000 gal at the Hollywood WWTP, averaging $1.50/1,000 gal. Increasing this average to 75% would raise the average cost to $2.60/1,000 gal.

1. Introduction

The Florida Department of Environmental Protection (FL DEP) contracted with the University of Florida to conduct a study on ocean outfalls in Southeast Florida. The purpose of the study is to evaluate the status and efficacy of wastewater disposal options in Southeast Florida, where the extent of water reuse is limited. Six publicly owned wastewater treatment plants (WWTPs) with ocean outfalls are considered in this report. The names of these facilities in geographical order (north to south) are given below. Also given for each facility is a shorter name that will be used henceforth in the report.

- City of Delray Beach, South Central Regional Wastewater Treatment Plant (Boynton-Delray WWTP)
- City of Boca Raton, Glades Road Wastewater Treatment Plant (Boca Raton WWTP)
- Broward County, North Regional Wastewater Treatment Plant (Broward/North WWTP)
- City of Hollywood, Southern Regional Wastewater Treatment Plant (Hollywood WWTP)
- Miami-Dade North District Wastewater Treatment Plant (Miami-Dade/North WWTP)
- Miami-Dade Central District Wastewater Treatment Plant (Miami-Dade/Central)

The State of Florida encourages and promotes water reuse as reflected in the state reuse objectives in Sections 403.064 and 373.250, Florida Statutes. Water reuse has been considered an important component of both wastewater management and water resource management in Florida. Benefits of water reuse include:

- Reuse decreases discharges of wastewater effluent to surface waters and deep injection wells and thus reduces environmental impacts associated with these disposal methods.
- Reclaimed water provides an alternative water supply for activities that do not require potable quality water such as irrigation and toilet flushing and helps to conserve potable quality water.
- High quality reclaimed water has the ability to recharge and augment existing water supplies.

Florida's reuse capacity has increased significantly in the past 20 years. By the year 2020, Florida is expected to reclaim and reuse 65% of all domestic wastewater. Some of the greatest challenges, but also the greatest potential benefits, of reuse implementation lie in highly urbanized Southeast Florida of Palm Beach, Broward, and Miami-Dade counties. According to the 2003 Reuse Inventory published by the Florida Department of Environmental Protection, Palm Beach, Broward, and Miami-Dade counties contain almost one-third of Florida's population and generate 39% of state's domestic wastewater (FL DEP 2004). However, they account for less than 10% of all reuse capacity in the state.

Broward and Miami-Dade counties rely heavily on ocean outfalls and deep well injection for effluent disposal, sending 510 million gallons per day (MGD) of their treated effluent to the ocean or deep, non-potable aquifers. Potential limitations on nutrient discharges to the coastal ocean and growing demands for water could alter both the economic and the hydrologic feasibility of this continuing export of fresh water.

The report includes ten chapters, as outlined in the Table of Contents. Wastewater treatment plants with ocean outfalls in Southeast Florida are reviewed in Chapter 2. Information on water supply facilities in the three counties with ocean outfalls is summarized in Chapter 3. Environmental risk associated with discharge or reuse of effluents in Southeast Florida is considered in Chapter 4. The socioeconomic impacts of reefs on Southeast Florida are also mentioned. U.S. and international case studies of water reuse in large urban areas outside Southeast Florida are reviewed in Chapter 5. Information on the withdrawal and reclamation of wastewater from mid and upper reaches of sewers—a practice known as satellite treatment—is also included. Methods for estimating the costs of traditional water reuse and groundwater recharge in Southeast Florida are presented in Chapter 6. Alternative strategies for management of treated effluents are proposed in Chapter 7, whereas indicators for evaluating the outcomes of these strategies are discussed in Chapter 8. Values of the indicators under various scenarios within the wastewater management alternatives are presented and discussed in Chapter 9. Findings of the report are summarized and conclusions are drawn in Chapter 10.

Three appendices are included in the report. Appendix 1 contains detailed information on the use of CapdetWorks 2.1 software for estimating wastewater treatment costs. Appendix 2 contains schematic diagrams of wastewater treatment process trains for meeting various effluent and water reclamation standards. Appendix 3 contains a glossary of terms used in the report. The Project Database contains in their entirety all relevant reports (in PDF format) that were obtained from consulting engineers and public agencies. The database also includes a searchable listing of the reports, as well as public domain articles on the topic of water reuse.

Reference

FL DEP (2004) 2003 Reuse Inventory. Florida Department of Environmental Protection, Division of Water Resource Management, Tallahassee, Florida. July 2004.

2. Wastewater Treatment Plants with Ocean Outfalls in Southeast Florida

Summary information on ocean outfalls and their associated wastewater treatment plants is given in the present chapter. The locations of the six ocean outfalls in Florida are shown from a statewide perspective in Figure 2-1. The three Florida Counties that are home to the outfalls are shown in Figure 2-2.

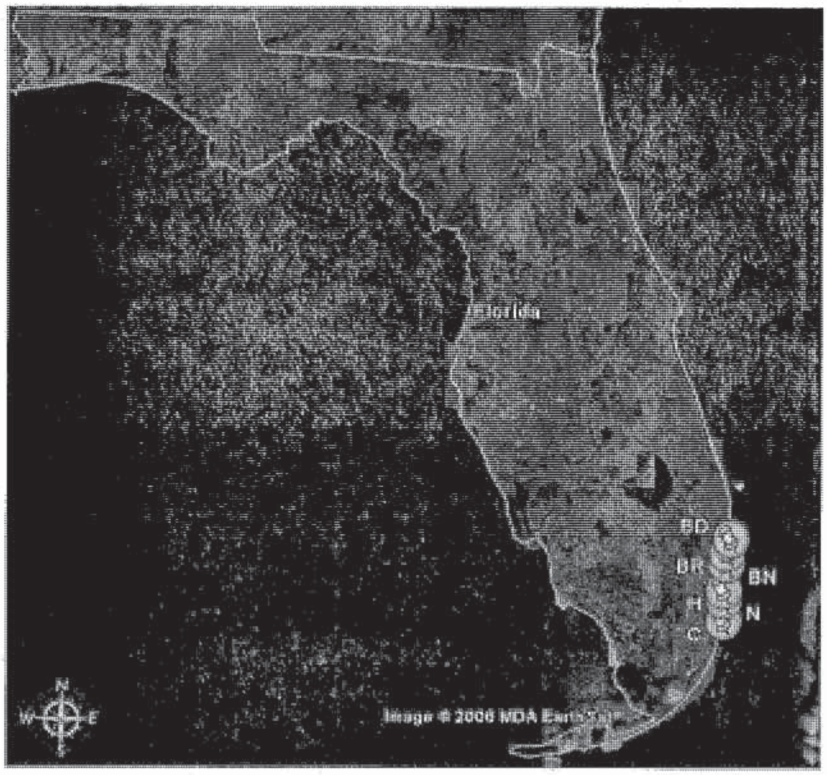

Figure 2-1. Ocean Outfalls in Florida. BD–Boyton-Delray, BR–Boca Raton, BN–Broward/North, H–Hollywood, N–Miami-Dade/North, C–Miami-Dade/Central. Photo from Google Earth (2005).

2.1 Boynton-Delray WWTP

An overview of the Boynton-Delray WWTP in Delray Beach and its associated facilities is given in Table 2-1. Included are brief descriptions of the treatment and alternative disposal methods, flows, reuse facilities, ocean outfall, and future plans. More extensive information is given below.

2.1.1 Description of Wastewater Treatment Plant

The Boynton-Delray WWTP, located at 1801 N. Congress Avenue, Delray Beach, was constructed in 1974 to provide wastewater treatment for the Cities of Boynton Beach and Delray Beach. The construction included two phases: Plant A with a 12 MGD design capacity was completed in 1979 with EPA grant funds and Plant B with the same design capacity was constructed in 1987. Subsequent facility improvements include conversion to fine bubble aeration, odor abatement, and installation of effluent pumping facilities. The Boynton-Delray WWTP is a complete-mix activated sludge plant. Liquid treatment facilities include screening, grit removal, flow equalization, aeration basins, clarifiers, chlorination and dechlorination. The design criteria of the aeration basins and secondary clarifiers are shown in Table 2-2. On-site solids processing includes thickening via a centrifuge or two dissolved air flotation units and lime stabilization to meet Class B criteria before being applied to land. Most of the wastewater is treated and then disposed of through an ocean outfall. A portion of the wastewater is reclaimed for water reuse. The current permitted plant capacity is 24 MGD annual average daily flow and 26.4 MGD maximum three-month average daily flow (Brown and Caldwell 1995). The plant site is constrained by housing developments on the west and by a freeway on the east (Fig. 2-3). Limited open area exists immediately south of the plant, whereas more extensive undeveloped area is located north of the WWTP.

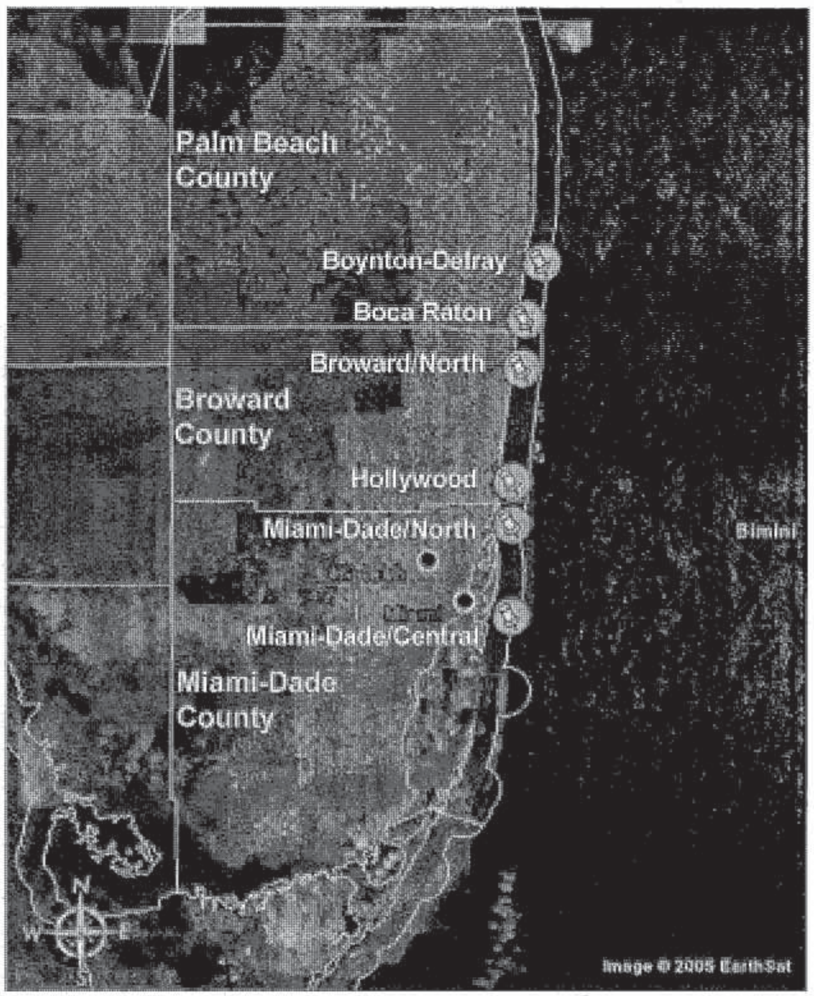

Figure 2-2. Florida Counties with Ocean Outfalls. Photo from Google Earth (2005).

Table 2-1. Overview of Boynton-Delray WWTP, Ocean Outfall and Associated Facilities

Treatment and alternate disposal	*Method*	Completely mixed activated sludge
	Disinfection level	High level for public access reuse Basic level for ocean outfall disposal
	Other disposal options	Emergency discharge to canal
2003 Flows	*Reuse*	4.3 MGD
	Ocean outfall	12.3 MGD
	Other disposal flow	- -
	Total treated flow	16.6 MGD
Reuse facilities	*Design capacity*	10 MGD
	Current flow	4.3 MGD
	Start up	1995 design
	Applications	On site; residential irrigation; golf course irrigation
Ocean outfall	*Latitude* *Longitude*	26° 27′ 72″ N 80° 02′ 53″ W
	Discharge depth	90 ft
	Distance offshore	5,200 ft
	Inside diameter	30 inches
	Number of ports	1
	Diameter of ports	30 inches
	Port orientation	Horizontal
Future plans	*WWTP*	Could not identify
	Reuse facilities	Expand design capacity to 24 MGD

2.1.2 Historical and Projected Flows and Concentrations

The Boynton-Delray WWTP served an estimated 210,500 people within its service area in 2005. This estimate is derived from historical population data from the Boynton-Delray Wastewater Treatment and Disposal Board (Brown and Caldwell 1995) extrapolated based on projected population growth rates for Palm Beach County (GEC 2003). The population for the Boynton-Delray WWTP service area is expected to increase to 294,300 by 2025, the end of the present study period. Population projections for the study period are presented in Table 2-3.

Table 2-2. Design Criteria for the Boynton-Delray WWTP

Treatment Facility	Value	Units
Aeration Basins		
Plant A		
No. of aeration basins	6	
Basin length	65	ft
Basin width	65	ft
Sidewater depth	16	ft
Volume per basin	0.5	MG
Total aeration basin volume	3	MG
Plant B		
No. of aeration basins	4	
Basin length of basins 1, 2	66	ft
Basin length of basins 3, 4	131.5	ft
Basin width of basins 1, 2, 3, 4	65	ft
Sidewater depth of basins 1, 2, 3, 4	15.35	ft
Total aeration basin volume	3	MG
Secondary Clarifiers		
Plant A		
No. of clarifiers	3	
Diameter of clarifiers	105	ft
Sidewater depth of clarifiers	14	ft
Total surface area of clarifiers	25,980	sf
Total volume of clarifiers	2.72	MG
Plant B		
No. of clarifiers	3	
Diameter of clarifiers	105	ft
Sidewater depth of clarifiers	16	ft
Total surface area of clarifiers	25,980	sf
Total volume of clarifiers	3.2	MG

Table 2-3. Population Projections for Boynton-Delray WWTP Service Area from 2005 to 2025. Based on data from Brown and Caldwell (1995) and GEC (2003)

Year	2005	2010	2015	2020	2025
Population	210,500	231,200	252,100	273,500	294,300

Figure 2-3. Aerial photograph of the Boynton-Delray WWTP (Google Earth 2005)

Based on an historical wastewater production rate of 92 gal/capita/day in Florida (Marella 1999), the projected 2005 average daily wastewater flow rate was 19.4 MGD. The average daily wastewater flow rate is expected to increase to 27.1 MGD by 2025, based on a constant wastewater production rate of 92 gal/capita/day. Projected wastewater flow rates for the study period are presented in Table 2-4.

Table 2-4. Wastewater Flow Projections for the Boynton-Delray WWTP from 2005 to 2025. Based on data from Brown and Caldwell (1995), GEC (2003) and Marella (1999)

Year	2005	2010	2015	2020	2025
Wastewater flow (MGD)	19.4	21.3	23.2	25.2	27.1

A review of the flow data indicated peaking factors for maximum month average daily flow/annual average daily flow and peak hourly flow/annual average daily flow of 1.45 and 2.15 respectively (Hodges 2003).

The average influent $CBOD_5$ and TSS concentrations from January 1994 to April 1995 were 131 and 146 mg/L, respectively. The annual average $CBOD_5$ and TSS reductions were 97% and 91%, resulting in average effluent $CBOD_5$ and TSS concentrations of 4.3 and 13.6 mg/L, respectively. The historical maximum month peaking factors for $CBOD_5$ and TSS were found to be 1.31 and 1.4 and did not change over time (Brown and Caldwell 1993; Brown and Caldwell 1995). A similar analysis was carried out from October 1991 to October 1992 (Brown and Caldwell 1993). Annual average influent and effluent ammonia concentrations in 1992 were 29 and 6 mg/L, respectively, representing an 80% decrease.

The City of St. Petersburg conducted research on chloride and TDS concentrations in reclaimed water and their impact on vegetation when used for irrigation purposes. These studies reported selected species and chloride tolerances. As a result of the study, the City of St. Petersburg tries to maintain chloride concentrations in reclaimed water below 400 mg/L to protect vegetation from adverse effects of high chloride concentrations (PBS&J 1992). The average effluent chloride concentration at the Boynton-Delray WWTP from April 1994 through April 1995 was 206 mg/L, which is below the guideline. However, chloride concentrations in 1992 exceeded 400 mg/L from time to time. Most of this contribution was attributed to the high volume of infiltration/inflow from the City of Delray Beach. Collection system improvements since 1992 have improved the effluent quality (Brown and Caldwell 1995).

The effluent limitations and monitoring requirements for ocean outfall disposal in southeast Florida are summarized in Table 2-5. The quality of effluent discharged from the Boyton-Delray WWTP complies with these requirements. This can be seen from the summaries of effluent water quality that are presented in Tables 2-6 and 2-7, which cover a 15-month monitoring period (8/31/03 to 10/31/04). The average effluent concentrations of $CBOD_5$ and TSS from August 2003 through October 2004 were 11 and 9 mg/L, respectively (Table 2-6). These values are below the respective discharge limits of 25 and 30 mg/L (Table 2-5). The removals for $CBOD_5$ and TSS during this period were 95% and 96%, respectively; much higher than the 85% requirement. The average effluent concentrations for total nitrogen and phosphorus were 18.7 and 1.7 mg/L, respectively. The annual average, 90^{th} percentile, geometric mean and maximum effluent fecal coliform values were 1, 1.2, 1 and 26.5 per 100 mL, respectively, as shown in Table 2-7. These values are well below the corresponding limits of 200, 400, 200 and 800 per 100 mL. The average influent concentrations for $CBOD_5$ and TSS were 220 and 229 mg/L for the same period, as shown in Table 2-8.

Table 2-5. Permit Requirements for Ocean Outfall Disposal in Southeast Florida

			Effluent Limitations				Monitoring Requirements		
Parameter	Units	Max/ Min	Annual Average	Monthly Average	Weekly Average	Single Sample	Monitoring Frequency	Sample Type	Notes
$CBOD_5$	mg/L	Max	25 30 [2]	25 30 [2]	40 45 [2]	60	Daily	24-hr FPC [3]	5
$CBOD_5$ removal	%	Min		85					
TSS	mg/L	Max	30	30	45	60	Daily	24-hr FPC [3]	5
TSS removal	%	Min		85					
Total Nitrogen as N	mg/L and lbs/day[1]	Max	None	None	_	None	Weekly	24-hr FPC [3]	6
Total Ammonia as N	mg/L and lbs/day[1]	Max	None	None	_	None	Weekly	24-hr FPC [3]	7
Total Nitrite+Nitrate as N	mg/L and lbs/day[1]	Max	None	None	_	None	Weekly	24-hr FPC [3]	7
Total Phosphorus	mg/L and lbs/day[1]	Max	None	None	_	None	Weekly	24-hr FPC [3]	6
Fecal Coliform Bacteria	See [4]						Daily	Grab	8

Sources: (FL DEP 2000), (FL DEP 2002), (FL DEP 2003b), (FL DEP 2003a), (PBS&J 2003)

[1] mg/L (Annual Avg, Monthly Avg and Single Sample) and lbs/day (Annual Avg and Monthly Avg)

[2] Effluent limitations for Miami-Dade/North

[3] Flow proportioned composite

[4] *[62-600.440(4)c]*

- The arithmetic mean of the monthly fecal coliform values collected during an annual period shall not exceed 200 per 100 mL of effluent sample.
- The geometric mean of the fecal coliform values for a minimum of 10 samples of effluent each collected on a separate day during a period of 30 consecutive days (monthly) shall not exceed 200 per 100 mL of sample.
- No more than 10 percent of the samples collected (the 90th percentile value) during a period of 30 consecutive days shall exceed 400 fecal coliform values per 100 mL of sample.
- Any one sample shall not exceed 800 fecal coliform values per 100 mL of sample.

[5] Only Monthly Avg and Weekly Avg requirements for Miami-Dade/Central, Expansion of Hollywood WWTP includes discharge limitations for $CBOD_5$ (20 mg/L, 25 mg/L, 40 mg/L and 60 mg/L) and TSS (20 mg/L, 30 mg/L, 45 mg/L and 60 mg/L).

[6] Only mg/L and lbs/day Single Sample requirements for Broward/North, only mg/L Monthly Avg requirements for Miami-Dade/North and Miami-Dade/Central

[7] Required only for Boynton-Delray, Boca Raton and Hollywood plants

[8] Only Geometric Mean and Single Sample requirements for Miami-Dade/North and Miami-Dade/Central plants

Table 2-6. Ocean Outfall Discharge Composition of the Boynton-Delray WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

Parameter	Average of monthly averages	Maximum monthly average
TSS (mg/L)	9	12.9
$CBOD_5$ (mg/L)	11	15.6
TSS removal (%)	96	–
$CBOD_5$ removal (%)	95	–
Total N (mg-N/L)	18.7	22.2
Ammonia N (mg-N/L)	11.7	15.4
Nitrite+Nitrate N (mg-N/L)	4.1	7.1
Total P (mg-P/L)	1.7	4.0

Table 2-7. Ocean Outfall Fecal Coliform Concentrations at the Boynton-Delray WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

	Value (# /100 mL)
Average of monthly averages	1
90^{th} percentile	1.2
Geometric mean	1
Maximum	26.5

Table 2-8. Average Influent Concentrations at the Boynton-Delray WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

Parameter	Average of monthly averages
TSS (mg/L)	229
$CBOD_5$ (mg/L)	220

Note: The monthly averages for the TSS and $CBOD_5$ on 1/31/04 were 267 mg/L and 264 mg/L respectively, which gives the highest sum (531 mg/L) of monthly averages for TSS and $CBOD_5$.

2.1.3 Reuse Facilities

According to the 2003 Florida DEP Reuse Inventory (FL DEP 2004), the reuse system has a design capacity of 10 MGD, of which 43% (4.3 MGD) is being utilized for in-plant, residential and golf course irrigation. The reuse system was designed in 1995 and includes filtration, chlorination and storage facilities. Three Tetra deep bed downflow sand filters, with a total surface area of 1,254 ft^2 and a design capacity of 10 MGD, are being used (Brown and Caldwell 1995). The reuse system is currently being expanded.

2.1.4 Ocean Outfall

Treated effluent from the Boynton-Delray WWTP is discharged through a 30 inch pipe that extends 5,200 ft from the shoreline and reaches a depth of 90 ft. The permitted capacity of the outfall is 24 MGD annual average daily flow and 26.4 MGD maximum three-month average daily flow (FL DEP 2000). The Boynton-Delray WWTP ocean outfall was inspected by volunteer divers on October 18 and November 8, 2003 to observe effluent plume characteristics and to collect water samples. The discharge pipe was found at 26° 27′ 71.5″ N, 80° 02′ 52.5″ W, at a different location than specified on the permit, at a depth of 95 feet and inclined toward the surface at approximately 30 degrees. A buoyant, freshwater effluent was found to exit the pipe with some force and traveled toward the surface. The plume was pushed northward with the current while it moved toward the surface and formed a boil several hundred yards down-current of the discharge point (Tichenor 2004).

2.1.5 Disposal Methods in Addition to Ocean Outfalls

The City of Delray Beach has no disposal method besides its ocean outfall. The Boynton-Delray WWTP has an emergency bypass system to discharge treated effluent to the L-30 Canal (FL DEP 2000).

2.1.6 Future Plans

The reclaimed water system at the Boynton-Delray WWTP will be expanded to 24 MGD so that all of the wastewater can be reclaimed for water reuse. A reclaimed water master plan was developed for the City of Delray Beach in November 2003. The City is currently constructing the first phase (Area 1) of the reclaimed water system. In March 2005, the City applied for a permit to add additional users in Areas 2 and 3 as part of the next phase of implementation (Matthews Consulting 2003).

The first phase of the plant expansion included construction of a 2 million gallon storage tank to increase reclaimed water production for area golf courses. The cost of the Crom Corporation tank was $900,000, of which $300,000 was funded by a grant from the South Florida Water Management District. In the second phase, the filtration system and chlorine contact facility will be enlarged, reclaimed water equalization will be added before the filters, and additional pumping capability will be provided. The Board applied for $6.6 million of federal funds to pay for the work. Another grant from the South Florida Water Management District was received for the Year 2005 to continue the expansion work (Smith 2004). The cities of Boynton Beach and Delray Beach are searching for additional large users of reclaimed water and are discussing with the Florida DEP the possibility of using the ocean outfall pipeline to distribute reclaimed water to users on the barrier island (Hodges 2003).

2.2 Boca Raton WWTP

An overview of the Boca Raton WWTP in Boca Raton and its associated facilities is given in Table 2-9. Included are brief descriptions of the treatment and alternative disposal methods, flows, reuse facilities, ocean outfall, and future plans. More extensive information is given below.

2.2.1 Description of Wastewater Treatment Plant

The original WWTP in the City of Boca Raton started operation in 1974 and had a design capacity of 10 MGD. In the mid 1980s, the plant was modified to increase its design capacity to 12 MGD (Boca Raton 2005b). The Boca Raton facility provides secondary treatment and on-site biosolids processing. Liquid treatment facilities include screening and grit removal, primary clarification, an activated sludge system with mechanical and diffused aeration, final settling tanks and chlorine addition. The design criteria of the aeration basins and secondary clarifiers are shown in Table 2-10. The biosolids processing facilities include gravity belt and rotary drum thickeners, anaerobic digesters and sludge dewatering. Most of the wastewater is treated and then discharged through an ocean outfall. Some of the wastewater is reclaimed for water reuse. The plant is permitted to treat a 17.5 MGD annual average daily flow, 20 MGD maximum month average daily flow and 40 MGD peak hourly flow (Hazen and Sawyer 1997b). The Boca Raton WWTP site is constrained on the north by athletic fields and a runway, on the west and south by freeways, and on the east by the Boca Raton Water Treatment Plant (Fig. 2-4).

Table 2-9. Overview of Boca Raton WWTP, Ocean Outfall and Associated Facilities

Treatment and alternate disposal	*Method*	Conventional activated sludge
	Disinfection level	High level for public access reuse Basic level for ocean outfall disposal
	Other disposal options	None
2003 Flows	*Reuse*	5.6 MGD
	Ocean outfall	10.7 MGD
	Other disposal flow	- -
	Total treated flow	16.3 MGD
Reuse facilities	*Design capacity*	9 MGD
	Current flow	5.6 MGD
	Start up	1989 on-site; 1993 Florida Atlantic University irrigation
	Applications	On site; residential irrigation; golf course irrigation; other public access areas
	Notes	- -
Ocean outfall	*Latitude*	26°21′00″N
	Longitude	80°03′16″W
	Discharge depth	90 feet
	Distance offshore	5,166 feet
	Inside diameter	36 inches
	Number of ports	1
	Diameter of ports	36 inches
	Port orientation	Up 45° from horizontal
Future plans	*WWTP*	Could not identify
	Reuse facilities	Expand design capacity to 15 MGD

Table 2-10. Design Criteria for the Boca Raton WWTP

Treatment Facility	Value	Units
Aeration Basins		
No. of aeration basins	3	#
Basin length	255	ft.
Basin width	85	ft.
Sidewater depth	13	ft.
Volume per basin	2.11	MG
Total aeration basin volume	6.32	MG
Secondary Clarifiers		
No. of clarifiers	5	#
Diameter of clarifiers 1, 2	105	ft.
Diameter of clarifiers 3, 4, 5	110	ft.
Sidewater depth of clarifiers 1,2	12	ft.
Sidewater depth of clarifiers 3, 4, 5	14	ft.
Total surface area of clarifiers	45,829	sf
Total volume of clarifiers	4.54	MG

Figure 2-4. Aerial photograph of the Boca Raton WWTP. A portion of the Boca Raton Water Treatment Plant is visible in the lower right corner of the photo (Google Earth 2005).

2.2.2 Historical and Projected Flows and Concentrations

The Boca Raton WWTP serves an estimated 138,200 people within its service area in 2005. This estimate is derived from historical population data from the City of Boca Raton Utility Services Department (Hazen and Sawyer 1997b) extrapolated based on projected population growth rates used for the entirety of Palm Beach County issued in the United States Army Corps of Engineers Comprehensive Everglades Restoration Plan Update (GEC 2003). The population for the Boca Raton WWTP service area is expected to increase to 193,200 by the Year 2025. Population projections for the study period are presented in Table 2-11.

Table 2-11. Population Projections for the Boca Raton WWTP Service Area from 2005 to 2025. Based on data from Hazen and Sawyer (1997b) and GEC (2003)

Year	**2005**	**2010**	**2015**	**2020**	**2025**
Population	138,200	151,700	165,400	179,500	193,200

Based on an historical wastewater production rate of 113 gal/capita/day prepared for the United States Geological Survey study to assess wastewater discharge trends in Florida (Marella 1999), the 2005 average daily wastewater flow rate is projected at 15.6 MGD. The average daily wastewater flow rate is expected to increase to 21.8 MGD in 2025, based on a constant wastewater production rate of 113 gal/capita/day. Wastewater flow rates for the study period are presented in Table 2-12.

Table 2-12. Wastewater Flow Projections for the Boca Raton WWTP from 2005 to 2025. Based on data from Hazen and Sawyer (1997b), GEC (2003) and Marella (1999)

Year	**2005**	**2010**	**2015**	**2020**	**2025**
Wastewater flow (MGD)	15.6	17.1	18.7	20.2	21.8

The average influent $CBOD_5$ and TSS concentrations during 1996 were 136 and 124 mg/L, respectively. The annual average $CBOD_5$ and TSS reductions were 91% and 95%, resulting in average effluent $CBOD_5$ and TSS concentrations of 12 and 6 mg/L. This effluent quality was typically achieved utilizing two out of three aeration basins and three out of five secondary clarifiers (Hazen and Sawyer 1997b).

The average effluent concentrations for $CBOD_5$ and TSS from August 2003 through October 2004 were 3 and 6 mg/L (Table 2-13), which are below the respective discharge limits of 25 and 30 mg/L. The removals of $CBOD_5$ and TSS were 98% and 96%, respectively; much higher than the 85% requirement. The average effluent concentrations of total nitrogen and total phosphorus were 16.9 and 0.7 mg/L, respectively. The annual average, 90th percentile, geometric mean and maximum effluent fecal coliform concentrations were 3, 10.1, 3.1 and 74.8 per 100 mL, respectively, as shown in Table 2-14. These values are well below the corresponding limits of 200, 400, 200 and 800 per 100 mL. The average influent concentrations for $CBOD_5$ and TSS were 190 and 185 mg/L for the same period (Table 2-15).

Table 2-13. Ocean Outfall Discharge Composition of Boca Raton WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

Parameter	Average of monthly averages	Maximum monthly average
TSS (mg/L)	6	7.9
$CBOD_5$ (mg/L)[1]	3	4.6
TSS removal (%)	96	–
$CBOD_5$ removal (%)	98	–
Total N (mg-N/L)	16.9	19.9
Ammonia N (mg-N/L)[1]	10.5	14.2
Nitrite+Nitrate N (mg-N/L)[1]	3.3	3.8
Total P (mg-P/L)	0.7	1.3

[1] Monitoring period between 2/29/04 and 10/31/04

Table 2-14. Ocean Outfall Fecal Coliform Concentrations at the Boca Raton WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

	Value (# /100 mL)
Average of monthly averages[1]	3
90^{th} percentile	10.1
Geometric mean	3.1
Maximum	74.8

[1] Monitoring period between 8/31/03 and 7/31/04 and 11/30/03 value is not reported

Table 2-15. Average Influent Concentrations at the Boca Raton WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

Parameter	Average of monthly averages
TSS (mg/L)	185
$CBOD_5$ (mg/L)	190

Note: The monthly averages for the TSS and $CBOD_5$ on 1/31/04 were 299 mg/L and 241 mg/L respectively, which gives the highest sum (540 mg/L) of monthly averages for TSS and $CBOD_5$.

2.2.3 Reuse Facilities

The Boca Raton WWTP added capability to produce a limited quantity of reclaimed water for process water and landscape irrigation onsite in 1989. Two automatic backwash filters with a total design capacity of 3 MGD were operated (CDM 1990). In 1993, Florida Atlantic University was being irrigated and Phase I of the reuse system construction was continuing to expand reclaimed water distribution to public access areas. The current reuse system includes chemical filter aid, filtration and high level disinfection. Six automatic backwash medium-depth mono-media sand filters with a total surface area of 3450 ft^2 and a design capacity of 9 MGD are being used (Brown and Caldwell 1993). According to the 2003 Florida DEP Reuse Inventory (FL DEP 2004), the reuse system has a design capacity of 9 MGD, of which 62% (5.6 MGD) is being utilized. The reuse system IRIS (In-city Reclamation Irrigation System) provides service to Boca Raton's Sabal Park/Pinelands area, Florida Atlantic University, Mizner Park and a number of commercial green spaces along Federal Highway, residential customers and golf courses (Boca Raton 2005a).

2.2.4 Ocean Outfall

The ocean outfall pipe from the Boca Raton WWTP consists of three sections with 42, 30 and 36 inch diameters. Treated effluent is discharged 5,166 ft from the shoreline at a depth of 90 ft. The permitted capacity of the wastewater effluent through the ocean outfall is 17.5 MGD annual average daily flow. In addition, the outfall is permitted to carry a 4.5 MGD annual average daily flow (7 MGD maximum daily flow) of membrane softening concentrate from the water treatment plant (FL DEP 2003b).

2.2.5 Disposal Methods in Addition to Ocean Outfalls

The City of Boca Raton has no disposal method besides its ocean outfall.

2.2.6 Future Plans

The City of Boca Raton submitted a capacity analysis report during permit renewal to the Florida DEP for a rerating of the Boca Raton WWTP's annual average daily flow from 17.5 MGD to 23 MGD, corresponding to a maximum month average daily flow of 26.5 MGD and a peak hourly flow of 46 MGD. The peaking factor for maximum month average daily flow/annual average daily flow is proposed to remain at 1.15, whereas peak hourly flow/annual average daily flow ratio is suggested to be reduced to 2.0, based on a review of historical hourly flow data from 1995 to 1996. The treatment processes limiting the rerated capacity were the primary clarifiers, return activated sludge pumping and sludge thickening. The peak flow to the outfall based on pumping capacity was estimated to be 28 MGD. The available total equalization capacity is 5.5 million gallons, consisting of a 2.5 million gallon effluent equalization tank and a 3.0 million gallon reuse system storage tank. The facilities were found to be adequate for the proposed 46 MGD peak hourly flow, considering a committed reuse flow of 2.0 MGD, 28 MGD ocean outfall and 4.0 million gallons of equalization required for a peak hourly flow rate duration of 6 hours (Hazen and Sawyer 1997b).

The reclaimed water master plan prepared by CDM for the City of Boca Raton proposed a reclaimed water system IRIS with a design capacity of 15 MGD to be completed by 2000. The service district included 2,480 acres of green space, including five large users (Florida Atlantic University and four golf courses), all public and commercial properties, multi-family condominium and rental complexes, and 12,773 single family homes. The reclaimed water system was found to reduce the annual water consumption by 25 to 30% and had the potential to eliminate the 10 MGD expansion of the water treatment plant and related water supply wells with an estimated capital cost of between 7.7 and 8.7 million dollars (CDM 1990). However, the water treatment plant was expanded in 1991, before the reclaimed water system was completed. The implementation of IRIS has been slower than planned.

2.3 Broward/North WWTP

An overview of the Broward/North WWTP in Broward County and its associated facilities is given in Table 2-16. Included are brief descriptions of the treatment and alternative disposal methods, flows, reuse facilities, ocean outfall, and future plans. More extensive information is given below.

2.3.1 Description of Wastewater Treatment Plant

The initial Broward/North WWTP, with a design capacity of 20 MGD and located at 2401 N. Powerline Road, Pompano Beach, started providing wholesale wastewater treatment service to large users in 1975. The plant underwent its first major expansion in 1980, which increased the design capacity to 66 MGD annual average daily flow. The plant reached 80 MGD annual average daily flow capacity through a second major expansion that was completed in 1992.

In 2001, a rerating was requested for the Broward/North WWTP from 80 MGD to 84 MGD and a capacity of 84 MGD annual average daily flow was permitted in 2003. The Broward County Office of Environmental Services started planning in 1995 to expand the Broward/North WWTP to 100 MGD design capacity. Sludge stabilization and dewatering improvements projects were completed in 2001 as part of the expansion (Hazen and Sawyer 2004).

The Broward/North WWTP provides secondary treatment and on-site biosolids processing. There are four individual treatment trains (Modules A, B, C, D). The liquid treatment facilities include screening, grit removal, an activated sludge system, secondary clarifiers, and chlorine contact tanks. The design criteria of the aeration basins and secondary clarifiers are shown in Table 2-17. Solids treatment facilities consist of dissolved air flotation thickeners, anaerobic digesters, and sludge dewatering. After the sludge is digested and dewatered, it is disposed of by land filling and land spreading. The sludge is rated as Class B, which is suitable for application to agricultural sites with restricted public access. Some of the wastewater is treated and then disposed of through an ocean outfall, another portion is treated and then disposed of through six Class I injection wells, and the remainder is reclaimed for water reuse (Hazen and Sawyer 2004). Some area remains open on the Broward/North WWTP site (Fig. 2-5). Commercial developments constrain the site boundaries on all four directions, although a parcel of undeveloped land extends from the northwest corner of the plant site.

Table 2-16. Overview of the Broward/North WWTP, Ocean Outfall and Associated Facilities

Treatment & alternate disposal	*Method*	Conventional activated sludge
	Disinfection level	High level for public access reuse Basic level for ocean outfall disposal
	Other disposal options	Class I injection wells
2003 Flows	*Reuse*	4.5 MGD
	Ocean outfall	36.5 MGD
	Other disposal flow	29.1 MGD
	Total treated flow	69.8 MGD
Reuse facilities	*Design capacity*	10 MGD
	Current flow	4.5 MGD
	Start up	1991
	Applications	On site; other facility; other public access
	Notes	Effluent from Modules B and C is further treated to produce reclaimed water for reuse
Ocean outfall	*Latitude* *Longitude*	26°15′00″N 80°03′45″W
	Discharge depth	107 ft
	Distance offshore	7,300 ft
	Inside diameter	54 inches
	Number of ports	1
	Diameter of ports	54 inches
	Port orientation	Horizontal
Future plans	*WWTP*	Expand to 100 MGD design capacity
	Reuse facilities	Utilize 10 MGD reuse design capacity

2.3.2 Historical and Projected Flows and Concentrations

The Broward/North WWTP serves an estimated 724,000 people within its service area in 2005, as presented by the Broward County Office of Environmental Services (Hazen and Sawyer 2004). The population for the Broward/North WWTP service area is expected to increase to 978,300 by 2025. Population projections for the study period are presented in Table 2-18.

Detailed flow data and projections for the Broward/North WWTP were available, indicating that the 2005 average daily wastewater flow rate would be 84.2 MGD (116 gal/capita/day). The average daily wastewater flow rate is expected to increase to 94.1 MGD in 2025. This flow rate reflects an anticipated reduction in wastewater production per capita from 116 gal/capita/day at the beginning of the study period to 96 gal/capita/day in 2025. The reduction in the per capita wastewater production is expected to result from increased residential population density. The increase in density per residential unit is anticipated since there is very little undeveloped land in the county, whereas migration to the area should continue. Projected wastewater flow rates over the study period are presented in Table 2-19.

Table 2-17. Design Criteria for the Broward/North WWTP

Treatment Facility	Value	Units
Aeration Basins		
No. of modules (A, B, C, D)	4	#
No. of aeration basins per module	4	#
Total no. of aeration basins	16	#
Basin length	225	ft.
Basin width	75	ft.
Sidewater depth	15.5	ft.
Volume per basin	1.96	MG
Total aeration basin volume	31.3	MG
Secondary Clarifiers		
No. of clarifiers per module	4	#
Total no. of clarifiers	16	#
Diameter of clarifiers	105	ft.
Sidewater depth of clarifiers in modules A, B, C	12	ft.
Sidewater depth of clarifiers in modules D	15	ft.
Total surface area of clarifiers	138,560	sf

Figure 2-5. Aerial photograph of the Broward/North WWTP (Google Earth 2005).

Table 2-18. Population Projections for Broward/North WWTP Service Area from 2005 to 2025 (Hazen and Sawyer 2004)

Year	2005	2010	2015	2020	2025
Population	724,000	790,600	856,300	919,500	978,300

Table 2-19. Wastewater Flow Projections for Broward/North WWTP from 2005 to 2025 (Hazen and Sawyer 2004)

Year	2005	2010	2015	2020	2025
Wastewater Flow (MGD)	84.2	88.6	90.8	92.2	94.1
Per Capita Usage (gal/day)	116	112	106	100	96

The average influent $CBOD_5$ and TSS concentrations during 2002 were 136 and 241 mg/L, respectively. The annual average $CBOD_5$ and TSS reductions were both 97%, resulting in average effluent $CBOD_5$ and TSS concentrations of 3.3 and 5.9 mg/L, respectively. This effluent quality was achieved with an average of ten out of sixteen aeration basins in service (Hazen and Sawyer 2004). The average influent $CBOD_5$ and TSS concentrations from 1997 to 2001 were 142 and 248 mg/L, respectively (Hazen and Sawyer 2002).

Additional monitoring data were summarized for the period August 2003 through October 2004. Effluent $CBOD_5$ and TSS concentrations averaged 4 and 7 mg/L, respectively as shown in Table 2-20. These values are well below the corresponding discharge limits of 25 and 30 mg/L. The removals for $CBOD_5$ and TSS were both 97%; much higher than the requirement of 85%. The average effluent concentrations of total nitrogen and phosphorus were 14.8 and 1.3 mg/L, respectively. Annual average, 90^{th} percentile, geometric mean and maximum effluent fecal coliform concentrations were 14, 25, 7 and 53 per 100 mL, respectively as shown in Table 2-21. These values are below the corresponding limits of 200, 400, 200 and 800 per 100 mL. The average influent concentrations for $CBOD_5$ and TSS were 130 and 217 mg/L, respectively, for the same period as shown in Table 2-22.

Table 2-20. Ocean Outfall Discharge Composition of Broward/North WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

Parameter	Average of monthly averages	Maximum monthly average
TSS (mg/L)	7	13
$CBOD_5$ (mg/L)	4	5
TSS removal (%)	97	--
$CBOD_5$ removal (%)	97	--
Total N (mg-N/L)	14.8	19.9
Total P (mg-P/L)	1.3	2.0

Table 2-21. Ocean Outfall Fecal Coliform Concentrations at the Broward/North WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

	Value (# /100 mL)
Average of monthly averages	14
90th percentile	25
Geometric mean	7
Maximum	53

Table 2-22. Average Influent Concentrations of the Broward/North WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

Parameter	**Average of monthly averages**
TSS (mg/L)	217
$CBOD_5$ (mg/L)	130

Note: The monthly averages for the TSS and $CBOD_5$ on 5/31/04 were 339 mg/L and 144 mg/L respectively, which gives the highest sum (483 mg/L) of monthly averages for TSS and $CBOD_5$.

2.3.3 Reuse Facilities

A 10 MGD reclaimed water system together with approximately 2 miles of 24 inch transmission line terminating at the North Broward County Resource Recovery Facility was placed in service at the Broward/North WWTP in 1991. The current reclaimed water system consists of a filter feed pump station, filters, a chlorine contact tank, chemical feed facilities, storage tanks, and distribution pumping systems (Hazen and Sawyer 2004). Forty Parkson Dynasand single media upflow continuous backwash filters, with a total surface area of 2000 ft^2 and a design capacity of 10 MGD, are arranged in 10 individual basins with four units per basin (Hazen and Sawyer 1992). Clarified effluent from modules B and C is diverted to the filtration system. The existing reclaimed water demand is 45% (4.5 MGD) of the current design capacity

2.3.4 Ocean Outfall

Treated effluent from the Broward/North WWTP is discharged through a 54 inch ductile iron pipe at a depth of 107 ft that extends 7,300 ft from the shoreline. The permitted capacity of the outfall is 66 MGD annual average daily flow (FL DEP 2003a).

2.3.5 Disposal Methods in Addition to Ocean Outfall

The Class I injection well system at the Broward/North WWTP that was constructed in 1990-1991 consisted of an injection well pumping station, four Class I injection wells, and two dual zone Floridan aquifer monitoring wells. In 2000-2001, two additional Class I injection wells and two monitoring wells were constructed. The combined design capacity of the ocean outfall/injection well systems with one injection well out of service is 174 MGD peak hourly flow and 87 MGD average daily flow with a peaking factor of 2.0 (Hazen and Sawyer 2002). The permitted peak hourly flow capacity for the six wells is 60 MGD (FL DEP 2003a). An average flow of 29.1 MGD was discharged to the wells during 2003 (FL DEP 2004).

Water quality issues have been encountered for one of the monitoring wells. The U.S. EPA published a draft rule change in 2000 and 2003 that requires operators of wells with questionable data to either demonstrate non-endangerment of the underground source of drinking water or provide higher levels of treatment, described as possibly filtration and high level disinfection (Hazen and Sawyer 2004). U.S. EPA published new rules governing Class I injection wells in 24 Florida Counties including Palm Beach, Broward and Miami-Dade Counties on 11/22/05. These federal rules became effective on 12/22/05.

2.3.6 Future Plans

Plans for expansion of the Broward/North WWTP to a design capacity of 100 MGD include construction of an additional treatment module (E) with 20 MGD annual average daily flow capacity, new sludge dewatering and storage facilities, expansion and improvements of preliminary treatment facilities and anaerobic digestion facilities, improvements to disinfection facilities, construction of new Class I injection wells, and updating of the plant distributed control system (Hazen and Sawyer 2004). The design criteria of the aeration basins and secondary clarifiers in Module E are shown in Table 2-23.

Broward County Office of Environmental Services has plans to utilize the 10 MGD design capacity of the reuse system. A portion of this capacity is already committed. An additional 2 MGD will be needed when the Broward/North WWTP is expanded to 100 MGD. There is an agreement with Wheelabrator Environmental Services to provide up to 2 MGD of reclaimed water and up to 2.3 MGD if the company adds boilers at the North Broward County Resource Recovery Facility. The Broward County Office of Environmental Services has started providing irrigation water for a portion of the Pompano Beach Park of Commerce, which is under development next to the plant (Hazen and Sawyer 2004).

Table 2-23. Design Criteria for Module E

Module E	Value	Units
Aeration Basins		
No. of aeration basins	4	#
Basin length	335	ft.
Basin width	52	ft.
Sidewater depth	15.5	ft.
Volume per basin	2	MG
Total aeration basin volume	8	MG
Secondary Clarifiers		
No. of clarifiers	3	#
Diameter of clarifiers	125	ft.
Sidewater depth	16	ft.
Total surface area of clarifiers	36,816	sf

The City of Pompano Beach has ongoing efforts to expand its own reclaimed water treatment design capacity and service area. This community tapped into the outfall line from the Broward North WWTP, built a filtration and high-level disinfection facility, and supplies reclaimed water within Pompano Beach. This utilization of a water resource that was previously being wasted results in an increase in the percentage of Broward/North WWTP flows that is reused (Hazen and Sawyer 2004).

Coconut Creek and the North Springs Improvement District have expressed interest in receiving reclaimed water from Broward/North WWTP for roadway median irrigation. An initiative to fund this project was introduced in 2003 by the State but was not accepted. The project was resubmitted in January 2004. If funding is obtained, the Broward County Office of Environmental Services is prepared to upgrade its facilities to meet this demand (Hazen and Sawyer 2004).

2.4 Hollywood WWTP

An overview of the Hollywood WWTP in Broward County and its associated facilities is given in Table 2-24. Included are brief descriptions of the treatment and alternative disposal methods, flows, reuse facilities, ocean outfall, and future plans. More extensive information is given below.

Table 2-24. Overview of Hollywood WWTP, Ocean Outfall and Associated Facilities

Treatment & alternate disposal	*Method*	Pure oxygen activated sludge
	Disinfection level	High level for public access reuse Basic level for ocean outfall disposal
	Other disposal options	Class I injection wells (in testing)
2003 Flows	*Reuse*	2.6 MGD
	Ocean outfall	39.5 MGD
	Other disposal flow	- -
	Total treated flow	42.1 MGD
Reuse facilities	*Design capacity*	4 MGD
	Current flow	2.6 MGD
	Start up	1994 Public access reuse
	Applications	Golf course irrigation
	Notes	- -
Ocean outfall	*Latitude* *Longitude*	26°01′04″N 80°05′04″W
	Discharge depth	93 ft
	Distance offshore	10,000 ft
	Inside diameter	60 inches
	Number of ports	1
	Diameter of ports	60 inches
	Port orientation	Horizontal
Future plans	*WWTP*	Expand to 50 MGD design capacity in two phases
	Reuse facilities	Increase reuse flow by 1.1 MGD

2.4.1 Description of Wastewater Treatment Plant

The Hollywood WWTP, located at 1621 N. 14th Avenue, Hollywood, has been operating since the 1940s. In 1973, trickling filters were replaced with a pure oxygen activated sludge system and the plant was expanded to 36 MGD. The design capacity was increased to 38 MGD in 1981 (Public Utility Management and Planning Services and Hazen and Sawyer 2001). The current design capacity of the plant is 45 MGD annual average daily flow as mentioned in the permit (FL DEP 2002). The permitted capacity reported in the Florida DEP (2002) permit and SFRPC (2005) are 42 and 48.75 MGD, respectively. The City started implementing a program in 1999 to expand the design capacity to 50 MGD in two phases (Hazen and Sawyer 1988; Hazen and Sawyer 1999a). The current activated sludge plant includes bar screens, grit tanks, influent pumps, oxygenation tanks, clarifiers, chlorination, effluent pumps, and post lime sludge stabilization facilities (Public Utility Management and Planning Services and Hazen and Sawyer 2001; Hollywood 2005c). The design criteria of the aeration basins and secondary clarifiers are shown in Table 2-25. Most of the wastewater is treated and then discharged through an ocean outfall. The remainder is reclaimed for water reuse. Two 24 inch Class I injection wells were constructed as part of an expansion process. The plant is sited within a golf course that is ringed with housing developments on the west, south, and east and by a recreational complex to the north (Fig. 2-6).

Table 2-25. Design Criteria for the Hollywood WWTP

Treatment Facility	Value	Units
Aeration Basins		
No. of trains (1, 2, 3, 4)	4	#
No. of aeration basins per train	4	#
Total no. of aeration basins	16	#
Basin length in trains 1, 2	58	ft.
Basin length in trains 3, 4	36	ft.
Basin width in trains 1, 2	58	ft.
Basin width in trains 3, 4	36	ft.
Sidewater depth in trains 1, 2	14	ft.
Sidewater depth in trains 3, 4	18	ft.
Volume per basins in trains 1, 2	0.35	MG
Volume per basins in trains 3, 4	0.17	MG
Total aeration basin volume	4.2	MG
Secondary Clarifiers		
Length of clarifiers no. 1-4	135	ft.
Width of clarifiers no. 1-4	135	ft.
Sidewater depth of clarifiers no. 1-4	12	ft.
Diameter of clarifiers no. 5-6	120	ft.
Sidewater depth of clarifiers no. 5-6	14	ft.
Total surface area of clarifiers	95,508	sf
Total volume of clarifiers	9.06	MG

Figure 2-6. Aerial photograph of the Hollywood WWTP (Google Earth 2005)

2.4.2 Historical and Projected Flows and Concentrations

The Hollywood WWTP serves an estimated 312,200 people within its service area in 2005. This estimate is derived from historical population data (Marella 1999) extrapolated based on projected population growth rates for Broward County presented in the United States Army Corps of Engineers Comprehensive Everglades Restoration Plan Update (GEC 2003). The population for the Hollywood WWTP service area is expected to increase to 425,600 by 2025. Population projections for the study period are presented in Table 2-26.

Based on an historical wastewater production rate of 128 gal/capita/day (Public Utility Management and Planning Services and Hazen and Sawyer 2001), the 2005 average daily wastewater flow rate was projected at 40.0 MGD. The average daily wastewater flow rate is expected to increase to 54.5 MGD in 2025, based on a constant wastewater production rate of 128 gal/capita/day. Projected wastewater flow rates for the study period are presented in Table 2-27.

The annual average influent BOD_5 and TSS concentrations from November 1985 through December 1987 were 86 and 84 mg/L. The low wastewater strength was caused by the infiltration/inflow in the Hollywood collection system (Hazen and Sawyer 1988). Effluent $CBOD_5$ concentrations for the Hollywood WWTP during high flow occurrence days in July and August 1989 were in the range of 5 to 19 mg/L (Hazen and Sawyer 1999a). The average effluent $CBOD_5$ concentration from May through October 1992 was 4 mg/L (Hazen and Sawyer 1993).

Table 2-26. Population Projections for Hollywood WWTP Service Area from 2005 to 2025. Based on data from Public Utility Management and Planning Services and Hazen and Sawyer (2001) and GEC (2003)

Year	2005	2010	2015	2020	2025
Population	312,200	340,100	368,400	397,500	425,600

Table 2-27. Wastewater Flow Projections for Hollywood WWTP from 2005 to 2025. Based on data from Public Utility Management and Planning Services and Hazen and Sawyer (2001), GEC (2003) and Marella (1999)

Year	2005	2010	2015	2020	2025
Wastewater flow (MGD)	40.0	43.5	47.2	50.9	54.5

The average effluent concentrations for $CBOD_5$ and TSS from August 2003 through October 2004 were 8 and 17 mg/L, respectively, as shown in Table 2-28. These values are below the respective discharge limits of 25 and 30 mg/L. The removals for $CBOD_5$ and TSS were 94% and 87%, respectively. The average effluent concentrations for total nitrogen and phosphorus were 16.6 and 1.1 mg/L, respectively. Several months of coliform data were missing from the data report, as explained in the footnotes to Table 2-29. Based on available data, values for the annual average, 90th percentile, geometric mean effluent fecal coliform concentrations were 7, 20.9 and 2.7, respectively, which are below the corresponding limits of 200, 400 and 200 per 100 mL. However, the maximum was 2,120 per 100 mL, which is above the limit of 800 per 100 mL. The average influent concentrations for $CBOD_5$ and TSS were 139 and 136 mg/L for the 15-month period, as shown in Table 2-30. The influent wastewater strength has increased due to infiltration/inflow reduction programs (Hazen and Sawyer 1988).

Table 2-28. Ocean Outfall Discharge Composition of the Hollywood WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

Parameter	Average of monthly averages	Maximum monthly average
TSS (mg/L)	17	26.6
$CBOD_5$ (mg/L)	8	17.9
TSS removal (%)[1]	87	–
$CBOD_5$ removal (%)[1]	94	–
Total N (mg-N/L)	16.6	21.2
Ammonia N (mg-N/L)	11.9	15
Nitrite+Nitrate N (mg-N/L)	1.2	4.8
Total P (mg-P/L)	1.1	1.4

[1] Calculated based on the given influent and effluent monthly average data

Table 2-29. Ocean Outfall Fecal Coliform Concentrations at the Hollywood WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

	Value (# /100 mL)
Average of monthly averages	7
90th percentile[1]	20.9
Geometric mean[1]	2.7
Maximum[2]	2120

[1] 11/30/03, 12/31/03, 1/31/04, 4/30/04 and 8/31/04 values were not reported

[2] 8/31/03, 11/30/03, 12/31/03, 1/31/04, 4/30/04, 8/31/04 and 9/30/04 values were not reported

Table 2-30. Average Influent Concentrations at the Hollywood WWTP from 8/31/03 to 10/31/04. Data from Florida DEP Discharge Monitoring Reports

Parameter	Average of monthly averages
TSS (mg/L)	136
$CBOD_5$ (mg/L)	139

Note: The monthly averages for the TSS and $CBOD_5$ on 5/31/04 were 158 mg/L and 162 mg/L respectively, which gives the highest sum (320 mg/L) of monthly averages for TSS and $CBOD_5$.

2.4.3 Reuse Facilities

Reclaimed water was used only for on-site processes until 1993, when process and storage facilities were installed to enable 4 MGD of public access reuse. In 1994 a transmission system was constructed to supply reclaimed water to golf courses (Public Utility Management and Planning Services and Hazen and Sawyer 2001). The current reuse system includes an 8 MGD continuous backwash tertiary filter system, high level disinfection and contact tanks, 0.5 MG of on-site reuse storage, pumping facilities and a reuse transmission and distribution system (Hollywood 2005b). The current reuse system has a permitted capacity of 4 MGD and is providing 2.6 MGD of reclaimed water to six local golf courses (FL DEP 2004). There are ongoing discussions with more users to provide an additional 1.1 MGD (FL DEP 2002).

Reuse has been found beneficial in Hollywood by reducing water withdrawals from the surficial aquifer system, helping to prevent saltwater intrusion. The City of Hollywood determined that about 4 MGD of off-site reuse was economically feasible, but it received resistance from users. The City therefore sponsored legislation to require reclaimed water to be used where it is available and reliable. Residential reuse was also considered. Capital cost for residential reuse (or dual distribution) water systems was estimated as $21 to $30 per gal/day of reuse capacity, whereas golf course irrigation was estimated as less than $2 per gal/day of reuse capacity. The City concluded that the cost of residential reuse in Hollywood was too expensive and inconvenient for single-families with small lots that utilize limited amounts of water for irrigation (Public Utility Management and Planning Services and Hazen and Sawyer 2001).

2.4.4 Ocean Outfall

The treated wastewater from the Hollywood WWTP is transported to the Atlantic Ocean through a 60 inch diameter outfall pipe that extends 10,000 ft off-shore, reaching a depth of 93 ft. The outfall pipe will be at or exceeding its recommended maximum hydraulic capacity when the plant is uprated to 50 MGD. Class I injection wells are therefore being constructed to serve as an additional disposal method (Hazen and Sawyer 1994). The City has an agreement with the Town of Davie and Cooper City to dispose of treated wastewater through the existing effluent disposal system. The permitted capacity with these flows is 46.3 MGD annual average daily flow (FL DEP 2002).

In September 1976, the 60 inch outfall pipeline failed near Michigan Street, at a point 1,200 ft off the Hollywood Beach. Repairs to the 96 ft of damaged pipe required several weeks. The Hollywood Beach was closed during this period. The failure was caused by trapped air and associated localized pressure surges (Hazen and Sawyer 1999a).

The Southeast Florida Outfall Experiment II (SEFLOE II) study characterized the minimum initial dilution properties of the outfall system at a design flow of 54 MGD. This flow was determined considering flows of 42 MGD from the Hollywood WWTP, 6.75 MGD from the Cooper City/Davie treatment plants, 2.2 MGD of reverse osmosis and membrane softening brines from the proposed water treatment plant, and 3 MGD of planned future flows. The minimum flux average dilution in the zone of initial dilution was 28.4:1, which is above the minimum of 20:1 established by regulations. The initial dilution characteristics of the Hollywood and Miami-Dade/Central outfall systems were compared. Hollywood was found to be superior to the multiport system in Miami-Dade/Central. It was therefore concluded that effluent from the Hollywood outfall undergoes rapid dilution (Hazen and Sawyer 1994).

2.4.5 Disposal Methods in Addition to Ocean Outfall

During the plant uprating process, effluent disposal options were reviewed and construction of two Class I injection wells (the Florida DEP requires a minimum of two) was chosen from among several options. Construction permits have been obtained by the City to install two 24 inch diameter Class I injection wells. Currently the two wells are under operational testing, as required to eventually obtain an operation permit. The tentative permitted capacity of the Class I injection well system is 18.6 MGD (Hazen and Sawyer 1999b).

2.4.6 Future Plans

The Hollywood WWTP is being expanded to 50 MGD (Hollywood 2005a). For upgrade to 45 MGD annual average daily flow, the following improvements were made (Public Utility Management and Planning Services and Hazen and Sawyer 2001; FL DEP 2002):

- Upgrade of influent pump station
- Installation of a third emergency generator for the influent pump station and other facilities on the south side of the WWTP
- Installation of a fourth emergency generator for the effluent and other facilities on the north side of the WWTP

- Construction of a 120 ft diameter clarifier (No. 7)
- Construction of return activated sludge pumping station (No. 4)
- Construction of a 24 inch diameter deep injection well
- Replace existing flow meter with a magnetic flow meter

Ugrading to 50 MGD annual average daily flow includes the following improvements:

- Construction of oxygenation train No. 5, consisting of four cells
- Construction of a 120 ft diameter clarifier No. 8
- Construction of second 24 inch diameter deep injection well
- Rehabilitation of oxygenation trains No. 1 and 2 and rehabilitation of clarifiers No. 1–4

The on-site storage for reclaimed water is limited during extreme storms. The possibility of using golf course ponds for additional storage during these periods is therefore being explored by the City of Hollywood. In the long term, the City is investigating the possibility of emergency discharge of reclaimed water mixed with golf course pond water to inland surface waters. The City is seeking this approach to get some relief for 5 to 10 years, but is aware of the difficulty of obtaining such a regulatory permit (Hazen and Sawyer 1999a).

2.5 Miami-Dade/North WWTP

An overview of the Miami-Dade/North WWTP in Miami-Dade County and its associated facilities is given in Table 2-31. Included are brief descriptions of the treatment and alternative disposal methods, flows, reuse facilities, ocean outfall, and future plans. More extensive information is given below.

2.5.1 Description of Wastewater Treatment Plant

The Miami-Dade/North WWTP located at 2575 N.E. 151st St., North Miami, started operation in the late 1970s. Liquid treatment facilities include bar screens, primary clarifiers, pure oxygen trains, secondary clarifiers and chlorination facilities. The design criteria of the aeration basins and secondary clarifiers are shown in Table 2-32. The sludge transfer pumping station pumps the primary sludge, waste activated sludge, and scum to the Miami-Dade/Central WWTP for biosolids treatment. Most of the treated effluent is disposed of through an ocean outfall. A portion of the wastewater is reclaimed for water reuse. Four Class I injection wells have been constructed, but a testing program must be completed before the wells may be placed in service. The maximum flow that can be discharged to the wells is 45 MGD. The plant has a rated capacity of 120 MGD annual average daily flow and is permitted to treat an annual average daily flow of 112.5 MGD (PBS&J 2003). The plant site has undeveloped land available to the north, east and south, with a freeway bounding the site on the west (Fig. 2-7).

Table 2-31. Overview of Miami-Dade/North WWTP, Ocean Outfall and Associated Facilities

Treatment & alternate disposal	*Method*	Pure oxygen activated sludge
	Disinfection level	High level for public access reuse Basic level for ocean outfall disposal
	Other disposal options	Class I injection wells (in testing)
2003 Flows	*Reuse*	2.3 MGD
	Ocean outfall	80.6 MGD
	Total treated flow	82.9 MGD
Reuse facilities	*Design capacity*	4.4 MGD
	Current flow	2.3 MGD
	Start up	1997 Florida International University irrigation
	Applications	On-site; Florida International University irrigation
	Notes	Influent from northwestern Miami with lower chloride concentrations is reclaimed for water reuse
Ocean outfall	*Latitude*	25°55′48″N
	Longitude	80°05′04″W
	Discharge depth	108 ft
	Distance offshore	11,700 ft
	Inside diameter	90 inches
	Number of ports	12
	Diameter of ports	24 inches
	Port orientation	Horizontal
Future plans	*WWTP*	Reactivate old ocean outfall for wet weather flows
	Reuse facilities	Could not identify

Table 2-32. Design Criteria for the Miami-Dade/North WWTP

Treatment Facility	Value	Units
Aeration Basins		
No. of trains	5	#
No. of aeration basins per train	4	#
Basin length	61	ft.
Basin width	61	ft.
Sidewater depth	15	ft.
Volume per basin	0.39	MG
Total aeration basin volume	7.8	MG
Secondary Clarifiers		
No. of clarifiers	12	#
Diameter of clarifiers	160	ft.
Sidewater depth of clarifiers	12	ft.
Total surface area of clarifiers	241,200	sf
Total volume of clarifiers	24.24	MG

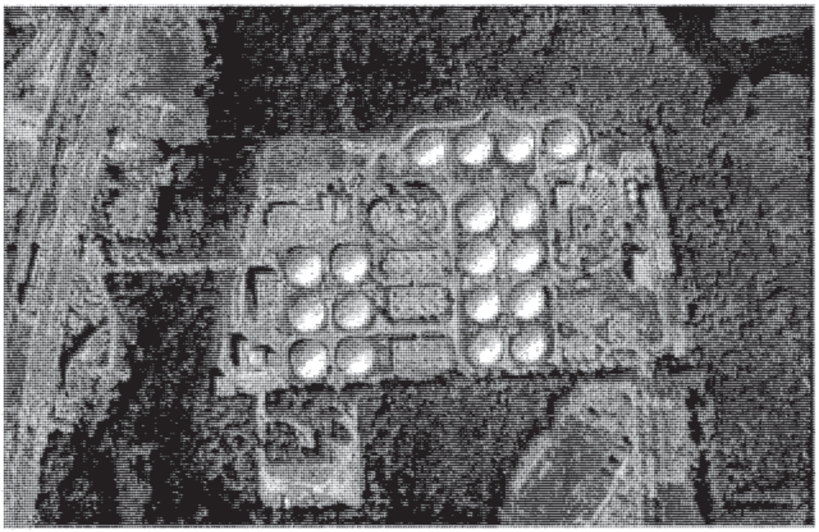

Figure 2-7. Aerial photograph of the Miami-Dade/North WWTP (Google Earth 2005)

2.5.2 Historical and Projected Flows and Concentrations

The Miami-Dade/North WWTP serves an estimated 635,400 people within its service area in 2005. Data on population for the entire district, which includes three wastewater treatment facilities (North, Central, and South) was obtained from the Miami-Dade Water and Sewer Department for 2001 (PBS&J 2003). The population of the service area for the Miami-Dade/North WWTP was estimated by dividing the wastewater flow for the Miami-Dade/North WWTP by the total wastewater handled by all three treatment plants, and then multiplying by the total number of residents within the three service areas. Data is presented by the Miami-Dade Water and Sewer Department through the year 2015. To obtain extrapolated population data for the years 2020 and 2025, the average population increase for the previous two projection years (2010 and 2015) were averaged and the increase percent was extrapolated linearly for the final two entries of the study period. The population for the Miami-Dade/North WWTP service area is expected to increase to 777,500 by 2025. Population projections for the study period are presented in Table 2-33.

Table 2-33. Population Projections for Miami-Dade/North WWTP Service Area from 2005 to 2025. Based on data from PBS&J (2003)

Year	2005	2010	2015	2020	2025
Population	635,400	658,800	700,600	735,800	777,500

The Miami-Dade Water and Sewer Department presents wastewater flow estimates for the Miami-Dade/North WWTP for the year 2005 in their Wastewater Management Master Plan (PBS&J 2003). The wastewater flow for 2005 was estimated by the Miami-Dade Water and Sewer Department to be 107.9 MGD, or 170 gal/capita/day. The data from the Miami-Dade Water and Sewer Department extends to the Year 2015. Wastewater flow data for 2020 and 2025 were extrapolated based on the per capita wastewater generation rate and includes the decrease in per capita production reflected in the Department's data between 2010 and 2015.

The decrease was extended linearly to obtain a per capita wastewater production of 165 gal/capita/day for 2020 and 162 gal/capita/day for 2025. The average daily wastewater flow rate is expected to increase to 126.3 MGD in the Year 2025. Projected wastewater flow rates for the study period are presented in Table 2-34.

Table 2-34. Wastewater Flow Projections for Miami-Dade/North WWTP from 2005 to 2025. Based on data from PBS&J (2003)

	2005	2010	2015	2020	2025
Wastewater flow (MGD)	107.9	111.9	116.6	121.3	126.3
Per capita usage (gal/day)	170	170	166	165	162

The average influent BOD_5 and TSS concentrations during 2001 were 99 and 127 mg/L, respectively. The annual average BOD_5 and TSS reductions were 94% and 89%, resulting in average effluent BOD_5 and TSS concentrations of 5.6 and 13.6 mg/L (PBS&J 2003). The average influent BOD_5 and TSS concentrations from 1984 through 1997 were 127 and 157 mg/L, respectively. The annual average BOD_5 and TSS reductions were 89% and 88%, resulting in average effluent BOD_5 and TSS concentrations of 14 and 19 mg/L (PBS&J 1998).

The wastewater effluent quality was reviewed for a variety of constituents. The Miami-Dade/North WWTP was found to have chloride concentrations of 580 mg/L. The impacts of high chloride concentrations on public access reuse, specifically with urban and agricultural irrigation, were evaluated in the 1992 Reuse Feasibility Study (PBS&J 1992). Infiltration/inflow reduction programs in the wastewater collection and transmission system were found to be useful for reducing high chloride concentrations in reclaimed water. The Miami-Dade/North WWTP treats wastewater influents with high and low chloride concentrations in two separate trains. Influent wastewater from North Miami and Miami Beach contains chloride concentrations or 1,000 mg/L or higher, whereas influent from the northwestern portion of the county has chloride concentrations in the vicinity of 135 mg/L. Effluent from the low chloride train, which has chloride concentrations less than 400 mg/L, is reclaimed for reuse applications. Further treatment of the WWTP effluent with membrane technology or dilution to reduce chloride concentrations was considered for the case where reclaimed water from the high chloride train is used to increase reuse capacity (PBS&J 1998).

Monitoring data reported to the Florida DEP from August 2003 through July 2004 were examined. The average $CBOD_5$ and TSS effluent concentrations during this period were 6 and 10 mg/L, respectively, as shown in Table 2-35. These values are below the respective discharge limits of 30 and 30 mg/L. The removals for $CBOD_5$ and TSS were not reported and could not be calculated because the influent average monthly concentrations for $CBOD_5$ and TSS were not reported. The average effluent concentrations for total nitrogen and phosphorus were 17.5 and 1.7 mg/L, respectively. Annual average and 90^{th} percentile effluent fecal coliform values were not reported. The geometric mean and maximum concentrations were 1.2 and 67 per 100 mL, respectively, as shown in Table 2-36. These values are below the corresponding limits of 200 and 800 per 100 mL.

Table 2-35. Ocean Outfall Discharge Composition of the Miami-Dade/North WWTP from 8/31/03 to 7/31/04. Data from Florida DEP Discharge Monitoring Reports

Parameter	Average of monthly averages	Maximum monthly average
TSS (mg/L)	10	12.4
$CBOD_5$ (mg/L)	6	9.2
TSS removal (%)	–	–
$CBOD_5$ removal (%)	–	–
Total N (mg-N/L)	17.5	20.5
Total P (mg-P/L)	1.7	2.1

Table 2-36. Ocean Outfall Fecal Coliform Concentrations at the Miami-Dade/North WWTP from 8/31/03 to 7/31/04. Data from Florida DEP Discharge Monitoring Reports

	Value (# /100 mL)
Annual average	–
90^{th} percentile	–
Geometric mean	1.2
Maximum	67.3

2.5.3 Reuse Facilities

The Miami-Dade/North WWTP has an on-site reuse system that consists of filtration, chlorination and pumping facilities and reclaimed water storage tanks. Three down flow filters with a total surface area of 510 ft^2 and a design capacity of 3 MGD, two continuous backwash filters with a total surface area of 200 ft^2 and a design capacity of 1.4 MGD, a down flow deep bed filter with a total surface area of 154 ft^2 and a design capacity of 1.6 MGD, and a dual media down flow filter with a total surface area of 150 ft^2 and a design capacity of 1.1 MGD are currently in use. The reclamation system started in 1997 to provide reclaimed water to Florida International University for landscape irrigation. The reuse system capacity is 2.9 MGD for on-site and 1.5 MGD for the university's applications. During 2003, the reclaimed water flow was 2.3 MGD (FL DEP 2004). The wastewater influent from northeastern Miami contains high chloride concentrations due to the infiltration/inflow of brackish groundwater. It is therefore not reclaimed for irrigation reuse. The influent from Northwestern Miami has lower chloride concentrations and is processed in a separate train for reuse applications (PBS&J 1998).

2.5.4 Ocean Outfall

The Miami-Dade/North Outfall was constructed in 1975. It consists of a 90 inch reinforced concrete pipe that extends 11,700 ft from the shoreline and discharges effluent through 12 ports at a depth of 108 ft. The permitted capacity of the outfall is 112.5 MGD annual average daily flow (PBS&J 2003).

2.5.5 Disposal Methods in Addition to Ocean Outfall

Four Class I injection wells were constructed at the Miami-Dade/North WWTP, but a testing program must be completed before the wells are allowed to operate. The maximum flow discharge to the wells is about 45 MGD (PBS&J 2003).

2.5.6 Future Plans

The Miami-Dade Water and Sewer Department developed alternatives for Miami-Dade County to handle wastewater increases from population growth and wet-weather flows. The alternatives included two Comprehensive Everglades Restoration Plan projects. In the first project, the South District WWTP would be expanded from 112.5 MGD to 131.25 MGD and would be converted to advanced wastewater treatment such as membrane treatment to meet effluent discharge requirements for the coastal wetlands next to Biscayne Bay. In the second project, a reclaimed water plant with a design capacity of 20 MGD would be constructed at the Bird Drive Basin. The reclaimed water from this plant would be used for aquifer recharge. Among the seven alternatives considered, the chosen alternative includes the use of an abandoned ocean outfall at the Miami-Dade/North WWTP and construction of a new 120 inch ocean outfall at the Miami-Dade/Central WWTP to handle future demands (PBS&J 2003).

2.6 Miami-Dade/Central WWTP

An overview of the Miami-Dade/Central WWTP in Miami-Dade County and its associated facilities is given in Table 2-37. Included are brief descriptions of the treatment and alternative disposal methods, flows, reuse facilities, ocean outfall, and future plans. More extensive information is given below.

2.6.1 Description of Wastewater Treatment Plant

The Miami-Dade/Central WWTP is located on Virginia Key at 3989 Rickenbacker Causeway, Miami. The initial 47 MGD facility (Plant 1) started operation in 1956. The treatment capacity was increased to 70 MGD in 1974 by adding two more aeration tanks. Plant 2, a 55 MGD pure oxygen activated sludge plant, became operational in 1980. Plant 1 was down-rated to 60 MGD the same year. An upgrade of Plant 1 to pure oxygen activated sludge was completed in 1999. Plant 2 was re-rated to 83 MGD. The complete facility has a permitted capacity of 143 MGD annual average daily flow. Plants 1 and 2 are operated independently of each other.

There is no influent screening at the site, as the wastewater is screened at Pumping Stations 1 and 2. Liquid treatment facilities include aerated grit chambers, pure oxygen trains, secondary clarifiers and chlorination facilities. The design criteria of the aeration basins and secondary clarifiers are shown in Table 2-38. Biosolids treatment facilities consist of gravity sludge thickening, anaerobic digestion, centrifuge dewatering and disposal to landfills or land application sites. After chlorination, the effluents from both plants are mixed in the effluent pumping station. Most of the treated wastewater is disposed of through an ocean outfall. A small portion of the wastewater is reclaimed for water reuse (PBS&J 2003). The site of the Miami-Dade/Central WWTP is bordered by Miami Bay on the west, north and east. An undeveloped area of Virginal Key lies to the south of the plant (Fig. 2-8).

Table 2-37. Overview of Miami-Dade/Central WWTP, Ocean Outfall and Associated Facilities

Treatment and alternate disposal	*Method*	Pure oxygen activated sludge
	Disinfection level	Basic level for ocean outfall disposal
	Other disposal options	None
2003 Flows	*Reuse*	8.9 MGD
	Ocean outfall	104.6 MGD
	Other disposal flow	- -
	Total treated flow	113.5 MGD
Reuse facilities	*Design capacity*	8.5 MGD
	Current flow	8.9 MGD
	Start up	1994 Public access reuse
	Applications	On-site
	Notes	All influent has high chloride concentrations
Ocean outfall	*Latitude*	25°44′31″N
	Longitude	80°05′10″W
	Discharge depth	100 ft
	Distance offshore	18,800 ft
	Inside diameter	90 and 120 inches
	Number of ports	5
	Diameter of ports	48 inches
	Port orientation	Vertical
Future plans	*WWTP*	Construct a new 120 inch ocean outfall
	Reuse facilities	Could not identify

2.6.2 Historical and Projected Flows and Concentrations

The Miami-Dade/Central WWTP served an estimated 761,700 people within its service area in 2005. The population for the Miami-Dade/Central WWTP service area is expected to increase to 932,100 by the Year 2025. Population projections for the study period are presented in Table 2-39. Methodology for population estimates for the Miami-Dade/Central WWTP are similar to those discussed in Section 2.5.2.

The average daily wastewater flow rate is expected to increase to 151.3 MGD in the Year 2025. Projected wastewater flow rates for the study period are presented in Table 2-40. Methodology for wastewater flow projections was similar to that discussed in Section 2.5.2.

The average influent BOD_5 and TSS concentrations during 2001 were 148 and 194 mg/L, respectively. The annual average BOD_5 and TSS reductions were 95.8% and 97.4%, resulting in respective average effluent BOD_5 and TSS concentrations of 6.2 and 4.9 mg/L (PBS&J 2003). The average influent BOD_5 and TSS concentrations from 1984 through 1997 were 117 and 104 mg/L, respectively. The annual average BOD_5 and TSS reductions were 84% and 87%, resulting in respective average effluent BOD_5 and TSS concentrations of 19 and 14 mg/L (PBS&J 1998).

Table 2-38. Design Criteria for the Miami-Dade/Central WWTP

Treatment Facility	Value	Units
Aeration Basins		
Plant 1		
No. of tanks	6	#
No. of aeration channels per tank	3	#
Channel length	210	ft.
Channel width	22	ft.
Sidewater depth	13	ft.
Volume per channel	0.45	MG
Total aeration tank volume	8.1	MG
Plant 2		
No. of trains	4	#
No. of aeration stages per train	6	#
Stage length	78.33	ft.
Stage width	39.17	ft.
Sidewater depth	10.17	ft.
Volume per stage	0.24	MG
Total aeration train volume	5.8	MG
Secondary Clarifiers		
Plant 1		
No. of tanks	6	#
No. of clarifier channels per tank	3	#
Channel length	275	ft.
Channel width	18	ft.
Sidewater depth	11	ft.
Total surface area of clarifiers	89,250	sf
Total volume of clarifiers	7.32	MG
Plant 2		
No. of tanks	10	#
No. of clarifier channels per tank	3	#
Channel length	275	ft.
Channel width	18	ft.
Sidewater depth	11	ft.
Total surface area of clarifiers	148,750	sf
Total volume of clarifiers	12.2	MG

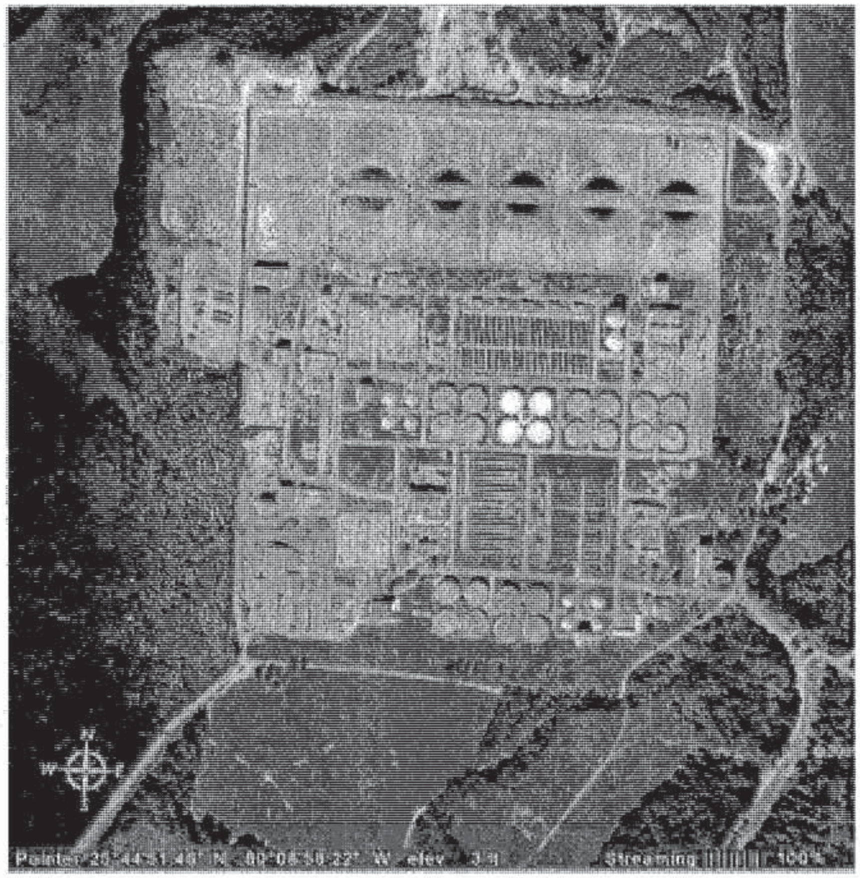

Figure 2-8. Aerial photograph of the Miami-Dade/Central WWTP (Google Earth 2005)

Table 2-39. Population Projections for Miami-Dade/Central WWTP Service Area from 2005 to 2025. Based on data from PBS&J (2003)

Year	**2005**	**2010**	**2015**	**2020**	**2025**
Population	761,700	789,800	839,900	882,000	932,100

Table 2-40. Wastewater Flow Projections for Miami-Dade/Central WWTP Service Area from 2005 to 2025. Based on data from PBS&J (2003)

Year	**2005**	**2010**	**2015**	**2020**	**2025**
Wastewater flow (MGD)	129.4	134.1	139.8	145.4	151.3
Per capita usage (gal/day)	170	170	166	165	162

An irrigation pilot study at the Miami-Dade/Central WWTP site was planned to evaluate the feasibility of using reclaimed water with high chloride concentrations for golf course irrigation. The landscape vegetation on Virginia Key and Key Biscayne was found to be naturally tolerant to high chlorides, due to the barrier island conditions (PBS&J 1992).

Influent wastewater at the Miami-Dade/Central WWTP contains high chloride levels due to the infiltration/inflow of brackish groundwater into the collection system. The combined effluent chloride concentration at the Miami-Dade/Central WWTP was 1,089 mg/L in 1994. Reclaimed water from this source was found to be unsuitable for irrigation without membrane treatment. On-site irrigation at the Miami-Dade/Central WWTP was considered because the landscape vegetation is tolerant to high chloride concentrations and most of this vegetation is turf grass, which tolerates chloride concentrations greater than 1,000 mg/L (PBS&J 1998).

Monitoring data reported to the Florida DEP from August 2003 through October 2004 were examined. The average effluent concentrations for $CBOD_5$ and TSS were 6 and 10 mg/L, respectively, as shown in Table 2-41. These values are below the respective discharge limits of 25 and 30 mg/L. The removals for $CBOD_5$ and TSS were both 95%, which is higher than the requirement of 85%. Average effluent total nitrogen and total phosphorus concentrations were 16.8 and 1.6 mg/L, respectively. The annual average and 90^{th} percentile effluent fecal coliform values were not reported. The geometric mean and maximum concentrations were 1.3 and 19.6 per 100 mL, respectively, as shown in Table 2-42. These values are below the corresponding limits of 200 and 800 per 100 mL. The average influent concentrations of $CBOD_5$ and TSS were 131 and 201 mg/L, respectively, for the same period, as shown in Table 2-43. There were no violations of effluent quality requirements.

Table 2-41. Ocean Outfall Discharge Composition of the Miami-Dade/Central WWTP from 8/31/03 to 10/31/04[1]. Data from Florida DEP Discharge Monitoring Reports

Parameter	**Average of monthly averages**	**Maximum monthly average**
TSS (mg/L)	10	16
$CBOD_5$ (mg/L)	6	11
TSS removal (%)	95	–
$CBOD_5$ removal (%)	95	–
Total N (mg-N/L)	16.8	22.5
Total P (mg-P/L)	1.6	3.4

[1] For all the data 1/31/04, 2/29/04 and 4/30/04 values were not reported

Table 2-42. Ocean Outfall Fecal Coliform Concentrations at the Miami-Dade/Central WWTP from 8/31/03 to 10/31/04[1]. Data from Florida DEP Discharge Monitoring Reports

	Value (# /100 mL)
Average of monthly averages	–
90^{th} percentile	–
Geometric mean	1.3
Maximum	19.6

[1] For all the data 1/31/04, 2/29/04 and 4/30/04 values were not reported

Table 2-43. Average Influent Concentrations at the Miami-Dade/Central WWTP from 8/31/03 to 10/31/04[1]. Data from Florida DEP Discharge Monitoring Reports

Parameter	Average of monthly averages
TSS (mg/L)	201
$CBOD_5$ (mg/L)	131

[1] For all the data 1/31/04, 2/29/04 and 4/30/04 values were not reported

Note: The monthly averages for the TSS and $CBOD_5$ on 3/31/04 were 248 mg/L and 156 mg/L respectively, which gives the highest sum (404 mg/L) of monthly averages for TSS and $CBOD_5$.

2.6.3 Reuse Facilities

The Miami-Dade/Central WWTP has on-site reuse systems for Plants 1 and 2. Each of the reuse systems includes a chlorine contact tank, reclaimed water and chlorine injector pumps, and strainers. The Plant 2 reuse system supplies reclaimed water to the sludge dewatering building, as well as the Plant 2 processes. The plant influent contains high chloride concentrations from infiltration/inflow of brackish groundwater and was found unsuitable for off-site irrigation (PBS&J 1998). The reuse system capacity and flow in 2003 were 8.5 and 8.9 MGD, respectively (FL DEP 2004).

2.6.4 Ocean Outfall

The initial ocean outfall that was placed online in 1956 included a gravity pipeline that extended 4,500 ft off-shore and discharged at a depth of 18 ft. Most of the onshore portion of the outfall pipeline consisted of 108 inch diameter reinforced concrete pipe. The offshore portion included a 90 inch diameter reinforced concrete pipe. In the 1970s, during expansion of the Miami-Dade/Central WWTP, an additional 14,296 ft of 120 inch diameter reinforced concrete pressure pipe was constructed to discharge effluent to a depth of 90 ft (Hazen and Sawyer 1997a).

The effect of Tropical Storm Gordon and Hurricane Andrew on the ocean outfall pipeline was evaluated and the pipeline was found to be hydraulically and structurally stressed (Rust Environment and Infrastructure 1995). The ocean outfall was rehabilitated in 2000. Both onshore and offshore portions of the original 108/90 inch portion of the outfall pipeline were changed. Modification of the onshore portion involved installation of 1600 ft of 120 inch pipe from the pumping station to the shoreline about 100 ft north of the existing 90 inch outfall pipe. Modification of the offshore portion included the addition of 4,442 ft of 120 inch pipe extending from shoreline to the existing 120 inch pipe (Hazen and Sawyer 1997a).

The current Miami-Dade/Central Outfall consists of parallel 120 and 90 inch pipes that connect to a single 120 inch pipe offshore. The offshore pipe extends 18,800 ft from the shoreline. The effluent is discharged through five 48 inch ports at a depth of about 100 ft. The permitted capacity of the outfall is 143 MGD annual average daily flow. The gravity flow is limited to 116 MGD by high tide conditions. An effluent pumping station is used to pump effluent through the outfall when flows exceed the maximum that can be conveyed by gravity (PBS&J 2003).

2.6.5 Disposal Methods in Addition to Ocean Outfall

The Miami-Dade/Central WWTP has no disposal method other than its ocean outfall.

2.6.6 Future Plans

Future plans for the Miami-Dade/Central WWTP were discussed in Section 2.5.6.

2.7 Summary of Flows in the Six WWTPs and Three County Area

Data collected and recorded by the United State Geological Survey, presented in Table 2-44, indicate that domestic wastewater discharged by municipal systems declined between the Years 1995 and 2000 in Broward and Miami-Dade Counties and marginally increased in Palm Beach County. These data suggest a substantial reduction in per capita usage, as much as 26% for Broward County.

Table 2-44. Wastewater Flows for the Three County Area for the Years 1995 and 2000 (Marella 1999; Marella 2004)

	1995 Average Daily Flow (MGD) (gal/capita/day)	2000 Average Daily Flow (MGD) (gal/capita/day)	Percent Difference
Palm Beach	107.7 (140)	108.1 (114)	0.3 (-18.5)
Broward	191.2 (175)	190.3 (129)	-0.5 (-26.4)
Miami-Dade	323.9 (206)	311.1 (170)	-4.0 (-17.3)

Despite the observed reduction in per capita usage, wastewater production is expected to increase over the next twenty years due to population increases, as shown in Table 2-45. Figure 2-9 depicts the projected increase in wastewater production over the study period.

Table 2-45. Summary of Six WWTP Projected Flows in MGD, 2005-2025

Year	2005	2010	2015	2020	2025
Boynton-Delray	19.4	21.3	23.2	25.2	27.1
Boca Raton	15.6	17.1	18.7	20.2	21.8
Broward/North	84.2	88.6	90.8	92.2	94.1
Hollywood	40.0	43.5	47.2	50.9	54.5
Miami-Dade/North	107.9	111.9	116.6	121.3	126.3
Miami-Dade/Central	129.4	134.1	139.8	145.4	151.3

Additional data reported by the USGS show that in 1995, the service areas of the Boynton-Delray and the Boca Raton WWTPs comprised 31% of the population and 28% of the total wastewater flow in Palm Beach County, as shown in Table 2-46. The service areas of the Broward/North and Hollywood WWTPs in Broward County accounted for 53% of both population and wastewater flow in the county during the same year, as shown in Table 2-47. The service areas of the Miami-Dade/North and Miami-Dade/Central WWTPs in Miami-

Dade County comprised 77% of the population and 71% of the total wastewater flow (Table 2-48).

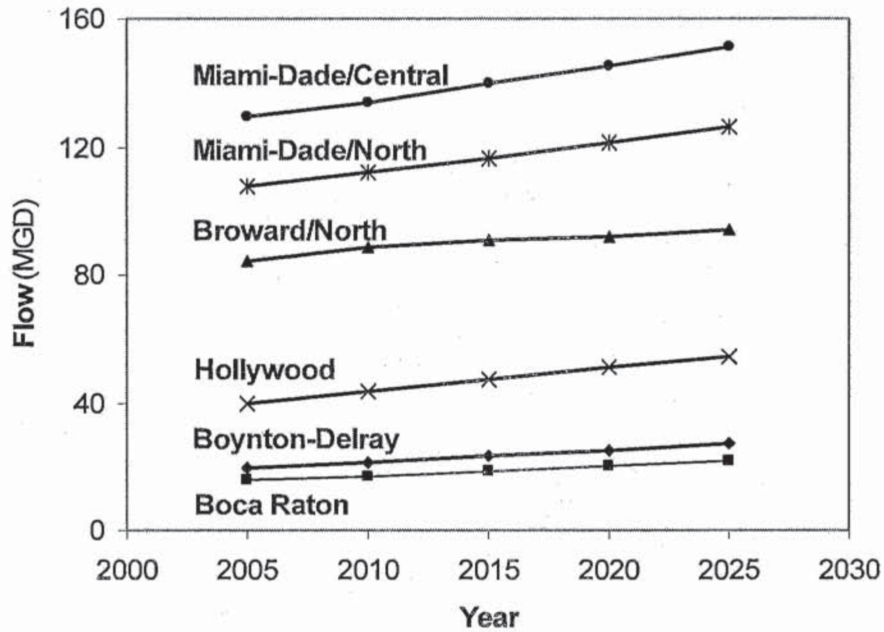

Figure 2-9. Projected Wastewater Flows for the six WWTPs with ocean outfalls from 2005–2025

Table 2-46. Palm Beach County Wastewater Flows in MGD by Service Area for the Year 1995 (Marella 1999)

	Population Served	Permitted Capacity	Total	Ground	Injection Well	Surface
Acme	17,000	4.8	2.4	0	2.4	0
Belle Glade	12,000	3	3.0	0	3.0	0
Boca Raton	**65,000**	**20**	**13.7**	**0**	**0**	**13.7**
Delray Beach	**175,000**	**24**	**16.6**	**0**	**0**	**16.6**
Loxahatchee	40,000	8	4.3	2.5	1.9	0
Pahokee	7,000	1.2	1.1	0	1.1	0
Palm Beach County Utilities Century	NA	1	0.4	0	0.4	0
Palm Beach County Utilities North	NA	4.5	1.5	0	1.5	0
Palm Beach County Utilities Southern	115,000	40	14.1	1.2	12.9	0
Royal Palm Beach Utilities	16,015	2.2	1.6	0	1.6	0
Seacoast Utilities	48,000	8	8.0	0	8.0	0
South Bay	4,000	1.4	0.8	0	0.8	0
U.S. Sugar Ritta Village	820	0.1	0.1	0.1	0	0
U.S. Sugar Bryant	1,300	0.1	0.1	0.1	0	0
West Palm Beach	267,000	40	40.1	0	40.1	0
United Technologies	NA	0.2	0.1	0	0.1	0
Total	768,135	158.5	107.8	3.8	73.8	30.2

Table 2-47. Broward County Wastewater Flows in MGD by Service Area for the Year 1995 (Marella 1999)

	Population Served	Permitted Capacity	Total	Ground	Injection Well	Surface
Broward County Utilities	**400,000**	**80**	**66.5**	**0**	**23**	**43.5**
Cooper City	12,600	1.3	1.3	0	0	1.3
Coral Springs	20,000	1.3	1.3	0	0	1.3
Davie	5,020	3	2.2	0	0	2.2
Ferncrest Utilities	5,500	0.6	0.3	0	0	0.3
Fort Lauderdale	224,420	43	40.7	0	40.7	0
Hollywood	**180,000**	**42**	**33.2**	**0**	**0**	**33.2**
Margate	47,279	8	8.1	0	8.1	0
Pembroke Pines	12,000	3.5	3.6	0	3.6	0
Plantation	75,184	15	12.8	0	12.8	0
Pompano Beach	NA	2.5	1.5	1.5	0	0
South Broward Utilities	5,267	0.5	0.5	0.5	0	0
Sunrise STP 1	40,000	7.5	7.1	0	7.1	0
Sunrise STP 2	14,480	3	1.5	0	1.5	0
Sunrise STP 3	50,000	8.5	7.4	0	7.4	0
Total	1,091,750	220.0	187.8	2.0	104.1	81.7

Table 2-48. Miami-Dade County Wastewater Flows in MGD by Service Area for the Year 1995 (Marella 1999)

	Population Served	Permitted Capacity	Total	Ground	Injection Well	Surface
American Village	1,000	0.2	0.6	0.6	0	0
Homestead	22,500	2	2.4	2.4	0	0
Miami-Dade/Central	**400,000**	**90**	**135.8**	**0**	**0**	**135.8**
Miami-Dade North	**800,000**	**121**	**95.2**	**0**	**0**	**95.2**
Miami-Dade South	350,000	75	90.5	0	90.5	0
TOTAL	1,573,500	288	324	3	90	231

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3. Water Supply Facilities in the Three Counties

South Florida is experiencing rapid population growth and attendant increases in water demands. The freshwater consumption rate in this region is expected to increase to 4.9 billion gallons per day by 2020, a 26% increase from 1995 (FL DEP 2002). The Everglades Comprehensive Everglades Restoration Plan (CERP) includes expansion of water supplies to restore the environment and partially meet the needs of a growing population. CERP plans to build 18 reservoirs among many innovative alternative water supplies. However, as the Florida Council of 100 (2003) notes, considerable uncertainty exists in the time-phasing and funding of these projects. Florida's water management districts are authorized to restrict water use due to water shortage conditions (Fumero 2003), thus shortfalls in water supply due to drought or delayed water infrastructure projects could lead to restriction or denial of consumptive use permits. Increased use of reclaimed water will directly reduce the increasing need for freshwater.

Summary information on sources of potable quality water, which are generally from the surficial aquifers in Southeast Florida, are noted in this chapter and past demands and population trends are utilized to develop future potable water demand projections. Information about water treatment plants (WTPs), including present capacities and plans for expansion, is also given in the present chapter.

Due to differences between potable water service areas and wastewater service areas, all of the water treatment facilities within the counties are listed. The potable water service areas that most closely cover the wastewater service areas are highlighted and summarized to develop a correspondence between water demand and wastewater production within a particular wastewater service area. It should be noted that there may be discrepancies between the actual water demand of the population within the six wastewater treatment plant (WWTP) service areas due to this lack of a clearly defined overlap between the utility service areas.

Future potable water demands are compared with design capacities to assess the potential future potable water demand that could be supplanted by reuse of reclaimed water for domestic landscape irrigation. Chapter 5 incorporates information from this chapter in the discussion of utilizing reclaimed water.

3.1 Palm Beach County

3.1.1 Water Sources and Water Demands

The population of the Palm Beach County wastewater service areas, that is, the areas served by the Boynton-Delray and Boca Raton WWTPs, relies primarily on groundwater to meet its potable water demand. In some parts of the County, the surficial aquifer is unnamed, while in other parts of the County, the surficial aquifer is the Biscayne Aquifer. These unconfined sources provide most of the raw water that is treated and distributed for the potable water service area.

Utilities in the potable water service areas have implemented water management methods to enhance their potable water supply. During times of drought, treated raw water is blended with finished water at the Boynton Beach West WTP to increase water supplies (Boynton Beach 2005a). Additionally, an aquifer storage and recovery well has been installed to store treated water for subsequent recovery when needed. Aquifer storage and recovery helps to reduce over-utilization of the shallow aquifer.

As shown in Table 3-1, the 297,000 residents within the potable water service area utilized 52.34 MGD in 1995. In 2000, the population had increased to 315,000 and the usage increased to 56.64 MGD The corresponding per capita usage was 176 gal/capita/day and 180 gal/capita/day, respectively (Brown and Caldwell 1995; Hazen and Sawyer 1997; Marella 1999; Marella 2004). In the year 2000, the Boynton-Delray wastewater service area had a per capita usage rate of 164 gal/capita/day, compared to 203 gal/capita/day in the Boca Raton wastewater service area, reflecting a higher per capita demand in the more affluent Boca Raton community.

Table 3-1. Historic Potable Water Demand for Wastewater Service Areas within the Palm Beach County Study Area. Based on data from Brown and Caldwell (1995), Hazen and Sawyer (1997), Marella (1999) and Marella (2004)

Year	**1995**	**2000**
Water usage (MGD)	52.3	56.6
Per capita usage (gal/capita/day)	176	180

As noted in Section 2.1, the population for the Palm Beach County area is expected to increase at a rate consistent with the high population influx typical for the region (GEC 2003). Table 3-2 indicates the projected potable water demand for the residents of the study area for the period from 2005 to 2025, utilizing the 2000 per capita usage of 180 gal/capita/day throughout the study period and the population projection estimated from the United States Army Corps of Engineers (GEC 2003). The potable water demand for the Palm Beach County study area is expected to increase from 62.5 MGD in 2005 to 87.4 MGD in 2025.

Table 3-2. Potable Water Demand Projections for Wastewater Service Areas within the Palm Beach County Study Area from 2005–2025. Based on data from Brown and Caldwell (1995), Hazen and Sawyer (1997), Marella (Marella 1999), Marella (2004), and GEC (2003)

Year	**2005**	**2010**	**2015**	**2020**	**2025**
Water demand (MGD)	62.5	68.7	74.9	81.2	87.4

3.1.2 Water Treatment Facilities and Future Plans

There are four WTPs in the service area within Palm Beach County. The Delray Beach, Boynton Beach East, and Boynton Beach West water treatment facilities are located within the wastewater service area of the Boynton-Delray WWTP, and the Boca Raton Glades Road WTP lies within the service area of the Boca Raton WWTP. Table 3-3 shows eight WTPs located within Palm Beach County; the WTPs that provide potable water to the population of the wastewater service areas that have WWTPs that discharge to ocean outfalls are shown in bold.

Table 3-3. Palm Beach County Water Treatment Plants (SFRPC 2005). WTPs listed in boldface type have service areas in common with the South Central Regional and Glades Road WWTPs.

Plant Name	Plant Address/ Location	Design Capacity (MGD)	Treatment process	Source of water	Ref.
Delray Beach WTP	**600 S.W. 2nd Ave., Delray Beach**	**26.0**	**Lime softening**	**Surficial aquifer**	**Delray Beach (2005b; 2005a)**
Boynton Beach East WTP	**1620 S. Seacrest Blvd., Boynton Beach**	**19.0**	**Lime softening**	**Surficial aquifer**	**Boynton Beach (2005b; 2005a)**
Boynton Beach West WTP	**5469 W. Boynton Beach Blvd., Boynton Beach**	**9.0**	**Membrane filtration**	**Surficial aquifer**	**Boynton Beach (2005b; 2005a)**
Glades Road WTP	**Glades Rd., Boca Raton**	**70.0**	**Lime softening & Membrane filtration**	**Biscayne Aquifer**	**(Boca Raton 2005)**
Palm Beach County WTP #2	Suburban Lake Worth	14.5	Lime softening + ozone treatment	Surficial aquifer	(Palm Beach County 2005a)
Palm Beach County WTP #3	Suburban Delray-Boynton Beach	30.0	Membrane filtration	Surficial aquifer	(Palm Beach County 2005b)
Palm Beach County WTP #8	Suburban West Palm Beach	20.0	Lime softening + ozone treatment	Surficial aquifer	(Palm Beach County 2005c)
Palm Beach County WTP #9	Suburban Boca Raton	27.0	Membrane filtration	Surficial aquifer	(Palm Beach County 2005d)

a) Delray Beach WTP. The Delray Beach WTP, located at 600 S.W. 2nd Ave., is a 26.0-MGD (design and permitted capacity) lime softening treatment facility (Delray Beach 2005b). Raw water is aerated to remove natural gases and lime is added in a clarifier for softening, color removal, and iron removal. The facility utilizes filtration, disinfection, and fluoride injection prior to distribution (Delray Beach 2005a).

b) Boynton Beach East and West WTPs. Two WTPs are operated to serve the City of Boynton Beach. The Boynton Beach East WTP, located at 1620 S. Seacrest Boulevard, was built in 1962 with a design capacity of 8 MGD and was expanded to 17.5 MGD in late 1970s (Brown and Caldwell 1993). The WTP currently has a design and permitted capacity of 19.0 MGD and uses advanced lime-softening and filtration treatment process. The Boynton Beach West WTP, located at 5469 W. Boynton Beach Blvd., Boynton Beach, started operation in 1994. This WTP utilizes membrane softening technology and has a design and permitted capacity of 9.0 MGD (Boynton Beach 2005b).

The Boynton Beach West WTP has one aquifer storage and recovery well with a permitted capacity of 6.4 MGD and is planning to install a second well in 2005 (Boynton Beach 2005a).

c) Glades Road WTP, Boca Raton. Boca Raton's first WTP was constructed in 1927 where the City Hall stands today. A new WTP was built in the northwest corner of Glades Road and Boca Raton Boulevard with a capacity of 2.0 MGD in 1956, which was subsequently replaced by a 20.0-MGD WTP in the current Utility Services Complex. The WTP design capacity was increased with a 10.0 MG storage tank to supplement the existing 7.5-MG tank. The number of filters was increased to eight by constructing a third filter building consisting of two new filters and the design capacity to expand with a ninth filter. The raw water supply was recently increased by permitting seven additional 2.0 MGD wells. An additional 40.0 MGD membrane softening water treatment facility was completed in 2004. The Glades Road WTP currently has a design and permitted capacity of 70.0 MGD (Boca Raton 2005).

3.2 Broward County

3.2.1 Water Sources and Water Demands

The public utilities within Broward County rely solely on the Biscayne Aquifer, a surficial aquifer unique to South Florida (Marella 1999).

As shown in Table 3-4, the 858,000 residents within the wastewater service areas of the Broward/North and Hollywood WWTPs utilized 138.5 MGD of potable water in 1995, increasing to 942,000 residents and 152.2 MGD in 2000. This potable water demand represents an increase of 9.9% in five years (Hazen and Sawyer 2001; Hazen and Sawyer 2004).

Table 3-4. Historic Potable Water Demand for Wastewater Service Areas within the Broward County Study Area. Based on data from Hazen and Sawyer (2001; 2004)

Year	**1995**	**2000**
Water usage (MGD)	138.5	147.2
Per capita usage (GPD)	162	162

The population within the potable water service area is expected to continue to increase in Broward County, although at a rate slightly below that of the past, decreasing from the 9.9% seen between 1995 and 2000 to an estimated 6.6% growth rate from 2020 to 2025 (Hazen and Sawyer 2001; GEC 2003; Hazen and Sawyer 2004). Table 3-5 indicates the projected water demand for the residents of the potable water service area from years 2005 to 2025, based on figures obtained from Hazen and Sawyer (2001; 2004) and a per capita usage of 162 gal/capita/day obtained from historical water demand and population values (Hazen and Sawyer 2001; GEC 2003; Hazen and Sawyer 2004). The potable water demand for the study area is projected to increase from 167.3 MGD in 2005 to 226.7 MGD in 2025.

Table 3-5. Water Demand Projections for Wastewater Service Area within the Broward County Study Area from 2005–2025. Based on data from Hazen and Sawyer (2001b; 2004) and GEC (2003)

Year	**2005**	**2010**	**2015**	**2020**	**2025**
Water demand (MGD)	167.3	182.6	197.8	212.7	226.7

The Broward County Office of Environmental Services is planning alternative technologies in case current sources of raw water prove to be inadequate. This alternative is the Floridan Aquifer, an artesian water supply located about 1,000 feet underground. Floridan Aquifer water is higher in total dissolved solids than water from the Biscayne Aquifer and thus needs to be treated with reverse osmosis membrane technology to meet regulatory requirements. The City of Hollywood and the Town of Jupiter currently use the Floridan Aquifer for a portion of their drinking water supply (Hazen and Sawyer 2004).

An integrated water resource plan will be used to develop alternative sources of raw water and innovative management methods, such as increasing water conservation, expanding reuse of reclaimed water, increasing utilization of stormwater through improved operations of the secondary canal system, and applying aquifer storage and recovery technology to meet potable water demands through 2025 (Hazen and Sawyer 2004).

3.2.2 Water Treatment Facilities and Future Plans

Table 3-6 indicates the locations of twenty eight WTPs identified in Broward County (SFRPC 2005). The WTPs that are in the service area of Broward/North WWTP are the Broward County 1A and 2A, City of Coral Springs, City of Lauderhill, and City of Tamarac Utilities West WTP; the Deerfield Beach East and West WTPs, Fiveash WTP, Hillsboro Beach WTP; North Springs Improvement District, Pompano Beach WTP, and the Springtree WTP–Sunrise #1 WTP. The WTPs that are in the service area of the Hollywood WWTP are the City of Dania Beach, City of Hallandale Beach, and Hollywood WTPs, Miramar West Water Plant, and the Pembroke Pines WTP #2.

Capacities and future plans for each WTP are shown in Table 3-7. Total permitted and design capacities for these WTPs are 415.9 and 490.7 MGD, respectively. The maximum day potable water demand is 319.0 MGD (76.7% of permitted capacity) while the annual average daily flow (AADF) is 242.0 MGD (58.2% of permitted capacity). The largest providers of potable water in the County are the Broward County, the City of Hollywood, Sunrise WTPs, and the Fiveash WTP in Fort Lauderdale. A design capacity of 37.0 MGD will be added by 2008 through expansion of eight of these WTPs (SFRPC 2005). Further information about the WTPs within the study area in Broward County is presented in the following sections.

Table 3-6. Broward County Water Treatment Plant Locations (SFRPC 2005). WTPs listed in boldface type have service areas in common with the Broward/North and Hollywood WWTPs.

Plant Permit #	FL DEP Facility ID	Plant Name	Plant Address	City
06-58-00009	**4060167**	**Broward County 1A WTP**	**3701 North State Road 7**	**Lauderdale Lakes**
06-58-00010	**4060163**	**Broward County 2A WTP**	**1390 N.E. 50th St.**	**Pompano Beach**
4060209	**4060209**	**City of Coral Springs WTP**	**3800 N.W. 85th Ave.**	**Coral Springs**
4060253	**4060253**	**City of Dania Beach WTP**	**1201 Stirling Road**	**Dania Beach**
FL4060573	**4060573**	**City of Hallandale Beach WTP**	**215 N.W. 6th Ave.**	**Hallandale Beach**
FL4060787	**4060787**	**City of Lauderhill WTP**	**2101 N.W. 49th Ave.**	**Lauderhill**
06-58-00059	4060845	City of Margate WTP	1001 West River Drive	Margate
4061429	**4061429**	**City of Tamarac Utilities West WTP**	**7805 N.W. 61st St.**	**Tamarac**
4060282	4060282	Cooper City Utilities WTP	11791 S.W. 49th St.	Cooper City
4060291	4060291	Coral Springs Improvement District WTP	10300 N.W. 11th Manor	Coral Springs
06-58-00027	4060344	Davie WTP System I	3790 S.W. 64th Ave.	Davie
06-58-00028	4060344	Davie WTP System III	3500 N.W. 76th Ave.	Hollywood
4060254	**4060254**	**Deerfield Beach East Water Plant**	**101 N.W. 2nd Ave.**	**Deerfield Beach**
4060254	**4060254**	**Deerfield Beach West Water Plant**	**290 Goolsby**	**Deerfield Beach**
4060419	4060419	Ferncrest Utilities WTP	3015 S.W. 54th Ave.	Fort Lauderdale
FL40604861 -01	**4060486**	**Fiveash Water Plant – Fort Lauderdale WTP**	**1500 S. State Road 7/4321 NW 9th Ave**	**Fort Lauderdale**
4060615	**4060615**	**Hillsboro Beach Water Plant**	**925 N.E. 36th St.**	**Pompano Beach**
4060642	**4060642**	**Hollywood WTP**	**3441 Hollywood Blvd.**	**Hollywood**
W11035	**4060925**	**Miramar West Water Plant**	**2600 S.W. 66th Terrace**	**Miramar**
4064390	**4064390**	**North Springs Improvement District WTP**	**9700 N.W. 53rd Court**	**Coral Springs**
4061407	**4061407**	**Park City WTP– Sunrise #2**	**8700 S.W. 19th Place**	**Fort Lauderdale**
4061083	**4061083**	**Pembroke Pines WTP #2**	**7960 Johnson St.**	**Pembroke Pines**
4061121-01	4061121	Plantation Central WTP	400 N.W. 73rd Ave.	Plantation
4061121-02	N/A	Plantation East WTP	N/A	N/A
06-58-00078	**4061129**	**Pompano Beach WTP**	**301 N.E. 12th St.**	**Pompano Beach**
4061408	4061408	Sawgrass WTP– Sunrise #3	777 Sawgrass Corporate Parkway	Sunrise
4064326	4064326	Southwest (S. Broward) WTP	15450 Stirling Road	Davie
4061410	**4061410**	**Springtree WTP– Sunrise #1**	**4350 Springtree Drive**	**Sunrise**

Table 3-7. Broward County WTP Capacities and Future Plans (SFRPC 2005). WTPs listed in boldface type have service areas in common with the Broward/North and Hollywood WWTPs.

Plant Name	Design Capacity (MGD)	Permitted Capacity (MGD)	Peak Flow (MGD)	AADF (MGD)	Additional Capacity (MGD/yr)
Broward County 1A WTP	**60.0**	**16.0**	**9.0**	**8.3**	**NR**[1]
Broward County 2A WTP	**40.0**	**30.0**	**17.4**	**15.4**	**NR**
City of Coral Springs	**16.0**	**16.0**	**10.3**	**8.4**	**NR**
City of Dania Beach WTP	**3.0**	**4.0**	**3.4**	**2.8**	**4.5/2007**
City of Hallandale Beach	**10.0**	**10.0**	**7.0**	**5.8**	**6.0/2006**
City of Lauderhill	**16.0**	**8.1**	**8.6**	**6.9**	**NR**
City of Margate WTP	18.0	13.5	9.1	7.0	NR
City of Tamarac Utilities West	**20.0**	**8.3**	**13.1**	**6.4**	**NR**
Cooper City Utilities	7.0	7.0	5.7	2.9	NR
Coral Springs Improvement District	7.1	5.8	5.5	4.2	NR
Davie WTP System I	3.4	3.4	1.2	1.0	NR
Davie WTP System III	4.0	4.0	3.5	3.4	4.0/2006
Deerfield Beach East Water Plant	**16.8**	**16.8**	**7.9**	**2.0**	
Deerfield Beach West Water Plant	**18.0**	**18.0**	**14.9**	**12.6**	**3.5/2008**
Ferncrest Utilities	1.0	1.0	0.9	0.8	NR
Fiveash Water Plant – Fort Lauderdale	**75.0**	**67.3**	**57.1**	**42.5**	**NR**
Hillsboro Beach Water Plant	**2.0**	**1.0**	**1.3**	**1.1**	**NR**
Hollywood WTP	**61.0**	**57.5**	**32.8**	**26**	**NR**
Miramar West Water Plant	**7.5**	**7.5**	**6.5**	**5.8**	**3.0/2007**
North Springs Improvement District	**6.8**	**6.5**	**5.4**	**4.1**	**NR**
Park City WTP– Sunrise #2	**6.0**	**6.0**	**5.5**	**2.9**	**NR**
Pembroke Pines WTP #2	**18.0**	**16.2**	**15.5**	**13.5**	**6.0/2005– 2007**
Plantation Central WTP	12.0	12.0	10.6	7.0	NR
Plantation East WTP	12.0	12.0	8.2	6.8	NR
Pompano Beach WTP	**50.0**	**24.0**	**21.9**	**17.2**	**NR**
Sawgrass WTP– Sunrise #3	18.0	18.0	12.2	8.8	6.0 – 2006
Southwest (S. Broward) WTP	2.0	2.0	1.9	0.5	NR
Springtree WTP– Sunrise #1	**24.0**	**24.0**	**22.7**	**17.9**	**4.0/2006**
County Total	490.7	415.9	319.0	242.0	37.0 by 2008

[1] None Reported

a) Broward County District 1A and 2A WTPs. The Broward County Office of Environmental Services owns and operates the District 1A and 2A WTPs. The District 1A WTP, located at 3701 North State Road 7, Lauderdale Lakes, started operation in 1960 with a design capacity of 3.0 MGD. The WTP was expanded to 10.5 MGD in 1979 and achieved its current design capacity of 16.0 MGD in 1994. Upflow clarifiers and multimedia filtration are provided in conjunction with lime softening treatment of the raw water from the District 1A well field (Hazen and Sawyer 2004).

The District 2A WTP, located at 1390 N.E. 50th Street, Pompano Beach, started with a 20.0-MGD design capacity in 1972 and was brought to its current design capacity of 40.0 MGD in 1994. The permitted operating capacity is 30.0 MGD. Upflow clarifiers and multimedia filtration are provided together with lime softening treatment of the raw water from the 2A and North Regional well fields (Hazen and Sawyer 2004).

The Broward County Office of Environmental Services is working on rebuilding substantial portions of the water systems to overcome deficiencies in handling existing and projected potable water demands. The improvement projects for Districts 1, 2 and 3 are anticipated to be completed by 2008, 2010 and 2005 at estimated costs of $320 million, $167 million and $95 million, respectively (Hazen and Sawyer 2004).

b) Hollywood WTP. The Hollywood WTP, located at 3441 Hollywood Blvd., Hollywood, started operation in 1925 with a design capacity of 0.5 MGD. In 1935, a water softening system was added to the WTP to improve potable water quality. In late 1970s, the WTP was expanded with a lime softening system. The City of Hollywood decided to utilize membrane treatment in the 1980s and the WTP was upgraded with a 16.0-MGD membrane treatment facility in 1996. The membrane treatment facility has the ability to be expanded to 300 MGD. The lime softened and membrane treated waters are blended together (Hollywood 2005b). The design capacity is 61.0 MGD and the permitted capacity is 57.5 MGD (SFRPC 2005). The emergency power capabilities at the Hollywood WTP are being upgraded, a new well field is being installed, and the south well field is being rehabilitated for future demands (Hollywood 2005a).

3.3 Miami-Dade County

3.3.1 Water Sources and Water Demands

The public utilities within Miami-Dade County rely only upon the Biscayne Aquifer, a surficial aquifer unique to South Florida (Miami-Dade County 2005).

As shown in Table 3-8, the 1,282,000 residents within the service area of the Miami-Dade/North and Miami-Dade/Central District WWTPs in Miami-Dade County utilized an average of 219.3 MGD in 1995. In the year 2000, 1,343,000 residents used 229.7 MGD, an increase in water usage of 4.7% (PBS&J 2003).

Table 3-8. Historic Potable Water Demand for Wastewater Service Areas within the Miami-Dade County Study Area. (PBS&J 2003)

Year	**1995**	**2000**
Water usage (MGD)	219.3	229.7
Per capita usage (GPD)	171	171

The 1995 and 2000 values presented in PBS&J (2003) are based on per capita usage of 171 gal/capita/day. The same per capita usage was used in developing the projections shown in Table 3-9. Projected water demands for the service area increase from 238.9 MGD in 2005 to 292.4 MGD in 2025.

Table 3-9. Water Demand Projections for Wastewater Service Area within the Miami-Dade County Study Area from 2005–2025. Based on data from PBS&J (2003) and GEC (2003)

Year	**2005**	**2010**	**2015**	**2020**	**2025**
Water demand (MGD)	238.9	247.7	263.4	276.6	292.4

3.3.2 Water Treatment Facilities and Future Plans

The locations of seven WTPs that serve Miami-Dade County (SFRPC 2005) are shown in Table 3-10. The WTPs that are in the service area of the North District WWTP are the City of N. Miami Winson, Hialeah-Preston and Norwood Water Plants. There are no WTPs that lie exclusively in the service area of the Central District WWTP. The Alexander Orr WTP is on the border of the Central and South District WWTP service areas.

Detailed information and future plans for each WTP are shown in Table 3-11. Total permitted and design capacities for the WTPs are 453.8 and 500.5 MGD, respectively. The peak demand is 412.4 MGD (90.9% of permitted capacity) while the annual average daily flow (AADF) is 380.3 MGD (83.8% of permitted capacity). The largest providers in the County are the Alexander Orr and Hialeah-Preston WTPs. Additional water supply of 111.3 MGD will be completed by 2013 through expansion of five of these facilities (SFRPC 2005). The Alexander Orr and Hialeah-Preston WTPs are operated by the Miami-Dade Water and Sewer Department. Additional information about these facilities is given below.

The Alexander Orr and Hialeah-Preston WTPs include lime softening, disinfection, fluoridation, and filtration treatment. They have a common distribution system that covers most of Miami-Dade County (MDWASD 2005). The WTPs were designed for a capacity of 225.0 and 217.7 MGD, respectively, and are permitted for 199.2 and 203.1 MGD, respectively (SFRPC 2005). The Hialeah-Preston WTP, located at 1100 West 2nd Ave., Hialeah, treats water from the northwest and other nearby well fields to serve the residents north of Flagler St. The Alexander Orr WTP, located at 6800 S.W. 87th Ave., Miami, receives its water from the Alexander Orr, Snapper Creek and Southwest well fields, and serves the southern part of the county, down to SW 264th Street. Air stripping facilities were installed at the Hialeah and Preston WTPs in 1992 to restore the contaminated Hialeah and Miami Springs well fields that were out of service (PBS&J 2003).

An aquifer storage and recovery program is underway to store surplus Biscayne aquifer water in the Upper Floridan Aquifer during the wet season and retrieve this water for dry season supply. Several aquifer storage and recovery wells have been installed and others are being constructed or planned. The South Florida Water Management District (SFWMD) developed VISION 2050 for South Florida, which emphasizes development of non-traditional water sources such as reclaimed water, salt water, and deeper aquifers. In the future, the lower east coast of Florida will depend less on the regional water management system and more on local water storage, aquifer storage and recovery, water reuse, and advanced water treatment technologies. As part of this plan, a 23,000-acre freshwater lake in Northwest Miami-Dade County is proposed for water supply during the dry season (PBS&J 2003).

Table 3-10. Miami-Dade County Water Treatment Plant Locations. WTPs listed in boldface type are within the service areas of the Miami-Dade/North and Miami-Dade/Central WWTPs

Plant Permit #	FDEP Facility ID	Plant Name	Plant Address	City
13-00017-W		**Alexander Orr**	**6800 S.W. 87th Ave.**	**Miami**
13-00046-W	4130645	City of Homestead	505 N.W. 9th St.	Homestead
13-00059-W	**PWO-000017**	**City of N. Miami Winson Water Plant[1]**	**12100 N.W. 11th Ave.**	**North Miami**
13-00029-W	4130255	Florida City	461 N.W. 6th Ave.	Florida City
13-00037-W		**Hialeah-Preston**	**1100 West 2nd Ave.**	**Hialeah**
13-00060-W	**4131618**	**Norwood Water Plant – N. Miami Beach[2]**	**19150 N.W. 8th Ave.**	**Miami Gardens**
13-00040-W		South Miami-Dade WTP[3]	11800 S.W. 208th St.	Miami

[1]The City of North Miami receives 50% of its water service from WASD, while the Winson Plant provides the other 50%. The Winson Plant also provides water service to Biscayne Park and parts of Unincorporated Miami-Dade County.

[2]The City of North Miami Beach receives 50% of its water service from WASD, while the Norwood Water Plant provides water to the other 50%. The Norwood Plant also provides water service to Sunny Isles Beach, Miami Gardens, Golden Beach, and Aventura.

[3]The South Miami-Dade WTP is currently under construction. The data provided are the cumulative total for five small WTPs (Leisure City WTP, Everglades Labor Camp WTP, Newton WTP, Elevated Tank WTP, and Naranja Lakes WTP) that the County uses. These WTPs will be taken out of service after the South Miami-Dade WTP is completed.

Table 3-11. Miami-Dade County Water Treatment Plant Capacities and Future Plans

Plant Name	Design Capacity (MGD)	Permitted Capacity (MGD)	Peak Flow (MGD)	AADF (MGD)	Additional Capacity (MGD/yr)
Alexander Orr	217.7	203.1	185.5	171.9	60.3/2013
City of Homestead	16.7	11.7	10.9	8.5	5.0/2008
City of N. Miami Winson Water Plant	9.0	9.3	10.0	8.5	NR[1]
Florida City	4.03	3.51	3.6	3.0	NR
Hialeah-Preston	225.0	199.2	177.6	166.1	10.0/2005
Norwood Water Plant – N. Miami Beach	16.0	16.0	16.0	15.5	16.0/2006
South Miami-Dade WTP	12.0	10.9	8.8	6.8	20.0/2006
County Total	**500.5**	**453.8**	**412.4**	**380.3**	**111.3 by 2013**

[1]None Reported

3.4 Summary of Three County Area

Water demands for the three county area are expected to continue increasing throughout the study period, but the projected increase could be reduced by the implementation of water conservation programs and technologies. The projections given in this report provide estimates of the region's water demand that are inclusive of current water demand trends using presumed minimal water conservation efforts.

As summarized in Table 3-12, aggregate water demand for the three county area have increased from 410.2 MGD in 1995 to 468.7 MGD in 2005. Population growth in the region is expected to continue this upward trend in water demand (Fig. 3-1), resulting in an aggregate water demand of 606.5 MGD by the year 2025. The service areas for Palm Beach County are expected to see about a 40% increase in water demand between the years 2005 and 2025. The service areas for Broward and Miami-Dade Counties are anticipated to experience 36% and 22% increases in water demand, respectively, over the same period.

Table 3-12. Summary of Historical and Projected Water Demands in MGD for the Three County Area from 1995–2025

	1995	2000	2005	2010	2015	2020	2025
Palm Beach	52.3	56.6	62.5	68.7	74.9	81.2	87.4
Broward	138.5	147.2	167.3	182.6	197.8	212.7	226.7
Miami-Dade	219.3	229.7	238.9	247.7	263.4	276.6	292.4
Total	410.2	433.5	468.7	499.0	536.1	570.6	606.5

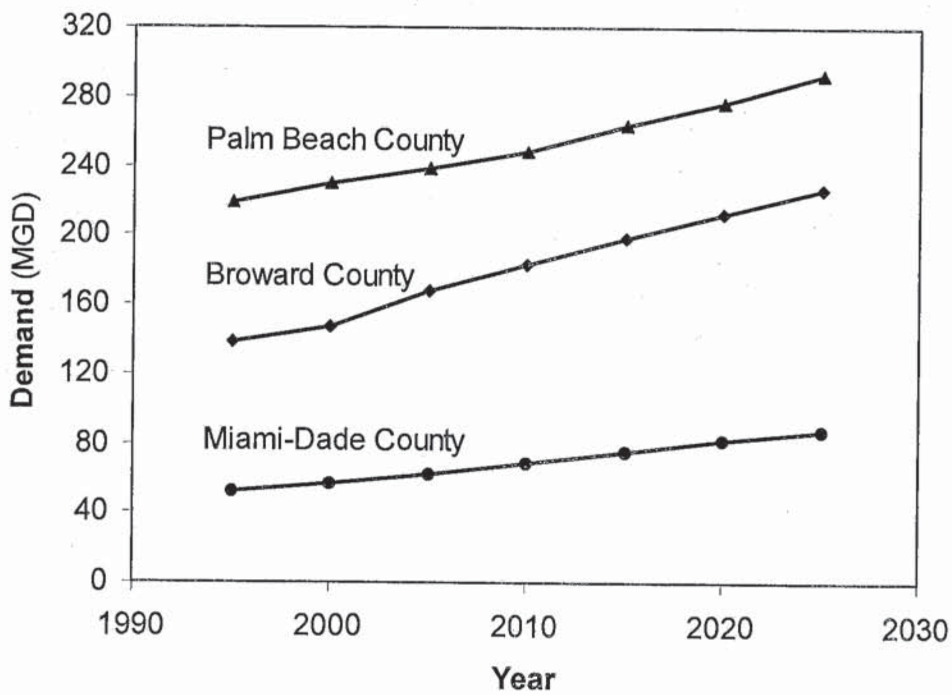

Figure 3-1. Historical and Projected Water Demands by County from 1995–2025

Each of the service areas within the three counties was analyzed to determine the future water demand in relation to the planned potable water design capacity for each of the 5-year projections. "Design capacity" indicates the amount of water that a WTP can deliver without having to incur physical modification and is preferred to the "permitted capacity", which is the amount of water that a WTP is permitted to deliver without a permit modification. In some instances where the "design capacity" is greater than the "permitted capacity", a WTP can have its "permitted capacity" increased without any physical modification to the WTP. In the case where a WTP has a "permitted capacity" less than a "design capacity", the increase in "permitted capacity" can be increased by requesting a re-rating of the WTP by the Florida Department of Environmental Protection. "New water" is the water demand in excess of the existing or planned water supply (design capacity) of the water treatment facility.

The analysis for "new water" can be used to identify WTPs where reclaimed water can be substituted for other, less available or more costly new water sources. For example, since approximately 40% of all residential potable water use is for irrigation (Heaney et al. 2000), reclaimed water can supplement current potable water supplies for landscape irrigation, potentially reducing the need for identifying new sources of potable water. Reclaimed water can be used for groundwater recharge, where applicable, or a component in an aquifer storage and recovery (ASR) systems. Additionally, reclaimed water can be utilized for make up water as part of the Comprehensive Everglades Restoration Program (CERP), a United States Army Corps of Engineers rehabilitation program that aims to improve the quality of the Everglades. Subsequent chapters of this report provide detailed information indicating the water quality standards for each of the water reuse options and the levels of treatment recommended to achieve water quality standards.

The new water analysis for Palm Beach County (Table 3-13) indicates that Palm Beach County has sufficient WTP design capacity to meet its needs until at least 2025.

Table 3-13. Summary of Projected Water Demands and WTP Design Capacities for Palm Beach County

Facility	Design Capacity (MGD) 2005		Flow projections (MGD) 2005	2010	2015	2020	2025
Boca Raton Glades Road WTP	70.0	Total	44.0	48.4	52.7	57.2	61.6
		New water*	0.0	0.0	0.0	0.0	0.0
Boynton Beach WTP	28.0	Total	15.4	16.9	18.4	20.0	21.5
		New water	0.0	0.0	0.0	0.0	0.0
Delray Beach WTP	26.0	Total	14.9	16.4	17.9	19.4	20.9
		New water	0.0	0.0	0.0	0.0	0.0
Total	124.0	Total	74.4	81.7	89.1	96.6	104.0
		New water	0.0	0.0	0.0	0.0	0.0

*Demand in excess of capacity

As depicted in Table 3-14, Broward County has 16 WTPs that provide potable water to the service areas of the Broward North and Hollywood WWTPs. The County presently has insufficient design capacity to meets its 2025 water demand. However, the water utilities within the County are planning five improvement programs during the study period to increase the design capacity by 26.9 MGD for a total of 426.8 MGD by the year 2008, which is sufficient to meet water demands throughout the study period.

Table 3-14. Summary of Projected Water Demands and WTP Design Capacities for Broward County

Facility	Design Capacity (MGD) 2005		Flow projections (MGD) 2005	2010	2015	2020	2025
City of Dania Beach WTP	3.0 (7.5 by 2007)	Total	3.0	3.3	3.6	3.9	4.2
		New water*	0.0	0.0	0.0	0.0	0.0
City of Lauderhill WTP	16.0	Total	7.5	8.2	8.8	9.5	10.2
		New water	0.0	0.0	0.0	0.0	0.0
City of Tamarac Utilities WTP	20.0	Total	7.0	7.6	8.3	8.9	9.6
		New water	0.0	0.0	0.0	0.0	0.0
Coral Springs WTP	16.0	Total	9.2	10.0	10.8	11.7	12.5
		New water	0.0	0.0	0.0	0.0	0.0
Deerfield Beach East WTP	16.8	Total	2.2	2.4	2.6	2.8	3.0
		New water	0.0	0.0	0.0	0.0	0.0
Deerfield Beach West WTP	18.0 (21.5 by 2008)	Total	13.8	15.0	16.2	17.5	18.8
		New water	0.0	0.0	0.0	0.0	0.0
District 1A WTP	16.0	Total	9.1	9.9	10.7	11.5	12.4
		New water	0.0	0.0	0.0	0.0	0.0
District 2A WTP	40.0	Total	16.8	18.3	19.9	21.4	22.9
		New water	0.0	0.0	0.0	0.0	0.0
Fiveash Water Plant	75.0	Total	46.4	50.6	54.8	59.1	63.3
		New water	0.0	0.0	0.0	0.0	0.0
Hallandale Beach WTP	10.0 (16.0 by 2006)	Total	6.3	6.9	7.5	8.1	8.6
		New water	0.0	0.0	0.0	0.0	0.0
Hillsboro Beach WTP	2.0	Total	1.2	1.3	1.4	1.5	1.6
		New water	0.0	0.0	0.0	0.0	0.0
Hollywood WTP	61.0	Total	28.4	30.9	33.5	36.2	38.7
		New water	0.0	0.0	0.0	0.0	0.0
Miramar Beach WTP	7.5 (10.5 by 2007)	Total	6.3	6.9	7.5	8.1	8.6
		New water	0.0	0.0	0.0	0.0	0.0
North Springs WTP	6.5	Total	4.5	4.9	5.3	5.7	6.1
		New water	0.0	0.0	0.0	0.0	0.0
Pompano Beach WTP	50.0	Total	18.8	20.5	22.2	23.9	25.6
		New water	0.0	0.0	0.0	0.0	0.0
Springtree–Sunrise #1 WTP	24.0 (28.0 by 2006)	Total	19.6	21.3	23.1	24.9	26.7
		New water	0.0	0.0	0.0	0.0	0.0
Total	399.9 (426.8 by 2008)	Total	214.9	234.1	253.5	273.6	293.0
		New water	0.0	0.0	0.0	0.0	0.0

*Demand in excess of capacity

Considerable improvements are necessary within Miami-Dade County to meet future water demands within the service area of the Miami-Dade/North and Miami-Dade/Central WWTPs (Table 3-15). The County is planning three improvement programs during the study period to increase its design capacity by 86.3 MGD for a total of 554.0 MGD by the year 2025. However, based on current plans for future improvements, the County will still need to identify sources for an additional 26.7 MGD by 2025.

Table 3-15. Summary of Projected Water Demands and WTP Design Capacities for Miami-Dade County

Facility	Design Capacity (MGD) 2005		Flow projections (MGD) 2005	2010	2015	2020	2025
Alexander Orr WTP	217.7	Total	200.3	226.0	239.5	253.3	266.5
	(278.0 in 2013)	New water*	0.0	8.3	0.0	0.0	0.0
Hialeah-Preston WTP	225.0	Total	193.5	218.4	231.4	244.7	257.5
	(235.0 in 2005)	New water	0.0	0.0	0.0	9.7	22.5
North Miami Winson WTP	9.0	Total	9.9	11.2	11.8	12.5	13.2
		New water	0.9	2.2	2.8	3.5	4.2
North Miami Beach Norwood WTP	16.0	Total	18.1	20.4	21.6	22.8	24.0
	(32.0 in 2006)	New water	2.1	0.0	0.0	0.0	0.0
Total	467.7	Total	421.8	476.0	504.3	533.3	561.2
	(554.0 by 2025)	New water	3.0	10.5	2.8	13.2	26.7

*Demand in excess of capacity

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4. Environmental Impacts of Ocean Outfalls

4.1 Introduction

The primary motivation for reducing discharges of pollutants to land and/or receiving waters is to protect water quality and avoid adverse impacts to public health, recreation, and the environment in general. Traditional indicators of water quality include dissolved oxygen (DO) levels in streams and rivers where levels below 4 or 5 mg/L under low flow conditions in the river or stream can lead to fish kills and other obvious manifestations of water quality problems. Nutrients (nitrogen and phosphorus) are other popular indicators of water quality. Excess nutrients cause algal blooms and other undesirable impacts in lakes and rivers. Florida has experienced some dramatic recent incidences lately of these impacts ranging from Lake Okeechobee to the lower St. Johns River wherein algal blooms occurred from Palatka to the mouth of the St. Johns River east of Jacksonville during the summer of 2005. Red tide outbreaks along the Gulf Coast have further heightened public awareness that human activities are having a detrimental impact on important receiving waters. In addition to DO and nutrients, bacterial water quality is used as an indicator of water quality.

The traditional concern with treated wastewater was where to dispose of it. Stricter regulations against discharge to receiving waters in Florida led to aggressive use of land disposal via effluent irrigation. In the past 25 years, there has been growing realization that this highly treated water could be reused. Thus, these land options were more properly referred to as reuse or recharge facilities.

In this study, the focus is on the six wastewater treatment plants that discharge to ocean outfalls in Southeast Florida. The following sections discuss this practice including studies of the relative risks of ocean disposal vs. other options. The relative risk approach is important to use since all disposal and reuse options have various impacts associated with them.

4.2 Description of Selected Ocean Outfall Studies

The six WWTPs in southeast Florida discharge treated effluent to the Atlantic Ocean via ocean outfalls as described in Chapter 2. Several studies have been made of the impacts of these discharges on the ocean and the associated reefs that are located near these outfalls. Summaries of these studies are presented below.

4.2.1 Southeast Florida Outfall Experiments (SEFLOE I and II)

The Southeast Florida Outfall Experiment I (SEFLOE I), initiated by utilities in Broward, Miami-Dade and Palm Beach Counties, characterized the impacts of ocean outfall wastewater disposal in Southeast Florida. Initial and subsequent dilutions were obtained through field dye and salinity data processing. The initial dilution, current meter and effluent discharge data were analyzed with dimensional analysis and regression to obtain semi-empirical relations. Dye concentration and salinity data were used to determine total physical dilutions as a function of distance from the surface boil. The Broward North and Hollywood outfall plumes were found to undergo enhanced dilution within the 100 meter range. This rapid dilution was attributed to an internal hydraulic jump. Subsequent mixing of plumes was dominated by buoyant spreading for several hundred meters from the boil. In the Miami-Dade North and Miami-Dade Central outfalls, the effluent was initially distributed over a wider area due to the multi-port diffusion. However, the dilutions were not as rapid as the Broward and Hollywood outfall plumes. Subsequent mixing of plumes was dominated by buoyant spreading and oceanic turbulence (Proni and Dammann 1989; Englehardt et al. 2001).

The SEFLOE II study was conducted between 1991 and 1994 as a cooperative effort of state, federal and local government agencies, together with Hazen and Sawyer (1994). Ocean outfalls at the North Regional and Southern Regional WWTPs in Broward County and the North and Central District WWTPs in Miami-Dade County were studied to provide site specific information. Physical, chemical, and biological data from field studies were analyzed to characterize outfall plumes and associated environmental conditions. Englehardt et al., (2001) summarize the results of the SEFLOE studies as follows:

- Bacteria—no organisms could be detected more than 800 meters from the outfall.
- Nutrients—Concentrations of ammonia, TKN, total phosphorous, and nitrate were found to reach background levels within 400 meters from the discharge points.
- Oil and grease—Visual field observations indicated no oil or grease sheens within plumes at the surface.

4.2.2 Comparative Assessment of Human and Ecological Impacts from Municipal Wastewater Disposal Methods in Southeast Florida

Englehardt et al. (2001) present a comparative assessment of the human and ecological impacts from municipal wastewater disposal in Southeast Florida. Their assessment includes ocean disposal from the six WWTPs. Ocean discharge differs from other surface water discharge due to the higher density of the saline ocean waters and the much greater dilution of the ocean. The buoyancy of the plume, marine currents and turbulence result in three distinct phases of dilution (Englehardt et al. 2001):

- Initial plume dilution takes less than two minutes from the time the effluent leaves the outfall until it reaches the ocean's surface. The freshwater-saltwater mixture creates a turbulent, rising plume with strong mixing. The mixing is further improved by the horizontal movement of the Florida Current. The plume rises to the surface downstream of the outlet by at least 10 meters. Englehardt et al. (2001) define the initial dilution as the ratio of the constituent in the effluent to the maximum concentration at the boil.
- Near-field dilution occurs after the effluent reaches the surface.
- Far-field dilution is the result of the interaction of the mixing plume and surface convective processes.

Field investigations revealed that surfacing plumes were present at all six WWTP outfalls throughout the year (Englehardt et al. 2001). All of the outfalls are in at least 28 meters of water and 2 miles offshore. They are located in the westerly boundary of the strong Florida Current, a tributary of the Gulf Stream.

Wanninkhof et al. (2006) evaluated farfield dilution of sewage outfall discharges in southeast Florida. Their studies indicate that the rapid dilution observed in the immediate vicinity of the outfall continues to occur in the 10 to 66 km downstream distances. They estimate that the dilution ratio is 212*distance (km). Thus, a unit of pollutant is diluted to 1/212 of its original value in one km. These authors do not address issues of reef impacts or pollutant control.

4.2.3 Relative Risk Assessment of Management Options for Treated Wastewater in South Florida

The 2003 US EPA relative risk assessment study involved deep well injection, aquifer recharge, discharge to ocean outfalls and surface waters as disposal options. Rapid-rate infiltration basins were chosen as the aquifer recharge option because, unlike slow-rate land application systems, they do not require back-up disposal methods, such as discharge to a storage area or to deep well injection, for wet-weather conditions (US EPA 2003).

A risk characterization was done initially for each disposal option to identify and describe the associated risks, the potential magnitude of the risks and the potential impacts on human and ecological health. The data and knowledge gaps for all disposal options were identified as part of the risk analysis. A relative risk assessment was then used to compare risks among the four wastewater disposal options. Each option had its own specific stressors, exposure pathways, receptors, and effects. A quantitative comparison was found to be infeasible because the parameters relevant to one disposal option were not necessarily relevant to the other options. The overall comparisons were presented as relative risk assessment matrices (US EPA 2003).

Treatment levels before disposal and attenuation factors, like travel distance and time, biological degradation, and adsorption, filtration through geologic media, dispersion by groundwater or ocean currents were found to control the concentrations of stressors received by the receptor. The human health risk from pathogenic microorganisms was higher for deep well injection and discharge to ocean outfalls compared to aquifer recharge and discharge to surface waters. Filtration significantly reduced the level of pathogenic protozoans in treated wastewater. Excess nutrients were found to cause ecological problems (US EPA 2003).

Human health risks from the four disposal options were low. The risk increased with less treatment or short exposure pathways. Filtration, together with high-level disinfection, reduced the risk for all options. The risk increased if there was a coincidence of the disposal location and recreational uses in surface and ocean waters. The risk also increased if harmful algal blooms occurred. The human health risks from deep well injection and aquifer recharge options included the potential impact on drinking water supplies (US EPA 2003).

Ecological health risks from deep well injection and aquifer recharge were found to be very low. The ecological risk from surface water disposal was low due to the advanced level of treatment. However, since the surface waters of South Florida are already impaired, the risk was higher. The ecological risk from ocean outfalls was low outside the mixing zones. The risk increased if harmful algal blooms or bioconcentration in food webs were caused. Risk to coral reefs would increase with the construction of new ocean outfalls (US EPA 2003).

Specific findings for ocean outfalls from this study are listed below.

- *The SEFLOE studies provide a risk assessment and a prediction that there should not be any adverse effects resulting from ocean discharge of secondarily-treated effluent. This prediction is based largely on the rapid dispersal and dilution of the effluent plumes by the Florida Current and the relatively low concentrations of stressors in the treated effluent.*
- *Prevailing directions and fast speeds of the Florida Current are major factors that decrease risk for the six ocean outfalls. Current speeds can be more than 60 or 70 cm/sec, while speeds of 20 to 40 cm/sec commonly occur. Northerly flow with the fastest speeds occurs approximately 60% of time. Southerly flow with similar or lesser speeds occurs about 30% of time. Westerly flow towards the east coast of Florida, which represents the highest risk, is estimated to occur less than approximately 4% of the time.*
- *Other factors that decrease risk are the distance of the outfalls from land. The lowest risk outfalls are farthest from land (Miami-Dade Central outfall), while the highest risk outfalls are closest to land (Boca Raton, Delray Beach).*
- *The use of multiport diffusers, compared to the use of single-port diffusers, appears to aid in dispersal of the effluent plume over a wider area, decreasing potential risk. Discharging the effluent at a fast initial speed also appears to increase the rate of dispersal and dilution of the effluent plume.*
- *Based on toxicity testing of marine organisms, there is no evidence that the diluted effluent causes acute toxic effects or short-term chronic effects.*
- *Based on nitrogen isotope studies of organic matter in sediments and nutrients in the water column, it does not appear that the nitrogen in outfall effluent is taken up in significant amounts by phytoplankton in the area. This may be because of the rapid dilution of the effluent nitrogen by the Florida Current.*
- *The State of Florida requires that Class III water quality standards be met outside a mixing zone of 400 m around the outfall. This mixing zone allows for dispersal, mixing, and dilution of the effluent plume.*
- *Concentrations of pathogens are controlled at the treatment plant through chlorination to meet water-quality standards within the required mixing zone; viruses and most bacteria are expected to be adequately inactivated by chlorine. However, there is no filtration to remove* Cryptosporidium *and* Giardia. *Lack of treatment to remove pathogenic protozoans probably constitutes the greatest human health risk posed by this wastewater management option.*
- *Pathogenic protozoans may also pose significant ecological risks related to infections of marine mammals. The effects of pathogenic protozoans on aquatic organisms need to be further investigated.*
- *The results of the SEFLOE study for metals monitoring indicates that, in general, water-quality standards are met at 400 m or 800 m.*
- *The chlorinated discharged effluent largely meets Class III water-quality standards for all regulated wastewater constituents within 400 m of the outfalls, with exceptions as noted.*
- *The lack of long-term ecological, microbial pathogen, and chemical monitoring studies makes it difficult to evaluate whether the conclusions of the SEFLOE studies will continue to hold true in the future.*

- *Human health risks are of some concern, both within the 400-m mixing zone and outside of it, primarily because treatment of effluent prior to discharge via ocean outfalls does not include filtration to remove* Cryptosporidium *and* Giardia. *The most probable human exposure pathways include fishermen, swimmers, and boaters who venture out into the Florida Current and experience direct contact, accidental ingestion of water, or ingest fish or shellfish exposed to effluent. Otherwise, there is a very small, but not nonzero, chance for onshore or nearshore recreational or occupational users to be exposed to effluent constituents, since there is a small (10%) chance that currents will change direction to east or west.*

4.3 Impacts on Coral Reefs Near Ocean Outfalls

Numerous natural and artificial reefs exist in the vicinity of the six ocean outfalls. Coral reefs represent a specific receptor that can be impaired by ocean outfall discharges. A thorough investigation of the extent of this impact would include quantification of the sources of the constituents in the water at the reefs as well as an evaluation of the impacts.

Recent studies by Tichenor (2004) suggest that the outfall discharge at Boynton Beach may be having an adverse effect on Lynn's Reef. However, the experimental design for the studies by Tichenor (2004) did not include a direct linkage of pollutant discharges and the relative importance of the concentrations of these discharges at a specific reef. Fauth et al. (2006) conducted a biomarker study that indicates that these reefs have been impacted in some cases. Lapointe et al. (2004) were able to directly link wastewater discharges in the Florida Keys with detrimental impacts to the nearby shallow seagrass and coral reef communities. This linkage was much easier to show since the discharges occurred directly offshore without the use of ocean outfalls and the extent of dilution and mixing is much less. Johns et al. (2001) present strong evidence that natural and artificial reefs are an important part of the tourist business in South Florida. A variety of initiatives are underway to foster better understanding and management of Florida's reefs. The Southeast Florida Coral Reef Initiative (SEFCRI) is described by Collier (2005). She suggests that research is needed to determine the relative importance of sewage outfall discharges on reef health. Lapointe and Risk (undated) conclude that $\delta 15N$ analyses of macroalgae, sponges and gorgonian corals recently collected from reefs in Palm Beach and Broward counties, Florida indicate a significant contribution of sewage nitrogen to the nitrogen pool in the coastal waters of the area. No complete report is available for this ongoing study. These recent and ongoing studies could provide valuable new insights into the extent of the cause-effect linkage between outfall discharges and impaired reefs in Southeast Florida. If the regulatory agencies feel that current wastewater treatment levels are insufficient to protect water quality in general and the reefs in particular, then more stringent regulations such as additional treatment requirements may be imposed in the future. The costs of added treatment are estimated elsewhere in this report.

4.4 Offshore Impacts of Wastewater Discharges in the Florida Keys

The land-based nutrient pollution in shallow seagrass and coral reef communities between the Content Keys (southern Florida Bay) and Looe Key (south of Big Pine Key) in the Lower Florida Keys were studied by LaPointe et al. (2004). The impacts of physical forcing (rainfall, wind and tides) and water management on mainland South Florida on the nutrient enrichment and blooms of phytoplankton, macroalgae, and seagrass epiphytes were evaluated (Lapointe et al. 2004). Phase I of the study included daily sampling in 1996 at three stations (inshore, nearshore, offshore) between Big Pine Key and Looe Key for dissolved inorganic nitrogen (DIN) and soluble reactive phosphorus (SRP) concentrations in the water column and phytoplankton biomass (chlorophyll a) before, during, and following episodic physical forcing events. Phase II of the study involved sampling of macroalgae for stable nitrogen isotope ratios from Content Keys to Big Pine Key in the summer (wet season) of 2000 and the spring (dry season) of 2001 (Lapointe et al. 2004). The Florida Keys National Marine Sanctuary (FKNMS) was found to be affected by sewage pollution. Contaminated groundwater with high DIN and SRP from the on site sewage disposal systems entered the ocean waters through submarine groundwater discharges (Lapointe et al. 2004). Land-based nutrient enrichment was found to be the primary factor in the seasonal development of phytoplankton, macroalgae, and seagrass epiphyte blooms in the inshore, nearshore, and offshore waters of the FKNMS. Chronic nutrient enrichment of coastal waters from local (sewage) and regional (agricultural) land-based sources were responsible for the elevated ammonia and SRP concentrations which caused eutrophication and macroalgal harmful algal blooms (Lapointe et al. 2004).

4.5 Socioeconomic Importance of Reefs

Johns et al. (2001) presented the results of a major study of the benefits of reefs in Southeast Florida. Over 6,000 surveys were given to residents, boat owners, and tourists regarding the economic value of natural and artificial reefs. This study did not address water quality directly. They estimate that visitors and residents spent 22.8 million person days using artificial and natural reefs in the three counties between June 2000 and May 2001. About two thirds of these visits were to natural reefs. About one half of these visits were for fishing and most of the balance was for snorkeling and scuba diving. Their results indicate that the residents and visitors to the three counties are willing to spend $24.51 million per year in additional fees to maintain the reefs in their present condition. This study does quantify the overall economic importance of reefs. However, it does not address the relative importance of the reefs that might be affected by the six ocean outfalls.

4.6 Summary and Conclusions

Several studies have been made of the impacts of the outfalls on the ocean. Surfacing plumes are present at all six WWTP outfalls throughout the year (Englehardt et al. 2001). Rapid dilution in the immediate vicinity of the outfall continues for 6 to 41 miles downstream (2006). Existing evidence suggests that the human and ecological risks from the six ocean outfalls are generally low because the wastewater is treated to reduce the contaminants and the rapid mixing and dilution reduces residual pollutant concentrations to very low levels (US EPA 2003). One concern cited by the US EPA (2003) was the risk posed to both humans and marine mammals by *Cryptosporidium* and *Giardia* in the unfiltered wastewater effluent.

Natural and artificial reefs near the six ocean outfalls contribute significantly to the tourist business in South Florida (2001). Recent studies by Tichenor (2004a; 2004b) suggest that the outfall discharge at Boynton Beach may be having an adverse effect on Lynn's Reef, but did not establish a link between pollutant discharges and the relative importance of pollutant concentrations at a specific reef. A biomarker study by Fauth et al. (2006) indicates that the reefs have been impacted in some cases. Offshore wastewater discharges with limited dilution and mixing in the Florida Keys were linked to detrimental impacts to the nearby shallow seagrass and coral reef communities (2004). Based on δ15N analyses of macroalgae, sponges and gorgonian corals recently collected from reefs in Palm Beach and Broward counties, Lapointe and Risk (undated) believe that sewage nitrogen is a significant contributor to the nitrogen pool in the area's coastal waters. No complete report is available for this ongoing study. These recent and ongoing studies could provide valuable new insights into the extent of the cause-effect linkage between outfall discharges and impaired reefs in Southeast Florida and indicate whether or not current wastewater treatment levels are sufficient to protect water quality in general and the reefs in particular.

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5. Water Reuse Options, Experience, and Potential

The greatest use of reclaimed water has been in regions suffering water scarcity or severe restrictions on disposal of treated effluents. Water utilities facing these difficulties have devised and implemented a variety of innovative approaches that utilize reclaimed water to help meet their communities' needs. Case studies of these projects have been summarized in several excellent reviews published over the last few years, e.g., Crook (2004), Radcliffe (2004), and Law (2003), as well as in journal papers, reports and Web sites prepared by water and wastewater utilities. A sampling of the experiences of some of the larger utilities is given in the present chapter. The current status of satellite water reclamation systems is also reviewed. These systems could reduce distribution costs for reclaimed water and also alleviate salinity problems of waters reclaimed from sewers in low-lying coastal areas such as Southeast Florida. The chapter ends with an analysis of the potential for traditional water reuse in Southeast Florida. The analysis sets up a new approach in identifying large users that are well-suited for traditional reuse. The methods introduced will be further used in a case study in Chapter 6 to produce feasible traditional reuse demand flow values that can alleviate the flows currently going to ocean outfalls. Traditional reuse demand flows are projected for the six wastewater treatment plants of interest and used in the evaluation of alternatives to ocean outfalls in Chapter 7 by using the methods presented in this chapter.

5.1 Experience of Large Utilities in the U.S.

The water reuse industry in the U.S. has experienced rapid growth in recent years. The State of Florida, which publishes a yearly Reuse Inventory, is a well-documented example of the increasing significance of water reuse in water management. Over the 18 year period from 1986 to 2004, both reuse flow and capacity in Florida have increased by more than 300% (Fig. 5-1), reaching 630 MGD and 1,270 MGD, respectively, in 2004 (FL DEP 2005a). California has seen its deliveries of reclaimed water increase from 150 MGD in 1970 to over 500 MGD in 2002 (DWR 2003). Statistics such as these firmly establish the feasibility of water reuse and its expanding role in water resources management.

While California, Arizona and Florida have practiced water reuse for many years, other states such as Texas are implementing their own programs as they recognize the value of water reuse as an integral component of water resources management. In this section, case studies from across the U.S. are described, emphasizing those operated by large municipal utilities. General locations of the case studies are shown in Figure 5-2.

5.1.1 Green Acres Project

a) Service area. The Green Acres Project serves users in the Los Angeles area, including Fountain Valley, Huntington Beach, Costa Mesa, Newport Beach, and Santa Ana, California (Fig. 5-3).

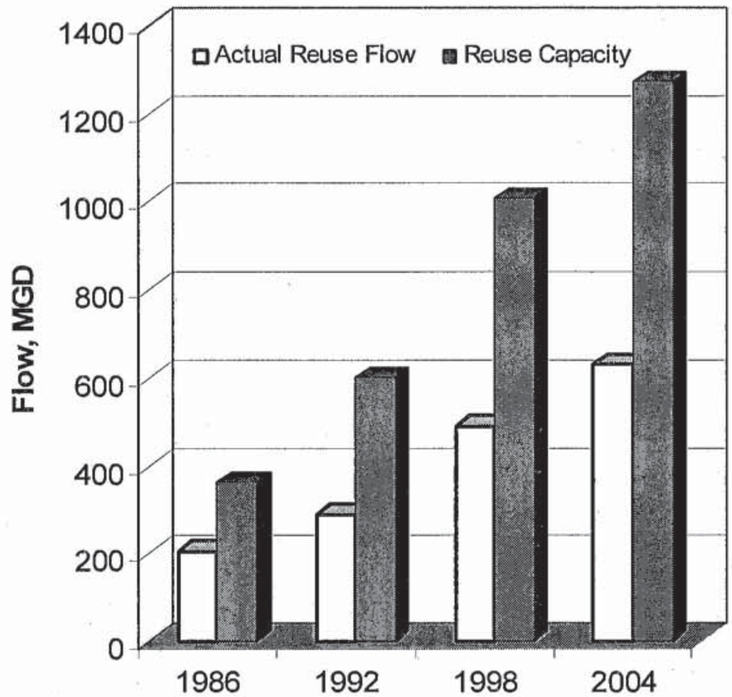

Figure 5-1. Growth of Water Reuse in Florida (FL DEP 2005a)

Figure 5-2. Selected Sites of Water Reuse in the USA. Photo from Google Earth.

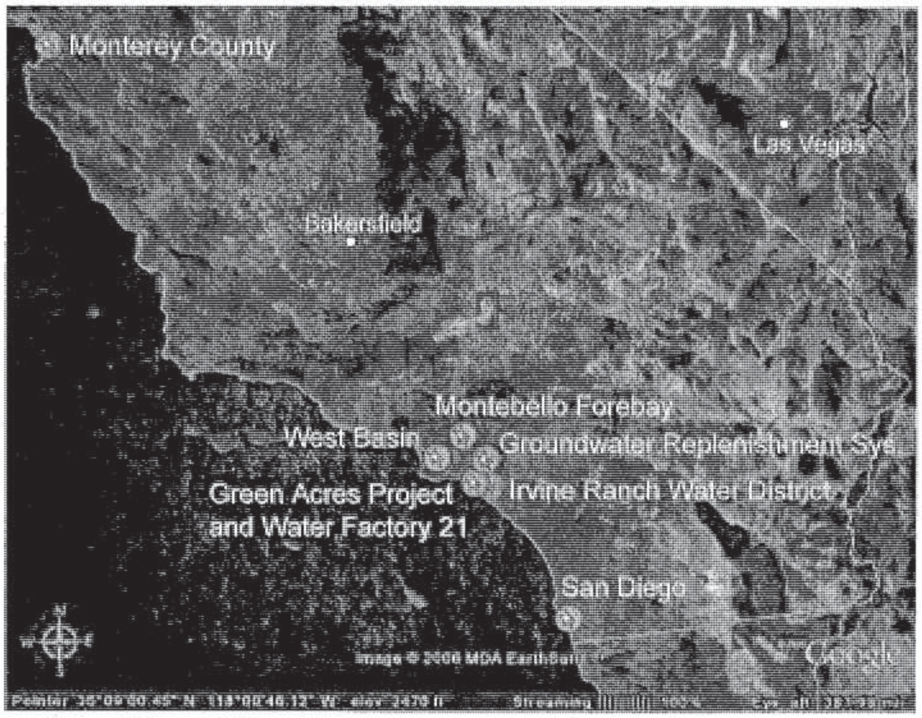

Figure 5-3. Selected Sites of Water Reuse in California. Photo from Google Earth.

b) Reclaimed water quality control. Reclaimed water is obtained from the Green Acres Project water reclamation plant during the summer months. During the winter months, the Green Acres Project plant is taken out of service and reclaimed water is obtained from the 15 MGD Irvine Ranch Water District's Michelson Water Reclamation Plant. Municipal wastewater undergoes filtration and disinfection in addition to secondary treatment at each facility. The water meets the disinfected tertiary recycled water requirements of California Title 22, which include a weekly median total coliform concentration no higher than 2.2/100 mL, a single sample maximum total coliform concentration of 23/100 mL, and an average daily turbidity no higher than 2 nephlometric turbidity units (NTU). Maximum limits also are specified in Title 22.

c) Reclaimed water distribution and customers. More than 6 MGD of reclaimed water, on the average, is delivered through 32 miles of pipelines to users in Fountain Valley, Huntington Beach, Costa Mesa, Newport Beach, and Santa Ana. Pipeline sizes range from 6 to 42 inches in diameter. A potential extension into central Huntington Beach would add 0.9 MGD of flow. The reclaimed water is used for landscape irrigation (parks, schools, golf courses, etc.) and industrial purposes such as cooling and process washdown.

d) Problem encountered. A carpet dyer found that the reclaimed water caused occasional spotting of dyed carpets and discontinued its use of the water. The Orange County Water District is exploring means to resolve the water quality issues involved.

e) Project costs. Capital cost of the project, including assistance for end-user retrofits, was \$49M. Annual operations and maintenance costs are \$0.9M. The Orange County Water District wholesales the reclaimed water to various water agencies.

f) Information sources. Information for this case study was taken from OCWD (2001) and Crook (2004).

5.1.2 Irvine Ranch Water District

a) Service area. The Irvine Ranch Water District is located in Orange County, California, and includes the City of Irvine (Fig. 5-3). The District serves a population of 316,000 and has a service area of 133 square miles. Reclaimed water makes up 20% of the Irvine Ranch Water District water supply.

b) Reclaimed water quality control. Reclaimed water is provided by the 15 MGD Michelson Water Reclamation Plant (WRP) and the 5.5 MGD Los Alisos WRP. Water drawn from the open reservoirs in the distribution system may be further treated before introduction to the transmission and distribution pipelines. Treatment operations that may be applied include straining, pressure filtration, and disinfection. The water meets the advanced tertiary standards of California Title 22 requirements, which include weekly median total coliform concentrations no higher than 2.2/100 mL and daily average turbidity no higher than 2 NTU.

c) Reclaimed water distribution and customers. A yearly average of 11 MGD is supplied to 1,750 customers. Most of the service area has access to a reclaimed water distribution system, which consists of 300 miles of reclaimed water pipelines. Some of the reclaimed water distribution lines were retrofitted. In new developments, distribution lines for reclaimed water are installed along with lines for domestic water and sewer. Reclaimed water is stored in winter months. The supply system is interconnected with that of the Orange County Water District to provide the opportunity for shut-down for maintenance.

There are over 3,400 metered connections to the reclaimed water distribution system. The combined capacity of the reclaimed water storage reservoirs is 656 MG. Two of the reservoirs are open, whereas the others are closed concrete or steel tanks. A total of 15 pump stations are located throughout the reclaimed water distribution system.

The primary use of reclaimed water is landscape irrigation, with 80% of all business and public area landscaping (parks, school grounds, golf courses, a cemetery, freeway landscapes, city-maintained streetscapes, common areas managed by homeowner associations, front and back yards at individual residential dwellings) irrigated with this water source. Additional uses include food crop irrigation, toilet and urinal flushing in 12 dual-plumbed office buildings, and commercial office cooling towers. Use of reclaimed water is mandated for high-rise buildings. The additional cost of providing a dual system in new buildings over seven stories adds only 9% to the cost of plumbing.

d) Problems overcome. More frequent reservoir tank cleaning, increased control valve maintenance, and potential damage to mainline valve body seats from higher chlorine levels are noted in the reclaimed water distribution system, in comparison to potable water distribution systems. The Irvine Ranch Water District now specifies a type of valve seat that has higher resistance to chlorine. Possible cross connections are checked for once a year. Leaks or spills are routed wherever possible to the sanitary sewer system instead of storm drains, or may be collected and trucked back to the plant. Salinity is an ongoing challenge. A significant source of total dissolved solids is self-generating water softeners. These were prohibited for many years by a City of Irvine ordinance. However, such bans by water agencies elsewhere in California were overturned by a court decision in 1997. The District is seeking legislation that would restore its ability to control salinity.

e) Education and outreach. The District uses brochures, videos, workshops, and other means to educate and involve the public about water reuse. Tours of the WRPs and water quality laboratory are held on a regular basis. The need for conserving water is taught at all grade levels. In addition, the concept of water reuse is introduced in the fifth grade.

f) Project costs and rate structure. Annual operations and maintenance costs in fiscal year 2002–2003 were \$6.6M. The base reclaimed water rate is \$0.82/1000 gal, which is 90% of the base domestic water rate. The District penalizes excess usage of reclaimed water with an ascending block rate.

g) *Future plans.* Conversion of an existing open reservoir will add 813 MG of seasonal storage of reclaimed water. The Irvine Desalter Project, currently in the planning stage, will treat water from a plume of trichloroethylene-contaminated groundwater using reverse osmosis, air stripping with activated carbon filters, and disinfection. The product water will be added to the reclaimed water system, providing an additional 1.6 MGD of flow. Plans call for the capacity of the Michelson WRP to be increased to 33 MGD by 2025 and eventual expansion of the Los Alisos plant to 7.8 MGD.

h) Information sources. Information for this case study was taken from Anderson (Anderson 2003), Crook (2004), Mantovani et al. (2001), Radcliffe (2004) and US EPA (2005).

5.1.3 Montebello Forebay Groundwater Recharge Project

a) Service area. Reclaimed water from three satellite water reclamation plants (WRPs) is used to recharge groundwater for the Central Basin, which is the main groundwater basin underlying the greater Los Angeles metropolitan area (Fig. 5-3). Additional reclaimed water from these facilities is used by the County Sanitation Districts of Los Angeles County for nonpotable applications such as landscape and agricultural irrigation, industrial process water, recreational impoundments, and wildlife habitat. The management of the WRPs and responsibility for monitoring reclaimed water quality is borne by the County Sanitation Districts of Los Angeles County. Management of the recharge facilities, including the river conveyance and spreading basins, is assumed by the Los Angeles Department of Public Works. Overall management of the groundwater basin, including groundwater monitoring, is the responsibility of the Water Replenishment District.

b) Reclaimed water quality control. The treatment plants are the Whittier Narrows WRP, the 100 MGD San Jose Creek WRP and the 13 MGD Pomona WRP. Each of these facilities provides biological nitrogen removal, filtration and disinfection in addition to secondary treatment. The biosolids generated at the plants are returned to one of the major trunk sewers and are subsequently treated at the Joint Water Pollution Control Plant near the coast in Carson. This decreases the complexity of the facilities and reduces both capital and operations and maintenance costs.

Reclaimed water produced by the WRPs meets primary drinking water standards and contains no more than 2.2 total coliforms/100 mL and 2 NTU of turbidity. Extensive sampling of the reclaimed water for viruses and parasites has shown it to be essentially free of measurable levels of pathogens.

c) Method of addition to natural waters. Reclaimed water from the San Jose Creek and Whittier Narrows WRPs is spread in an unconfined region of the Central Basin known as the Montebello Forebay. Available reclaimed water from the Pomona WRP is discharged to San Jose Creek, a tributary of the San Gabriel River, and ultimately becomes a source of recharge in the Montebello Forebay. Up to 60,000 acre-ft of reclaimed water in a single year or up to a running three-year average of 50,000 acre-ft/yr may be applied. Stormwater runoff and imported surface water are used along with reclaimed water for recharge. The running three-year percentage of reclaimed water in this mix should not exceed 35% of total recharge.

The total area available for spreading recharge water is 698 acres. Additionally, percolation occurs over 133 acres of the unlined San Gabriel River. Batteries of spreading basins are normally operated on a 21-day cycle, consisting of 7 days each of filling, emptying (through percolation), and drying. The vadose zone underlying the basins is generally 10 ft or more in thickness.

d) Health effects studies. Four different heath effects studies, the latest in 1999, have concluded that there is no evidence that populations consuming groundwater—estimated to contain as much as 31% reclaimed water in the Montebello Forebay—had a higher risk of cancer, mortality, infectious disease, or adverse birth outcomes than those using other water sources.

e) Project benefits. The Montebello Forebay Groundwater Project has helped reduce the cumulative groundwater overdraft in the Central Basin. It provides a new water supply that meets the demand of 250,000 persons. Use of reclaimed water in lieu of imported water saves the Districts $12M/yr.

f) Information sources. Information for the present case study was taken from Crook (2004).

5.1.4 Monterey County Water Recycling Project

a) Service area. Reclaimed water is distributed within the Salinas Valley, which lies in the northern part of Monterey County, California (Fig. 5-3). The water reaches 222 parcels of farmland in the 12,000 acre service area.

b) Reclaimed water quality control. A 30 MGD regional wastewater recycling facility was constructed adjacent to the regional secondary treatment plant to provide tertiary treated, reclaimed water for agricultural applications. The tertiary treatment includes flocculation, dual media filtration and chlorine disinfection. The facility delivers 20 MGD of reclaimed water.

c) Distribution system and customers. The reclaimed water distribution system includes 46 miles of water transmission and distribution pipelines, 22 supplemental wells to augment reclaimed water flows at times of peak demand and 111 flow-metered connections. Equalization storage is provided to smooth diurnal inflow variations. Three booster pump stations maintain pressure in the system. Crops irrigated include lettuce, celery, broccoli, cauliflower, artichokes, and strawberries.

d) Problems overcome. Minor problems have included the need to flush construction debris from the system, excessive sand in the water extracted from wells, and a few pipeline breaks. The system is run by a three-person crew on a continuous basis. No adverse effects to the crops, soil or field workers have been noticed. Salinity control is an ongoing challenge. The reclaimed water has a sodium absorption ratio of 4.7, compared to the ratio of 1.7 for good quality well water. The blend of reclaimed and well water used for irrigation typically has a sodium absorption ratio somewhat above 3.0, which is the maximum desired by the growers. Soils irrigated with the blend of reclaimed and well water have a higher sodium absorption ratio and exchangeable sodium percentage than soils irrigated with well water. The Monterey Regional Water Pollution Agency is currently focusing on source control as a means of limiting salt concentration in reclaimed water.

e) Education and outreach. A Water Quality and Operations Committee was formed early in the project to gain input from users. A proactive education plan was developed in 1977 to address perception issues.

f) Project costs and rate structure. Construction cost of the project was $75 million. The total cost to treat and deliver recycled water to agricultural areas is $0.90/1000 gallons. This amount excludes secondary treatment costs, but includes debt service from loans and operations and maintenance for tertiary treatment and distribution. Revenue is provided from land assessments ($233/acre/yr) and a water delivery charge of $0.05/1000 gal.

g) Information sources. Information for the present case study was taken from Crook (2004) and Sheikh (2004).

5.1.5 Water Factory 21 and Groundwater Replenishment System

a) Service area. The Orange County Water District has operated Water Factory 21, an advanced water reclamation facility, since 1976. The Orange County Water District began construction in 2003 of the Groundwater Replenishment System, which will provide 70,000 acre-ft/yr (62.5 MGD) of reclaimed water (Fig. 5-3).

b) Reclaimed water quality control. The treatment train of the 15 MGD Water Factor 21 includes secondary treatment (provided by an adjacent wastewater treatment plant operated by the Orange County Sanitation District), lime clarification, filtration, reverse osmosis, and UV/hydrogen peroxide disinfection/advanced oxidation. The reverse osmosis units were found to remove sufficient nitrogen from the reclaimed water, so the air stripping towers were removed from service in 1986. The treatment train for the Groundwater Replenishment System, located in Fountain Valley, will include secondary treatment, microfiltration, reverse osmosis, and hydrogen peroxide/UV advanced oxidation/disinfection.

c) Method of addition to natural water body. After treatment by reverse osmosis and activated carbon, reclaimed water from Water Factor 21 is mixed with deep well water and injected into four aquifers prone to seawater intrusion using multi-point injection wells. Most of the injected water flows inland to augment groundwater used as a potable supply source. Reclaimed water for the Groundwater Replenishment System will be pumped through a 14 mile long, 78 inch force main to deep spreading basins near Anaheim. Depending on the time of year, 15 to 40 MGD of the water will be diverted to an expanded Talbert Gap Seawater Intrusion barrier currently served by Water Factory 21. Some of the reclaimed water could be made available for irrigation, industrial process water, or other approved uses by connections to the conveyance pipeline.

d) Health effects studies. No evidence of significant risks from this practice has emerged.

e) *Outreach.* Water user telephone surveys, mailings, print and cable television advertising, and meetings with community groups, businesses, hospitals, and elected officials have been used to inform water users on the need for the project and the water quality.

f) Project costs, rate structure and benefits. Both of the Orange County groundwater recharge systems protect coastal aquifers against seawater intrusion and replenish the groundwater. The Groundwater Replenishment System is estimated to cost $454M with an annual operations and maintenance budget of $22M. Funding has been provided by several agencies, including $92.5M in federal and state grants and a State Revolving Fund loan of $145M.

g) Information sources. Information for the present case study was taken from Crook (2004) and GRS (2004).

5.1.6 San Diego, California

a) Service area. Reclaimed water is distributed from the North City WRP (Fig. 5-3). The North City Distribution System extends from the coast to the City of Poway and provides service to Mira Mesa, Miramar Ranch North, Scripps Ranch, University City, and Torrey Pines. The South Bay Distribution System will eventually connect to facilities being constructed by the Otay Water District. The system also delivers reclaimed water to the adjacent International Boundary and Water Commission Wastewater Treatment Plant.

b) Reclaimed water quality control. The treatment sequence at the 30 MGD North City WRP includes primary settling, activated sludge with anoxic selectors to control filamentous bacteria and anthracite coal filters. A portion of the filtrate is demineralized using electrodialysis reversal process in order to decrease the salinity of the reclaimed water. The demineralized stream is combined with filtrate prior to chlorine disinfection. The quality level of the reclaimed water is suitable for irrigation of food crops, parks, playgrounds, etc. Control of the North City plant is transferred to the utility's communications center in

Kearny Mesa from 12:30 am to 5:30 am each night, with an operator on call in the event of an emergency. The North City WRP currently treats 22.5 MGD.

The 15 MGD South Bay WRP has a similar sequence of treatment processes as described above. Disinfection is accomplished through ultraviolet irradiation and there is no process for demineralization. The facility is staffed from 6:00 am to 4:00 pm Monday through Friday. Plant control is accomplished from the utility's communications center outside these hours. The facility currently discharges up to 9 MGD of secondarily treated wastewater that is disposed of via an ocean outfall.

c) Reclaimed water distribution and customers. Reclaimed water from the North City WRP is distributed through 79 miles of pipeline, two storage tanks and two pump stations. There are 356 metered connections, including a single metered connection with the City of Poway, which serves an additional 193 customers. The single largest use of reclaimed water is landscape irrigation. Additional uses include industrial processes, cooling towers, soil compaction, dust suppression, circuit board washing and urinal flushing. Customers include General Atomics, Motorola, CalTrans, University of California at San Diego, Torrey Pines Municipal Golf Course, Nissan Design, Burnham Institute, Metro Biosolids, Miramar Landfill and the City Poway. The City has a guaranteed water program that exempts research and development or industrial manufacturing firms from mandatory water restrictions during periods of drought in exchange for participation in daily water conservation programs that include use of reclaimed water.

The South Bay Distribution System currently consists of a pipeline along Dairy Mart Road. It will eventually tie in with facilities being constructed by the Otay Water District.

d) Education and outreach. Businesses, public agencies, homeowners' associations and academic institutions with proximity to the optimized system are being contacted to retrofit their properties and receive education on the use of reclaimed water.

e) Project costs and rate structure. The cost for reclaimed water started at $1.34 per hundred cubic feet of water ($1.79/1000 gal) in 1997. This was lowered by the San Diego City Council to $0.80 per hundred cubic feet ($1.07/1000 gal) in 2001 to encourage use of reclaimed water. This rate is 57% less than the current potable water rate of $1.87 per hundred cubic feet ($2.50/1000 gal).

f) Future plans. A pricing structure that covers the actual cost of producing reclaimed water will be considered by the City Council in 2006.

g) Information sources. Information for this case study was taken from the City of San Diego (City of San Diego 2005; City of San Diego undated-e; City of San Diego undated-b; City of San Diego undated-d).

5.1.7 West Basin Municipal Water District, California

a) Service area. The West Basin Municipal Water District is a public agency that wholesales water to local cities, mutual water companies, private companies and investor-owned utilities in a 200-square mile area of southwest Los Angeles County. It obtains secondarily treated wastewater from the Hyperion Wastewater Treatment Plant in Los Angeles and pumps it through five miles of 60 inch force main to the District reclamation facility in El Segundo (Fig. 5-3).

b) Reclaimed water quality control and customers. The El Segundo WRP provides filtration and disinfection in addition to secondary treatment and meets California Title 22 standards for tertiary quality reclaimed water. About 2.5 MGD of this water is used for irrigation through the Water Replenishment District. The El Segundo WRP also feeds three satellite plants, each of which polishes the water for a specific industrial user. One satellite plant provides nitrification and disinfection for a flow of 7.4 MGD that is used for industrial cooling makeup water. A second satellite plant applies lime treatment, reverse osmosis, and disinfection to a flow of 6.5 MGD, producing drinking quality water that is used for recharge of groundwater to provide a barrier to seawater intrusion as part of the West Coat Basin Barrier Project. The third satellite plant provides microfiltration, reverse osmosis, and disinfection to a flow of 5.8 MGD that is used for low pressure boiler feed water. Another 2.4 MGD of reclaimed water from the third satellite plant is passed through the reverse osmosis process a second time and then used as high pressure boiler feed water. The reject water (concentrate) from the reverse osmosis units is returned to the Hyperion Wastewater Treatment Plant for disposal by ocean outfall.

c) Education and outreach. An extensive ongoing public outreach program is maintained by the West Basin Municipal Water District, including a children's education program, reclaimed water marketing and school education.

d) Project cost and rate structure. The selling price of the reclaimed water is 20 to 40% less than imported water. (Imported water sells for $510/acre-ft.) Nitrified water sells for 20% less than imported water. Reclaimed water receiving reverse osmosis treatment is sold at the same rate or slightly higher than imported water.

e) Plans for expansion of services. The West Basin Municipal Water District has begun a 10 MGD expansion of Title 22 water production. A 5 MGD expansion of Barrier water production is also underway. The increased flow of Barrier water will shift the proportions of reclaimed water and natural water used for groundwater recharge from 50:50 to 75:25.

f) Information sources. Information for the present case study was taken from Crook (2004) and Miller (2003).

5.1.8 Phoenix

a) Reclaimed water production and customers. Situated in an arid desert, the City of Phoenix, Arizona has practiced water reuse since the turn of the century. Water reclamation facilities are co-located with the City's wastewater treatment plants. The total wastewater treated is 140,000 acre-ft/yr (125 MGD), of which nearly 80,000 acre-ft/yr (71 MGD) is reused. The ratio of reclaimed water use to wastewater treated (57%) is one of the highest reuse ratios among large municipalities in the U.S.

i) 23rd Avenue WWTP. Up to 30,000 acre-ft annually (27 MGD) of reclaimed water is produced for delivery to farms in the nearby Roosevelt Irrigation District. In return, the District sends groundwater to the Salt River Project—a canal bringing water to the Phoenix area from a series of reservoirs on the Salt River—for use as raw water for the City's surface water treatment plants. Delivery of reclaimed water in excess of exchanged groundwater is credited to the City as groundwater recharge, giving the City flexibility to pump more groundwater during drought or for specific projects.

ii) *91st Avenue WWTP.* The Palo Verde Nuclear Generation Plant is contracted to receive as much as 105,000 acre-ft per year (94 MGD) of reclaimed water from the 91st Avenue WWTP. Actual usage for the Palo Verde plant has been 70,000 acre-ft/yr (62 MGD).

iii) Cave Creek Water Reclamation Facility. Golf courses and other turf users in the northern portions of Phoenix are served by the Cave Creek Water Reclamation Facility, which has a capacity of 8 MGD.

b) Future plans. Several innovative projects are underway to help assure dependable water availability in the future. Realization of these projects would enable Phoenix to reclaim more than 90% of its wastewater, totaling over 200,000 acre-ft/yr (179 MGD).

i) Tres Rivers Demonstration Project. A pilot study involving 12 acres of free-water-surface wetlands is underway at the convergence of the Salt, Gila and Agua Fria rivers. The Tres Rios Demonstration Project is developing design criteria for a wetlands system that could meet upcoming effluent quality standards.

ii) Agua Fria Linear Recharge Project. A conceptual plan was developed for groundwater recharge along the Agua Fria River using a portion of the reclaimed water from the 91st Avenue WWTP. The project involves discharging water into the dry riverbed at several locations and allowing the water to percolate into the aquifer. As much as 60,000 acre-ft/yr (54 MGD) of reclaimed water could be applied in this project, generating pumping credits available to all owners of the 91st Avenue WWTP. Phoenix and its partners would develop strategies for recovering the water, which in some instances would be treated for potable use.

iii) *The Market Resource Center.* A recommendation of the 25-yr Master Plan for the 91st Avenue WWTP was to treat available wastewater (remaining after commitments) to the highest water quality standards. This new source of water would be offered to identify future markets.

c) Information sources. Information for the present case study was obtained from Gritzuk and Conway (2004).

5.1.9 San Antonio

a) Reclaimed water quality control. Four major water recycling centers (WRCs) are operated by the San Antonio Water System (Fig. 5-2). The combined output of these plants is 116

MGD. The facilities provide treatment to meet Texas regulations for Type I reclaimed water, which applies to water that is likely to come into contact with humans. These regulations specify BOD_5 and turbidity should be no higher than 5 mg/L and 3 NTU, respectively, on a 30-day average basis. The geometric mean for fecal coliforms must be no higher than 20 CFU/100 mL, while the maximum concentration of fecal coliforms in any grab sample must not exceed 75 CFU/100 mL.

b) Distribution system and customers. Downstream water rights are allocated 49% of San Antonio Water System reclaimed water. The Dos Rio WRC discharges treated reclaimed water to the San Antonio River, from which the City's municipally-owned electric generating facility withdraws up to 36 MGD of reclaimed water to cooling water lakes. The electric generating facility pays the San Antonio Water System $0.153/1000 gal for use of this water. A reclaimed water distribution system containing 75 miles of pipeline was recently completed to provide up to 31 MGD to additional water users. The Salado Creek and Leon Creek WRCs currently feed the system, providing more than 14 MGD to 45 customers that include industrial cooling water, river maintenance, golf courses, schools and commercial sites. The overall transmission and distribution system includes 11 operational pump and storage facilities.

c) Problems overcome. One of the problems encountered was water quality degradation during startup of the distribution system, due to microbial growth in supply lines and tanks. This was attributed to stagnation of water in the system associated with low flows. Chlorination points were installed within the distribution system to maintain a chlorine residual of at least 1 mg/L throughout the system. Additionally, storage tanks are drained and cleaned of sediment periodically. Another problem in the first few years of operation was a series of pipeline failures. Two of the incidents involved joint failures in the main transmission lines. Concern was expressed that high levels of dissolved salts, particularly chlorides, could adversely affect vegetation. In response, the San Antonio Water System included assurances in the reclaimed water agreement that total dissolved solids would be no higher than 1500 mg/L and that the sodium absorption ratio would not exceed 5.0.

In 2002, a cross-connection between the non-potable and potable water system at a golf course was discovered. To preclude further incidents, the San Antonio Water System now provides training for customer workers involved in routine system operation before reclaimed water service begins. A five-step process is followed to ensure complete separation between the reclaimed and potable water systems. After initiation of reclaimed water service, the San Antonio Water System staff rechecks and tests the reclaimed water system.

d) Project costs and rate structure. The price of reclaimed water in the San Antonio Water System is $0.98/1000 gal, which is 49% of the potable water rate. The rates vary somewhat based on season and amount of water used. A lower amount ($0.25/1000 gal) is charged to customers who trade pumping withdrawal rights to the local aquifer in return for reclaimed water.

e) Information sources. Information for the present case study was taken from Coker (2004), Crook (2004) and Fletcher (2006).

5.1.10 Pinellas County

a) Service area. Pinellas County is located in the west central region of Florida, bounded by the Gulf of Mexico on the west and by Tampa Bay to the south and east (Fig. 5-4).

b) Reclaimed water quality control. Pinellas County Utilities operates two regional water reclamation facilities (WRFs). The William E. Dunn WRF, located in the northern part of the county, has a capacity of 9.0 MGD and produces 6.5 MGD of reclaimed water on the average. Wastewater undergoes nitrogen and phosphorus removal, filtration and high-level disinfection in addition to secondary treatment. All of the reclaimed water from the Dunn WRF is sent to the reclaimed water distribution system. In addition, up to 0.8 MGD of reclaimed water is purchased from the City of Oldsmar and up to 3 MGD is purchased from the City of Clearwater. The South Cross Bayou WRF in the southern part of the county has a capacity of 33 MGD and produces an average of 26 MGD of treated effluent. On the average, 7.4 MGD is reclaimed for water reuse. The remaining reclaimed water is discharged to a tidal creek. Like the Dunn WRF, the wastewater receives nitrogen and phosphorous removal and high-level disinfection in addition to secondary treatment.

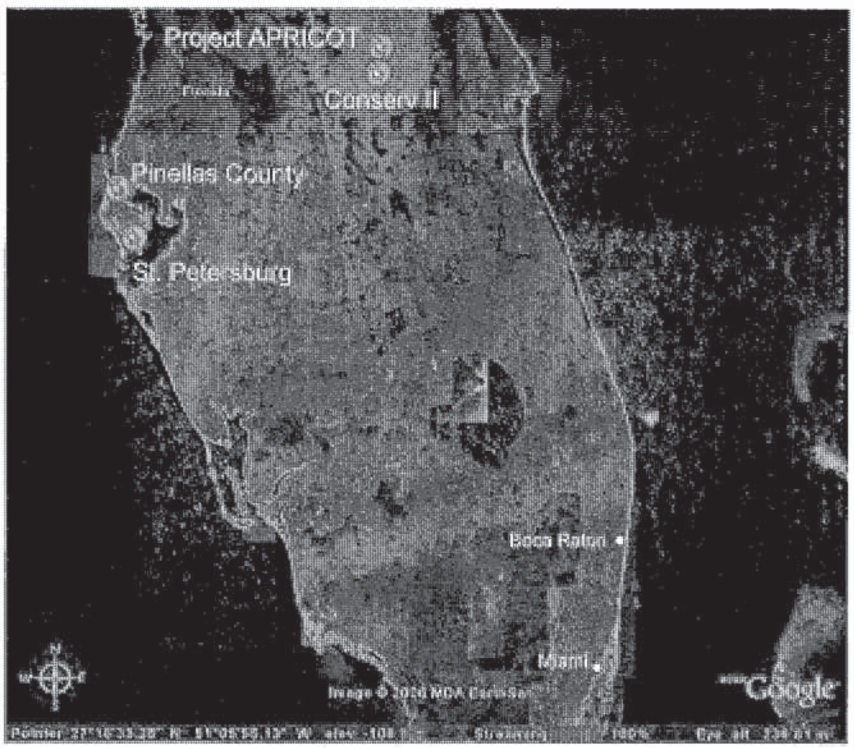

Figure 5-4. Selected Sites of Water Reuse in Florida. Photo from Google Earth.

c) Distribution system and customers. The Dunn WRF includes a 63 MG storage pond and 17 MG reject pond. Strainers are installed in the outlet line of the storage pond to remove particulate material that could clog irrigation systems. In 2002, Pinellas County had 10,400 users of reclaimed water who were supplied with an average of 14.7 MGD. Types of use included golf courses, parks, playgrounds, schools and residences.

d) Problems overcome. One problem encountered was algae growth in pipelines, due to stagnant conditions that resulted from delays in connecting to the system. This was corrected by a flushing program. Connection procedures were changed to remedy the root cause of the problem.

e) Project costs and rate structure. Reclaimed water use by residential customers is not metered. An availability charge of $7/month is mandatory and irrigation customers pay an additional $2/month for unrestricted use. Multi-family and nonresidential customers pay the availability charge plus $0.29/1000 gal.

f) Information sources. Information for the present case study was taken from Crook (2004).

5.1.11 Project APRICOT

a) Service area. Project APRICOT (A Prototype Realistic Innovative Community of Today) is located in Altamonte Springs, Florida (Fig. 5-4).

b) Reclaimed water quality control. Reclaimed water is produced by activated sludge treatment with anoxic and aerated zones for nitrogen removal, followed by alum addition, flocculation, and deep bed denitrifying filters for additional nitrogen removal. The water is then re-aerated and disinfected with chlorine prior to distribution. The capacity of this reuse system is 14.6 MGD and about 5.9 MGD of reclaimed water was reused in 2004.

c) Distribution system and customers. A dual distribution was installed throughout the city, consisting of 83 miles of 4 inch through 30 inch transmission mains, with 6,000 residential service connections and several hundred commercial connections. One elevated 0.5 MG storage tank and a surface storage/augmentation facility are included in the system in addition to two 3 MG storage tanks at the reclamation facility. Commercial and multi-family dwellings are required to connect to the system, as well as all new single-family houses constructed after January 1989. The system involves extensive efforts to get reclaimed water into existing residential subdivisions. Reclaimed water is used for household irrigation, fire mains, ornamental fountains and ponds and for toilet flushing in commercial buildings. Interestingly, one of the commercial customers is a car wash. Vegetable growing is allowed, provided that they are peeled, skinned, cooked or thermally processed before consumption, or that a drip irrigation system is used. Aboveground outside taps at individual households are prohibited, whereas belowground taps in lockable boxes are allowed. Hoses must be disconnected after use.

d) Challenges. Shortages occur in hot weather, requiring importation of sewage from other utilities for treatment to meet the demand. The City is actively managing demand by enforcing mandatory watering restrictions.

e) Education and outreach. The City has engaged in a detailed communication program with its residents. A full-time information liaison position was created within the Public Works

Department. This person issued press releases, coordinated with homeowners and condominium associations, and generally acted as a spokesperson for APRICOT. Two videos and several brochures discussing water quality issues were produced by the City.

f) Project costs and rate structure. The distribution network was constructed over a 15 year period at a cost of $40 million, all of which was funded locally. Reclaimed water supplied to commercial buildings and multi-unit dwellings is metered, whereas reclaimed water supplied to single family houses is not. Commercial users and condominiums were charged $0.82/1000 gal in 1997 (40% of potable water rates). Single family dwellings paid a flat fee of $10/month.

g) Information sources. Information for the present case study was taken from Altamonte Springs (1997), FDEP (2005b; 2005a), (Helgeson 2004; 2005b), Mantovani et al. (2001), Radcliffe (2004), York (2005) and Williams (1996).

5.1.12 St. Petersburg

a) Service area. St. Petersburg is located in the west central part of Florida (Fig. 5-4). The city is largely confined to a peninsula bounded to the west by the Gulf of Mexico and Boca Ciega Bay and to the south and east by Tampa Bay.

b) Reclaimed water quality control. Wastewater from the City of St. Petersburg is treated in four regional water reclamation facilities (WRFs) that provide coagulation, filtration and high-level disinfection in addition to secondary treatment. The total outflow from the four WRFs in 2002 was 42 MGD, of which 21 MGD was reused. The remaining water was disposed of through deep well injection into a nonpotable aquifer.

c) Distribution system and customers. Reclaimed water is distributed to more than 10,500 customers through more than 200 miles of pipelines, including 100 miles of trunk and transmission mains and 190 miles of small diameter distribution pipe. Residences using the water for landscape irrigation account for 10,000 of the customers. Other customers include six golf courses, 95 parks, 64 schools and 335 commercial areas. Reclaimed water provides fire protection via more than 300 reclaimed water hydrants.

Covered storage tanks are included in the system at each of the WRFs. Five City-owned and four privately owned booster pump stations maintain pressure in the system for all applications. Top loading, double check valve, backflow prevention assemblies are used to protect potable water services at residences. Backflow prevention provisions for commercial users are specified according to the level of risk posed by the users' activities.

d) Problems overcome. Problems that cropped up during the early years of operation of the reclaimed water system included water heater pressure relief valves, high chloride concentrations and inadequate supply. Backflow assemblies installed on residential services caused problems in plumbing systems when pressure built up by the hot water heater caused a discharge at the heater's temperature and pressure relief valve. The City overcame this problem by providing to property owners pressure relief regulating devices that fit on the water heater's external spigot and directed discharges outside rather than inside the homes.

Alternative solutions were to install expansion tanks or flushometers on the toilets. Irrigation with reclaimed water containing chloride concentrations in excess of 400 mg/L was found to damage chloride-sensitive plants. The high chlorides were due to seawater infiltration into sewers near the coast. Programs were successfully implemented to decrease chloride levels. These included an infiltration/inflow correction program, mixing high-chloride reclaimed water with low-chloride reclaimed water, and diverting reclaimed water containing very high chloride concentrations to the deep injection wells. Shortages of reclaimed water occurred during the dry spring months when wastewater flows tended to be low, whereas irrigation demands were highest. Installation of more storage has been marginally successful in alleviating this problem.

e) Education and outreach. Public forums that address water quality issues, booklets and videos on water conservation, taped television messages broadcast weekly, a Web site with links to water conservation information, annual public recognition awards, and community events promoting water reuse and conservation have been used for adult education. Programs for youth education on water conservation have been created for use in schools and youth agencies.

f) Project costs and rate structure. A voluntary assessment program allows residential customers pay for the cost of extending distribution lines to serve them. This cost typically ranges from $500 to $1,200 per customer. The connection fees for a residence consist of a $180 tapping fee and $115 for a backflow prevention device on the potable water line. A charge of $11.36 is made for the first acre-ft/month ($0.035/1000 gal), with $6.51/acre-ft ($0.02/1000 gal) charged for additional water use in the same month. Not all commercial customers are metered. Metered commercial customers pay $0.33/1000 gal.

g) Information sources. Information for the present case study was taken from Crook (2004).

5.1.13 Water Conserv II

a) Service area. The Water Conserv II project consists of a network of rapid infiltration basins and irrigated agricultural land 20 miles west of Orlando, Florida (Fig. 5-4).

b) Reclaimed water quality control. Reclaimed water is provided by the City of Orlando Water Conserv II Water Reclamation Facility and the Orange County South Regional Water Reclamation Facility. They provide secondary treatment, nitrogen removal, filtration, and high level disinfection. Reclaimed water total suspended solids cannot exceed 5.0 mg/L in a single sample. The high level disinfection standard mandates no detectable fecal coliforms in at least 75% of samples in any 30-day period and no more than 25 fecal coliforms/100 mL at any time.

c) Distribution system and customers. The distribution system consists of 21 miles of transmission piping that links two water reclamation facilities to a distribution center. Reclaimed water is transported from the distribution center to 76 agricultural and commercial customers through a 49 mile pipeline network that can handle up to 75 MGD. The reclaimed water that is not used for irrigation is distributed to rapid infiltration basins for groundwater recharge. The rapid infiltration basin system consists of eight sites with 72 basins, taking up

3,725 acres. The project reuse capacity is 68 MGD, with the rapid infiltration basins accounting for 22 MGD. About 20 MGD of reclaimed water was used for irrigation and 16.7 MGD was used for groundwater recharge in 2003. The irrigated land includes 10,035 acres of citrus, 7 foliage and landscape nurseries, 2 tree farms, 3 ferneries, and the Orange County National Golf Center.

d) Problems overcome. The project began operations in 1986. Severe freezes in the 1980s put several growers out of business and encouraged others to move, decreasing the acreage of orange groves served. Research carried out in parallel with the project has shown that total juice production from the oranges grown on project land is as high as oranges from conventionally irrigated land, tree condition is at least as good as in groves irrigated with well water, and soil pH is maintained in a favorable range without lime addition, as required in groves irrigated with well water.

e) Project costs and rate structure. The capital costs of the reuse distribution system total $278M and the current annual operating budget is $4.8M. The U.S. EPA provided $100M, with the rest coming from the City of Orlando and Orange County, Florida. Reclaimed water is provided at no cost to orange growers. This provision—extending for 20 years from the project startup—was included in the original project agreement to encourage participation by growers. Charges to residential and commercial users are $0.84 and $0.70 per 1000 gal, respectively. Residential users also pay $3.14 monthly per connection.

f) Future plans. The project reuse capacity is slated to expand to 81 MGD, of which 53 MGD is planned for irrigation and the balance for groundwater recharge. New commercial customers are anticipated to include a large sand mining operation, an additional golf course, residential irrigation, and a major regional/municipal interconnect for landscape irrigation.

g) Information sources. Information for the present case study was taken from Crook (2004), Cross (Cross undated), and FDEP (2005b).

5.2 Experience of Large Utilities outside the U.S.

Worldwide, water reuse is becoming an increasingly common component of water resources planning due to due to limited opportunities for conventional water supply development and increasing costs of wastewater disposal (Williams 1996). The greatest water reuse occurs in regions suffering water scarcity, such as the Middle East and Australia, or in densely populated regions with severe restrictions on disposal of treated wastewater effluents, such as England and Germany (Marsalek et al. 2002) and Japan (Ogoshi et al. 2001). In this section, case studies of water reuse in Australia and Singapore are presented, providing examples of nonpotable and indirect potable reuse.

5.2.1 Rouse Hill, Australia

a) Service area. The Rouse Hill Development Area northwest of Sidney will eventually accommodate some 300,000 people (Fig. 5-5). The development incorporates a dual distribution system that supplies flush water for indoor toilets as well as water for landscape irrigation. Reclaimed water is also used for fire protection, allowing the potable water mains to be reduced in size. The number of homes serviced as of 2004 was 12,000.

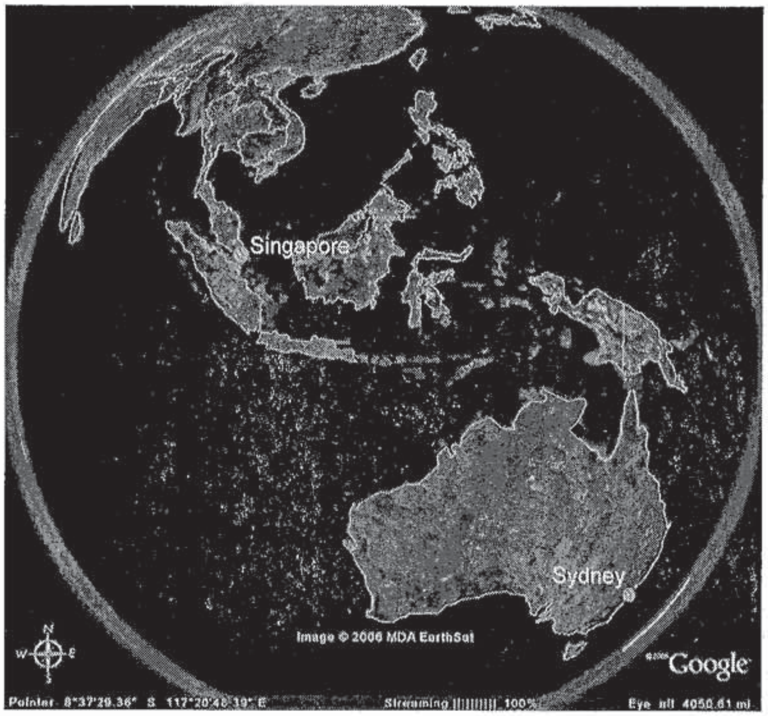

Figure 5-5. Selected Sites of Water Reuse outside the U.S. Photo from Google Earth.

b) Reclaimed water quality control. Reclaimed water is supplied by the Rouse Hill Sewage Treatment Plant, which can treat 4.4ML/d (1.2 MGD) for reuse by a treatment train consisting of activated sludge with biological nitrogen and phosphorus removal, coagulation and flocculation with alum addition, tertiary settling, filtration, ozonation, strainers, microfiltration and superchlorination. Microbiological water quality limits for reclaimed water are 1 fecal coliform/100 mL, 25 total coliforms/100 mL, 2 viruses/50 L, and 1 parasite/50 L. Limits are also placed on turbidity (2 NTU geometric mean; 5 NTU in 95% of samples) and color (15 TCU).

c) Distribution system and customers. The reclaimed water is pumped from the sewage treatment plant to three 2 ML (0.5 MG) elevated reservoirs, from which it flows through 34 km (21 miles) of distribution network to the homes. Each reservoir is equipped with dechlorination facilities to ensure that the chlorine residual at the consumers does not exceed 0.5 mg/L.

d) Problems overcome. The ozonation process has been unreliable. Consequently, microfiltration is relied upon for parasite removal and superchlorination is used to back up the ozonation process. Many errors were detected in the plumbing work done by private contractors between the Sydney Water main and the final house fittings. Training programs have been developed to assist plumbers and sales staff understand their roles in relation to public health. It is recognized that an ongoing effort will be needed at Rouse Hill to educate customers, as well as plumbers, about cross connection control. Complicating this issue are numerous differences between the National Plumbing and Drainage Code and State-based regulations.

e) Education and outreach. Research indicates that residents are proud of the Rouse Hill system and feel that they are helping to pave the way of future water management.

f) Project costs and rate structure. The capital cost for Stage 1 infrastructure was $285M (Australian), of which $35M was associated with the sewage treatment plant and $22M with the reclaimed water distribution system. Charges for reclaimed water in Australian currency are $0.28/kL, compared to $0.98/kL for potable water. The modest charge for reclaimed water has encouraged consumption. In the summers between January 2001 and December 2002, Rouse Hill total consumption was 20% above the Sidney average. The production cost for reclaimed water is estimated at $3–4/kL when the Rouse Hill system is fully operational.

g) Information sources. Information for the present case study was taken from Law (1996) and Radcliffe (2004).

5.2.2 Singapore

a) Reclaimed water quality control. A demonstration facility was operated at the Bedok Sewage Treatment Plant for two years, beginning in the year 2000 (Fig. 5-5). The demonstration facility included two parallel 5 ML/d (MGD) reverse osmosis trains, each fitted with thin film aromatic polyamide composite membranes configured for 80-85% recovery in a three-stage array. The UV system at this plant consisted of three UV units in series. Experience from the 24-month sampling, analytical testing and monitoring program showed that high turbidity (> 10 NTU) in secondary effluent has a deleterious impact on the performance of microfiltration. Inflows of tidal seawater into the sewer system through leakage ultimately resulted in reduced performance of the reverse osmosis component of the plant. Biological fouling of the reverse osmosis membranes reduced their effectiveness, but free chlorine could not be used to combat fouling because of deleterious effect on the membranes. In general, biological and other forms of fouling increased operating pressures and the required frequency of cleaning.

Three water reclamation plants are in use. These are the Bedok and Kranji Water Reclamation Plants, which were commissioned at the end of 2002, and the Seletar Water Reclamation Plant was commissioned in January 2004. The total capacity of the three water reclamation facilites is 92,000 m^3/d (20 MGD).

Effluent from secondary treatment is processed by microfiltration, reverse osmosis and UV disinfection. The reclaimed water meets all U.S. EPA and WHO primary and secondary standards for drinking water. It has better clarity, lower color, and lower particle content than Singapore's raw water sources (rivers and reservoirs) and is equivalent in these quality parameters to the tap water currently supplied in the city. The dissolved organic matter concentration in the reclaimed water is substantially lower that that in the tap water. Typical water quality parameter values for the reclaimed water are at or below 5 NTU turbidity, 100 mg/L total dissolved solids, and 5 Hazen units of color. Total coliforms and enterovirus are undetectable.

b) Nonpotable and indirect potable reuse. Reclaimed water from the Bedok and Kranji Water Reclamation Plants is supplied to wafer fabrication plants at Woodlands and Tampines/Pasir Ris and to other industries for nonpotable use. The Seletar Water Reclamation Plant supplies reclaimed water to a wafer fabrication plant at Ang Mo Kio. Singapore's goal is to increase use of reclaimed water for nonpotable applications to at least 15% of the total water demand by the year 2010.

The Public Utilities Board has begun adding 3 MGD of reclaimed water (1% of total daily water consumption) to the raw water reservoirs. The Board has a goal of increasing this amount to 2.5% of daily water consumption by 2011.

c) Studies. A review of the two-year demonstration study was carried out by an expert panel. It found that the plant operated at 80-82% recovery, required 0.7-0.9 kWh/m^3 of electrical energy, and achieved over 7 log (99.99999%) reduction of microorganisms. The panel concluded that the reclaimed water is suitable for human consumption and can be reliably produced. It recommended that the Singapore Government consider use of the reclaimed water to supplement the existing water supply. A health effects study was ongoing at the time the expert panel report was written. The study seeks to evaluate short and long term health effects on mice and fish. In addition, the effect of the reclaimed water on reproduction and development of the fish is being investigated. Preliminary results indicate the absence of a carcinogenic effect on the mice and fish and absence of reproductive and developmental effects on the fish.

d) Outreach. The Public Utilities Board coined the term "NEWater" for the high quality reclaimed water that is produced and built a NEWater Visitor Center at the site of the demonstration facility to inform the public about the need for water reuse, the rigorous treatment sequence applied for water reclamation, and the excellent quality of the product. Interactive computer, video and electronic presentations are emphasized in order to appeal to young Singaporeans.

e) Information sources. Information for the present case study was taken from Macpherson (2003), Ong (2002), PUB (undated) and Radcliffe (2004).

5.3 Comparisons between Case Studies

Key characteristics of the nonpotable reuse applications discussed in this chapter are compared in Table 5-1. The case studies are from California, Texas, Florida, Australia and Singapore. Six of the systems have in excess of 3,000 connections. The size of the distribution systems ranges from 5 to 300 miles and delivered flow ranges from 6 to 118 MGD. None of the nonpotable reuse applications has reported public health impacts. Challenges in system management include more frequent system cleaning relative to potable water distribution systems and high salinity relative to crop tolerances. Shortages of reclaimed water during warm weather were cited in several cases, attesting to the popularity of the delivered product. Every system has invested efforts at public education, both in the planning stages and continuing after the system is placed online.

Key characteristics of the systems for groundwater recharge to potable aquifers and indirect potable reuse that were discussed in this chapter are summarized in Table 5-2. The water reclamation sequence for groundwater recharge by direct injection and indirect potable reuse by supplementation of surface water supplies includes secondary treatment, lime clarification and filtration or membrane filtration, reverse osmosis, and UV disinfection. In the California systems, advanced oxidation is included at the disinfection stage. A sequence consisting of secondary treatment, nitrogen removal, filtration and high-level disinfection is applied for reclamation of water that is subsequently allowed to percolate through the vadose zone to underlying groundwater in the Montebello Forebay. All health effects studies have concluded that ingesting reclaimed water poses no additional risk to consumers. Controlling concentrations of chemicals of concern in reclaimed water was the main problem cited in these systems.

5.4 Satellite Water Reclamation Systems in the U.S. and Australia

5.4.1 Introduction

Regional wastewater management systems have become the norm in the cities of industrialized countries due to their success in protecting public health (Fane and Fane 2005). Regional systems also tend to be more cost-effective than distributed systems due to economies of scale when reuse is not included. However, regional systems may be more expensive if reuse is included because the reclaimed water needs to be returned to the original source areas over longer distances. The treatment plant in a regional collection system is typically located at the lower end of the system, far removed from many potential users of reclaimed water. Reclaimed water distribution costs can be reduced by integrating satellite facilities for water reclamation into regional systems (Butler and MacCormick 1996). Satellite facilities withdraw wastewater from a sewer, reclaim the liquid portion, and return the solids to the sewer (Okun 2000). They maintain economies of scale for biosolids management, since the biosolids are still processed in a regional facility. Satellite facilities lessen the hydraulic load on the regional treatment plant, thus delaying or ameliorating the need for capacity upgrades. They can also achieve higher qualities of reclaimed water. For example, wastewater chloride concentrations in coastal areas impacted by seawater intrusion tend to be high because of infiltration and inflow of salty groundwater. Wastewater from upper portions of the sewerage, where local groundwater is less impacted by saltwater intrusion, can serve as a better starting point for water reclamation.

A typical satellite facility is shown in Figure 5-6. Wastewater is withdrawn from the sewer and is treated by a series of unit processes to achieve requisite water quality, including biological treatment through a suspended growth process such as activated sludge. Primary settling is generally included to decrease aeration requirements and reduce the size of the biological treatment unit. After separation of activated sludge from mixed liquor in a final settling tank, the effluent is coagulated, filtered and disinfected. Chlorine may be added upstream of the filter in order to prevent attached growth in the filter media. Particulate matter removed in the treatment process, including primary and waste activated sludge, is returned to the sewer. The reclaimed water produced by the indicated sequence of treatment processes would meet the standards for unrestricted public access reuse.

Table 5-1. Comparison of Nonpotable Reuse Case Studies

Project	Locale	Flow (MGD)	Dist. sys. size (miles)	No. of connections	Status	Costs/Rate structure
Green Acres	Calif.	6.9	32	Wholesale provider	Demand to increase to 7.9 MGD	$49M project cost / $0.9M annual operations and maintenance
Irvine Ranch Water District	Calif.	11	300	3,400	Expanding storage and treatment capacity	$6.6M annual operations and maintenance / Base reclaimed water rate is $0.82/1000 gal (90% of domestic water rate)
Monterey County	Calif.	20	46	111	Aquifer storage and recovery to be added	$75M construction cost / $0.90/1000 gal delivery cost / revenue obtained from land assessments ($233/acre/yr) and delivery charge ($0.05/1000 gal)
San Diego	Calif.	22.5	79	549	South Bay Distribution System awaiting connections to customers	Reclaimed water price is $0.80/hundred cubic feet / Increase in price projected for 2006
West Basin Water Management District	Calif.	118	5	3+	Adding 10 MGD	Price charged is 20–40% less than imported water, which sells for $510/acre-ft
Phoenix	Ariz.	71	- -	- -	Planning increase to 179 MGD	- -
San Antonio Water System	Texas	50	75	45	67 MGD cap committed	$124M capital cost / Price charged is $0.98/1000 gal (49% of potable water rate) / $0.25/1000 gal charged if withdrawal rights to local aquifer are given up

Table 5-1 (continued)

Project	**Locale**	**Flow** (MGD)	**Dist. sys. size** (miles)	**No. of connections**	**Status**	**Costs/Rate structure**
Altamonte Springs	Florida	5.7	83	6,000+	Actively managing demand with mandatory watering restrictions	$40M capital cost for distribution system / $0.82/1000 gal charged to commercial users and condominiums / Single family dwellings pay $10/mo
Pinellas County	Florida	14.7	- -	10,400	Expanding	Fees include an availability charge of $7/mo / Multifamily and nonresidential customers pay an additional $0.29/1000 gal
Project APRICOT	Florida	5.9	83	6,000+	Shortages occurring in warm weather	$40 capital cost / Commercial users and multi-unit dwelling paid $0.82/1000 gal in 1997 (40% of potable water rates) / Single family dwellings paid $10/month
St. Petersburg	Florida	21	200	10,500	Need to develop additional potable water supply has been postponed	Metered commercial customers pay $0.33/1000 gal / Residential customers pay $0.035/1000 gal for the first acre-ft and $0.02/1000 gal thereafter / $500–1,200 connection fee
Water Conserv II	Florida	37	70	76	Reuse capacity to expand from 68 to 81 MGD	$278M capital cost and $4.8M annual operating budget / Growers currently pay no fee / Residential users pay $0.84/1000 gal plus $3.14/connection/mo / Commercial users pay $0.70/1000 gal

Table 5-1 (continued)

Project	Locale	Flow (MGD)	Dist. sys. size (miles)	No. of connections	Status	Costs/Rate structure
Rouse Hill	Sydney, Australia	1.2 (current capacity)	21	12,000	Will eventually serve 300,000 people	$22M (Aus) capital cost for reclaimed water distribution system / Users pay $0.28/kL (29% of potable water fee)
Singapore	- -	- -	- -	3+	Intend to supply at least 15% (45 MGD) of total water demand by 2010	- -

Table 5-2. Comparison of Groundwater Recharge and Indirect Potable Reuse Case Studies

Project	Location	Flow (MGD)	Treatment	Application method	Comments	Project Costs/Benefits
Montebello Forebay	Calif.	6	Secondary, nitrogen removal, filtration, disinfection	Infiltration	4 studies concluded no adverse health effects	Provides new water supply equivalent to demands of 250,000 persons / Saves \$12M/yr in water purchases
Orange County Water Factory 21	Calif.	15	Secondary, lime clarification, filtration, reverse osmosis, H_2O_2/UV oxidation/disinfection	Injection to potable aquifer	NDMA reduced to acceptable levels by applying RO plus UV/advanced oxidation	Both of the Orange County groundwater recharge systems protect against seawater intrusion and replenish groundwater
Orange Country Groundwater Replenishment System	Calif.	62.5	Secondary, membrane filtration, reverse osmosis, H_2O_2/UV oxidation/disinfection	Injection to potable aquifer	Under construction	\$454M capital cost and \$22M/yr operations and maintenance / Partial funding from \$92.5M in grants and \$145M in loans
Singapore	- -	3	Secondary, microfiltration, reverse osmosis, UV disinfection	Add to raw water reservoirs	2-yr water quality demonstration completed; parallel epidemiological study in progress	0.7-0.9 kWh/m^3

The potential for substituting compact membrane bioreactors for the aeration basin, final settling tank and filter as shown above has generated considerable interest on the part of water and wastewater utilities (Farmhand Foundation 2004; Wallis-Lage et al. 2004; Cupps and Morris 2005). The small footprint, automation capability, and "double" disinfection (once by the membrane and once by the disinfection unit) of such facilities make them a viable candidate for neighborhood scale water reclamation (Butler and MacCormick 1996; Fane and Fane 2005)

As the present review shows, satellite water reclamation facilities are well established, having been in use for over four decades. The facilities are diverse in size, with the largest producing 35 MGD of reclaimed water and the smallest treating 0.01 MGD. Examples are drawn from systems in the U.S. and Australia, where interest in this technology is highest.

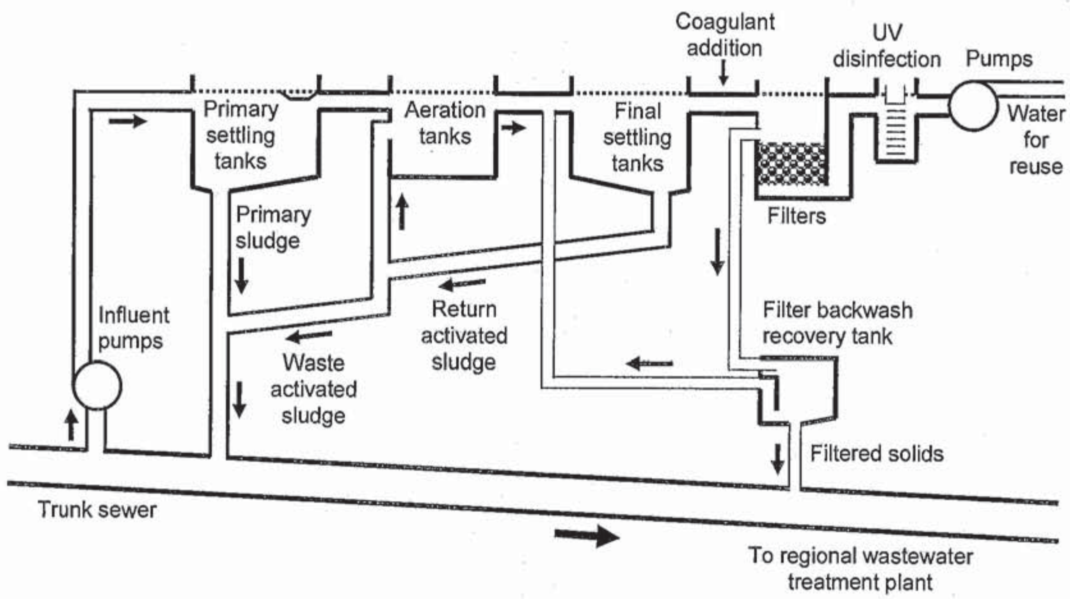

Figure 5-6. Profile of an Illustrative Satellite Water Reclamation Facility. Redrawn and modified from LACSD (undated)

5.4.2 Los Angeles and Orange Counties

Four satellite water reclamation systems are located in Los Angeles County and Orange County, California (Fig. 5-7). Two are operated by the Sanitation Districts of Los Angeles County, one by the City of Los Angeles, and one by the Irvine Ranch Water District in conjunction with the Orange County Sanitation District.

a) Sanitation Districts of Los Angeles County. The largest system of satellite water reclamation systems belongs to the Sanitation Districts of Los Angeles. It includes eight satellite facilities that together produce an average 73 MGD of reclaimed water (LACSD undated). The system spans a distance of 42 miles from the Joint Water Pollution Control Plant to the La Canada Water Reclamation Plant (WRP). Wastewater solids returned to the sewer from each of the satellite plants travel to the Joint Water Pollution Control Plant. Here, the solids are removed from the wastewater, anaerobically digested and dewatered.

Methane from anaerobic sludge digestion fuels a combined cycle power plant (gas turbines followed by boilers and a steam turbine) that provides enough electricity to make the plant self sufficient with respect to energy requirements.

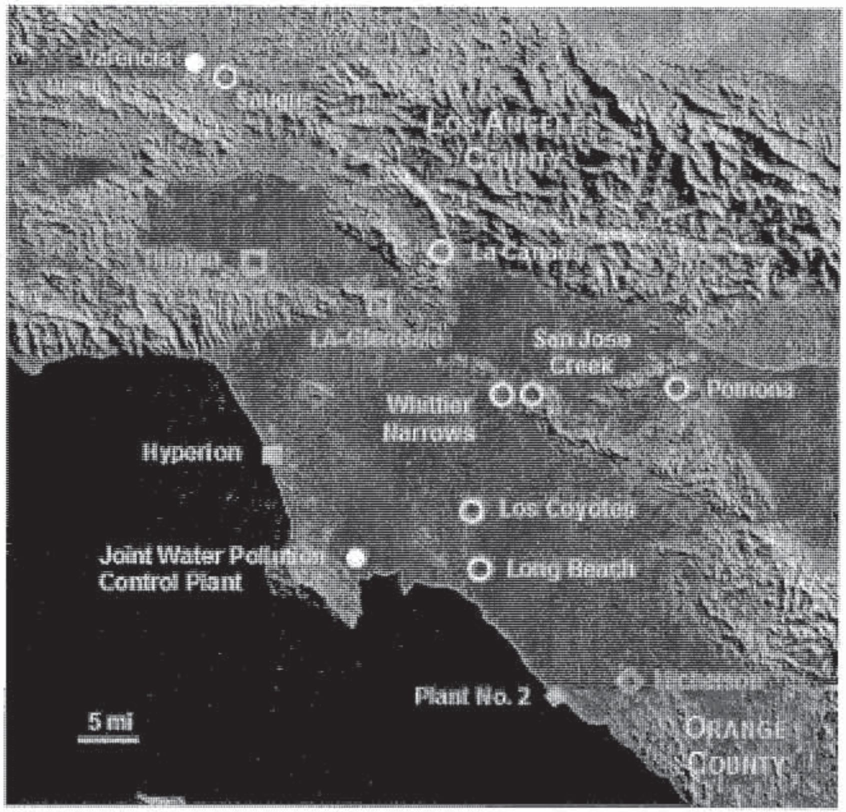

Figure 5-7. Satellite Water Reclamation Systems in Los Angeles County and Orange County, California (IRWD 2006; City of Los Angeles undated; LACSD undated). Open points denote satellite facilities and solid points represent regional treatment plants. Facilities operated by the Los Angeles County Sanitation Districts are represented by circles and facilities operated by the City of Los Angeles are represented by squares. The Michelson Water Reclamation Plant is operated by the Irvine Ranch Water District and Treatment Plant No. 2 is operated by the Orange County Sanitation District. Facility locations are shown on a digital relief map of California (USGS 2002).

The system includes the Whittier Narrows WRP, which is the pioneering satellite facility in the U.S., beginning operations in 1962. The facility currently produces 15 MGD of reclaimed water for groundwater recharge into the Rio Hondo and San Gabriel Spreading Grounds as part of the Montebellow Forebay Project. Reclaimed water is also used for irrigation at an adjacent nursery. The process train of the Whittier Narrows WRP is typical of the satellite facilities operated by the Sanitation Districts of Los Angeles County, consisting of primary settling with optional coagulation, activated sludge with polymer addition to the final settling tanks if needed, alum coagulation and filtration, and chlorination before and after filtration, with 90 minutes of chlorine contact time after filtration (CMHC 2006; LACSD undated). Wastewater solids, including primary sludge, waste activated sludge, and filtered solids are returned to the sewer. Reclaimed water that will be discharged to surface water is dechlorinated before leaving the plant.

Two additional satellite facilities produce reclaimed water for groundwater recharge as part of the Montebellow Forebay Project. The San Jose Creek WRP is the largest of the satellite facilities, with a capacity of 100 MGD. It produces 35 MGD of reclaimed water for reuse at 17 different sites, including irrigation of parks, schools and greenbelts, as well as groundwater recharge. The Pomona WRP produces 8 MGD of reclaimed water that is reused at over 90 different sites. The remainder of the reclaimed water is discharged into the San Jose Creek channel, where it makes its way to the unlined portion of the San Gabriel River and percolates into the groundwater.

The 5 MGD Los Coyotes WRP, along with the San Jose Creek WRP, provide reclaimed water for the Century and Rio Hondo Reclaimed Water Distribution Systems. These systems comprise a looped network of 65 miles of dedicated pipelines that distributes water to a number of municipal and private water purveyors. The reuse distribution system was developed by the Central Basin Municipal Water District in cooperation with the Sanitation Districts of Los Angeles County and 29 other public agencies and private entities, and delivers up to 22,000 acre-ft (20 MG) annually.

The La Canada WRP produces 0.2 MGD of reclaimed water for golf course irrigation. The Long Beach WRP, which treats a total flow of 25 MGD, produces 5 MGD of reclaimed water for reuse at over 40 sites, including repressurization of oil-bearing strata, as well as irrigation of schools, golf courses, parks and greenfields.

The second satellite water reclamation system operated by the Sanitation Districts of Los Angeles County is located in the northern part of the county and consists of the Saugus WRP, a satellite facility, and the Valencia WRP. The Saugus WRP incorporates biological nitrogen removal in its process train. Primary sludge from the Saugus WRP is returned to the sewer and flows 3 miles to the Valencia WRP, where it is removed, anaerobically digested, and thickened. Waste activated sludge from the Saugus WRP is pumped through a force main to air flotation tanks at the Valencia WRP for thickening prior to anaerobic digestion. Methane produced by sludge digestion is used as for plant fuel.

The Saugus WRP produces 7 MGD of reclaimed water for reuse applications. Water not reused is dechlorinated and discharged to the Santa Clara River.

b) City of Los Angeles. The City of Los Angeles operates two satellite water reclamation facilities (City of Los Angeles undated). The Donald C. Tillman WRP, northernmost of the two facilities, has a capacity of 80 MGD. Its sequence of unit processes includes primary settling, activated sludge with nitrification and denitrification, coagulation and filtration, and chlorination. Grit, screenings, primary and waste activated sludge, and filter backwash are returned to the sewer and travel 29 miles to the Hyperion Treatment Plant. Sludge is removed and anaerobically digested at the Hyperion Treatment Plant. Methane from digestion is piped to a nearby power plant in exchange for reduced electricity rates.

Landscaped Japanese gardens adjacent to the Tillman WRP are irrigated with reclaimed water from the plant. The reuse demand totals 26 MGD and includes in-plant applications and many users in the San Fernando Valley in addition to the gardens. The remainder of the reclaimed water is discharged to the Los Angeles River.

The southernmost satellite facility in the City of Los Angeles system is the LA-Glendale WRP, which treats 20 MGD of wastewater using a process train similar to that at the Tillman WRP. Solids removed in the treatment process are returned to the sewer and flow to the Hyperion Treatment Plant. Reclaimed water from the LA-Glendale WRP totaling 4.5 MGD is used for landscape irrigation, cooling water makeup, and irrigation of parks, freeway landscaping, local cemeteries and nearby golf courses. The plant is highly automated and staff can control processes from remote locations.

c) Irvine Ranch Water District/Orange County Sanitation District. The Michelson WRP is operated by the Irvine Ranch Water District and produces 11 MGD of reclaimed water (IRWD 2006). Its treatment train includes primary settling, activated sludge with nitrification and denitrification, dual media filtration, and chlorine disinfection. Primary and waste activated sludge are returned to the sewer and flow 7 miles to the Orange County Sanitation District Treatment Plant No. 2. Sludge is removed from the wastewater by primary settling at Treatment Plant No. 2, anaerobically digested, and dewatered. Methane recovered from the digesters is used to generate electricity for plant use.

Reclaimed water from the Michelson WRP is distributed through 250 miles of reclaimed water pipelines for use in landscape and agricultural irrigation as well as other applications. Excess reclaimed water is stored in several reclaimed water reservoirs and is supplied to the Orange County Sanitation District's Green Acres Project.

5.4.3 San Diego County

Two satellite water reclamation systems are operated by the Metropolitan Wastewater Department of San Diego (Fig. 5-8). The North City WRP currently treats 22.5 MGD of wastewater and has a capacity of 30 MGD (City of San Diego undated-b). The capacity for reclaimed water production is effectively 24 MGD when partial demineralization is practiced. The process train includes primary settling, activated sludge with anoxic selectors to control filamentous bacteria and anthracite coal filters. A portion of the filtrate is demineralized using an electrodialysis reversal process in order to decrease the salinity of the reclaimed water. The demineralized stream is combined with filtrate prior to chlorine disinfection. Primary and waste activated sludge are pumped 5 miles to the Metro Biosolids Center, where they are thickened, anaerobically digested, and dewatered. Methane collected from the digesters is burned at a co-generation facility that provides electricity and steam for the Metro Biosolids Center and the North City WRP. Control of the North City plant is transferred to the utility's communications center in Kearny Mesa from 12:30 am to 5:30 am each night, with an operator on call in the event of an emergency.

An average reclaimed water flow rate of 6 MGD from the North City WRP is distributed through 79 miles of pipeline, two storage tanks and two pump stations. There are 356 metered connections, including a single metered connection with the City of Poway, which serves an additional 193 customers. The single largest use of reclaimed water is landscape irrigation. Additional uses include industrial processes, cooling towers, soil compaction, dust suppression, circuit board washing and urinal flushing. Excess reclaimed water is conveyed to the Point Loma Wastewater Treatment Plant for disposal through ocean outfall.

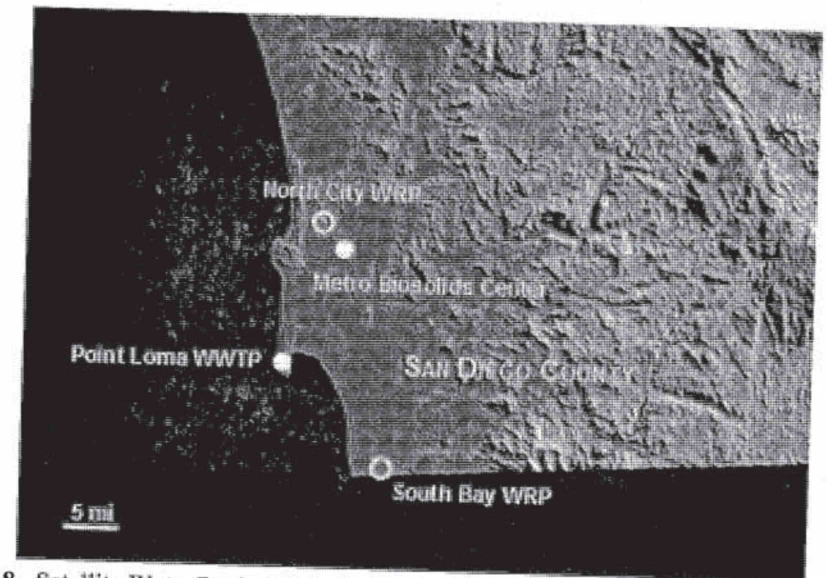

Figure 5-8. Satellite Water Reclamation Systems in San Diego County, California (City of San Diego undated-b; City of San Diego undated-e; City of San Diego undated-c; City of San Diego undated-a). Open points denote satellite facilities and solid points represent regional treatment plants. Facility locations are shown on a digital relief map of California (USGS 2002).

The treatment sequence of the South Bay WRP is a similar to that of the North City WRP, except that disinfection is accomplished through ultraviolet irradiation instead of chlorination and there is no process for demineralization. Primary and waste activated sludge is returned to the sewer and flows 22 miles to the Point Loma Wastewater Treatment Plant, where the sludge is removed, anaerobically digested, and then pumped 17 miles to the Metro Biosolids Center for dewatering.

The South Bay WRP has a capacity of 15 MGD and treats 5–6 MGD. Currently, 1.2 MGD of reclaimed water is applied for beneficial reuse, including 0.7 MGD supplied to the adjacent International Boundary and Water Commission Wastewater Treatment Plant. Total planned reuse with completion of ongoing projects is 7 MGD. Excess reclaimed water is piped to the ocean outfall at the Point Loma WWTP. The South Bay WRP is staffed from 6:00 am to 4:00 pm Monday through Friday. Plant control is accomplished from the utility's communications center outside these hours.

5.4.4 Thurston County

The Cities of Lacey, Olympia and Tumwater, Washington, together with Thurston County, formed the LOTT Alliance to plan for water and wastewater management (Cupps and Morris

2005). The Alliance's plan calls for three satellite water reclamation facilities to be completed over a 30-year period (Fig. 5-9). Construction of the first satellite facility, the Martin Way Reclaimed Water Plant (RWP), began in 2004 and startup is scheduled for mid-2006. Its treatment sequence includes grit removal, a membrane bioreactor using hollow fiber membranes, and chlorine disinfection (DE 2006). The quality of water produced will meet Class A standards, which include limits of 2 NTU for the monthly average operating turbidity, 5 NTU for the maximum turbidity at any time, 2.2 per 100 mL for the 7-day median total coliform concentration, and 23 per 100 mL for a single sample concentration of total coliforms. In addition, nitrate N and nitrite N are limited to 10 mg/L and 1 mg/L, respectively, for groundwater recharge.

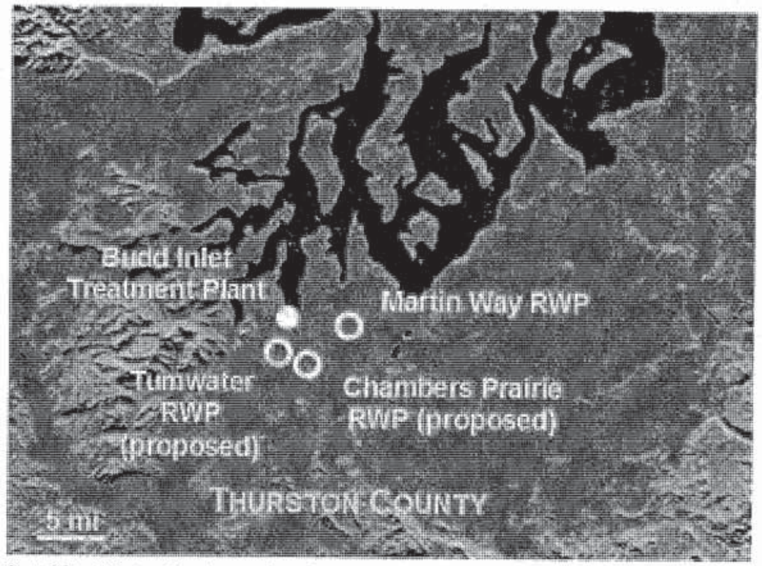

Figure 5-9. Satellite Water Reclamation Systems in Thurston County, Washington (LOTT Alliance 2005). Open points denote satellite facilities and the solid point represents the regional treatment plant. Facility locations are shown on a digital relief map of Washington State (USGS 2002).

The plant has an initial capacity is 2.0 MGD and is expandable to 5 MGD. Waste activated sludge will be returned to the Martin Way Pump Station and pumped 5 miles to the Budd Inlet Wastewater Treatment Plant, where it will be removed, thickened, anaerobically digested, and dewatered. Methane gas collected from the digesters is used as fuel for an engine generator that produces electricity and heat for the plant.

The $18.5 Martin Way RWP is designed to blend in with its neighborhood. Much of the plant equipment will be placed below a ground-level, flat roof that is covered with soil and native vegetation. Reclaimed water will be piped 3 miles to the $6.2 million Hawks Prairie Reclaimed Water Park, also under construction. The park includes 20 acres of constructed wetlands and groundwater recharge basins. Some of the reclaimed water will be used to irrigate parks and to supply commercial and industrial customers in the city of Lacey. The total cost of the satellite water reclamation facility, reclaimed water pipeline, and water park is $30 million (Dodge 2005).

The LOTT Alliance is currently acquiring land for groundwater recharge sites associated with two more satellite water reclamation facilities, one to be constructed in the Chambers Prairie area beginning in 2023 and the other to be constructed in Tumwater sometime after 2025. Each of these plants would have an initial capacity of 1 MGD and be capable of expansion to 5 MGD.

5.4.5 Clark County

Two satellite water reclamation systems are located in the Las Vegas area (Fig. 5-10). The Desert Breeze Water Resource Center (WRC) is a satellite facility operated by Clark County (Grinnell 2006; Clark County Water Reclamation District undated), which is responsible for treating wastewater from unincorporated parts of Clark County within the Las Vegas Valley, including most of the Las Vegas Strip. The capacity of the satellite facility is 5 MGD, expandable to 10 MGD. Available wastewater in the area limits reclaimed water production to 4.3 MGD.

The process train includes equalization, activated sludge with nitrification, final settling tanks, automatic backwash filters, UV disinfection, and hypochlorite addition for reclaimed water distribution. The tanks and most of the equipment are below ground, making the site unobtrusive to the neighborhood (Fig. 5-11). The reclaimed water meets a total coliform limit of 2.2 CFU per 100 mL on a 30-day average basis. Waste activated sludge is returned to the sewer and flows 14 miles to the Main Facility, where it is removed by primary settling, thickened, dewatered, and disposed of by landfilling.

The Desert Breeze WRC provides reclaimed water to four 18 hole golf courses and one 27 hole golf course, as well as 2 parks and 2 schools. The 2005 demand was 3.8 MGD, of which 2.7 MGD was satisfied using reclaimed water. The remainder was met using water extracted from a potable aquifer.

The City of Las Vegas operates two satellite facilities (City of Las Vegas 2005; Grinnell 2006). The larger of the two is the $37 million Durango Hills WRC, which has a capacity of 10 MGD. The process train is similar to that of the Desert Breeze WRC, with all treatment processes underground or under cover. Waste activated sludge is returned to the sewer and flows 18 miles to the Water Pollution Control Facility, where it is removed by primary settling, thickened, anaerobically digested, and dewatered. Methane collected from the anaerobic digesters is burned to heat the digesters and power some equipment, including blowers that supply air to the activated sludge process.

Reclaimed water from the Durango Hills WRC is supplied to 11 golf courses through a distribution system comprising one main pump station, a 2 MG storage reservoir, 17 miles of pipelines, two remote booster pumping stations, and four recharge wells. Reclaimed water production is limited by available wastewater flows, averaging 3.2 MGD in 2005, since the collection system is not yet built out. Excess reclaimed water is discharged to a storm drain during low demand periods.

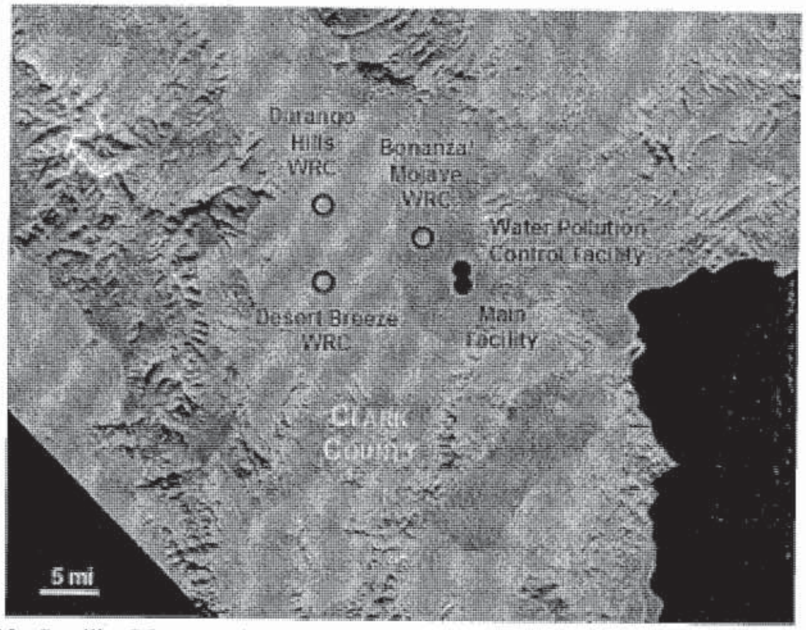

Figure 5-10. Satellite Water Reclamation Systems in Clark County, Nevada (City of Las Vegas 2005; Grinnell 2006; Clark County Water Reclamation District undated). Open points denote satellite facilities and the solid point represents the regional treatment plant. Facility locations are shown on a digital relief map of Nevada (USGS 2002).

Figure 5-11. Desert Breeze Water Resource Center (Clark County Water Reclamation District undated)

The Bonanza/Mojave WRC provides reclaimed water to a single 18 hole golf course. The facility's capacity is 1.1 MGD. The 2005 reclaimed water production averaged 0.2 MGD.

Waste activated sludge from this facility is returned to the sewer and is pumped 11 miles to the Water Pollution Control Facility.

5.4.6 Maricopa County

The Kyrene Water Reclamation Facility in Tempe, Arizona has recently been expanded to 9 MGD capacity and retrofitted with membrane technology (Zenon 2004; Nichols 2006). The facility is expected to resume operations in spring 2006. The flow treated before the upgrade was 4.5 MGD. The treatment sequence includes screening and grit removal, aerated equalization, activated sludge with nitrification and denitrification, a membrane system for separation of activated sludge from treated effluent, and UV disinfection (City of Tempe 2005). The entire process is located underground. Residual solids are returned to the sewer and flow to the 91st Avenue Wastewater Treatment Plant in Phoenix, where they are removed by primary settling, anaerobically digested, and spread on drying beds (PCA undated).

The completed Kyrene WRF will produce very high quality A+ reclaimed water suitable for a wide range of non-potable water uses in Tempe. Up to now, applications included cooling at the Salt River Project Kyrene Electrical Generating Station (1.2 MGD in 2004), irrigation use at the Tempe Ken McDonald Golf Course, and a small amount for groundwater recharge at the golf course. Excess reclaimed water is discharged to the Salt River. Reclaimed water reuse at the power plant and the golf course allow Tempe to receive surface water from the Salt River Project in exchange for reclaimed water deliveries to these sites. More extensive water reuse alternatives are being considered for the city's Reclaimed Water Master Plan, including possible replenishment of the Tempe Town Lake (Kamienski 2004).

5.4.7 Melbourne, Australia

The locations of satellite water reclamation facilities around Port Phillip Bay, Australia that are in operation or have been evaluated are shown in Figure 5-12. A 1,300 kL/d (0.34 MGD) facility on the eastern side of the bay has been in operation since 1974 (Farmhand Foundation 2004). All flow is used for irrigation. The solids removed during treatment are returned to the sewer and flow to the Eastern Treatment Plant (Melbourne Water undated).

A 30 L/d (0.01 MGD) membrane bioreactor was demonstrated at Kings Domain Gardens, 150 m from the South Yarra Main Sewer north of the bay (Mallia et al. 2003; Farmhand Foundation 2004). This unit, which was housed in a portable shipping container, has a process train consisting of a submersible grinder pump mounted directly in the channel beneath a manhole, screens with 3 mm apertures, Zenon Membrane Bioreactor containing hollow fiber membranes having a 0.04 micron nominal pore size, reverse osmosis unit containing Dow low-fouling membranes designed for brackish water, and calcium hypochlorite dosing. Solids removed during treatment were returned to the sewer and flowed to the Western Treatment Plant (Melbourne Water undated).

The unit was operated for three months. Class A water quality, which allows virtually unrestricted use of water for garden watering, closed toilet flushing, etc., was achieved even before hypochlorite dosing. A seed irrigation trial carried out in parallel with the demonstration showed no effect of the product water on the tested species.

A 35 kL/d (0.01 MGD) system that provides localized filtration of wastewater without need for biological digestion was demonstrated at Flemington Race Course in the northern bay area (Borton 2003; Waste Technologies of Australia 2006; WME 2006). The system is one-half the size of a portable shipping container (Fig. 5-13). Its process train consists of a 200 micron screen, chlorination of screened influent, microfiltration, reverse osmosis, and chlorination of reclaimed water. Solids removed in the treatment processes were returned to the sewer and flowed to the Western Treatment Plant (Melbourne Water undated).

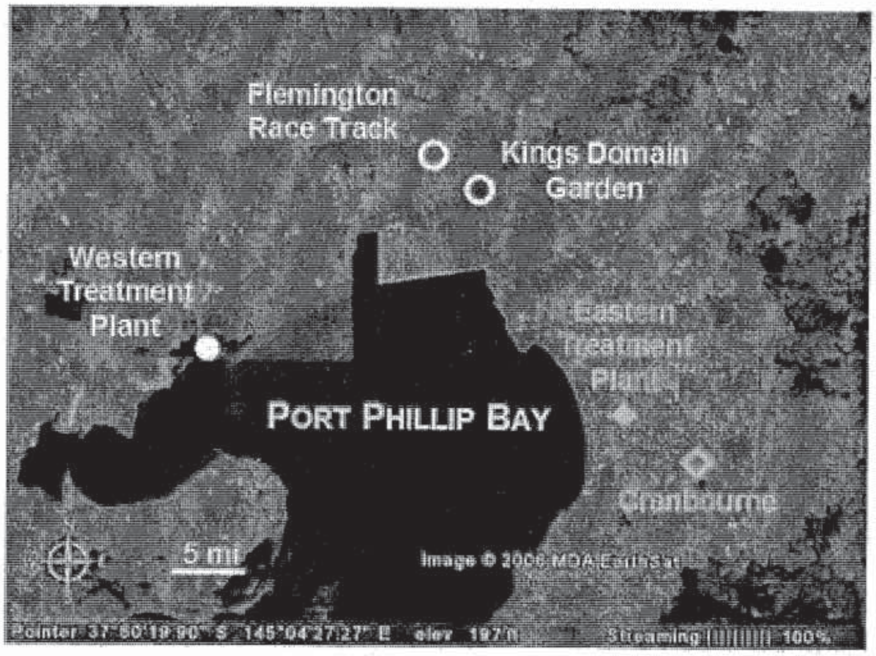

Figure 5-12. Satellite Water Reclamation Systems in Melbourne, Australia (Mallia et al. 2003; Farmhand Foundation 2004; WME 2006; Melbourne Water undated). Open points denote satellite facilities and the solid points represent regional wastewater treatment plants. Photo from Google Earth.

The membrane system produces Class A water and achieves a 7 log reduction in viruses and 6 log reduction in protozoan parasites. Cost of the water produced was estimated at $1 (Au) per 1000 L, with 20% of the cost due to energy requirements. Water from the unit was used to irrigate roses and other plants.

5.4.8 Canberra, Australia

A 300 kL/d (0.08 MGD) satellite water reclamation facility has been in operation in Southwell Park in the city of Canberra since 1995 (Butler and MacCormick 1996; Farmhand Foundation 2004; ActewAGL 2006). Reclaimed water produced by the unit is used to irrigate Southwell Park. The $2.4 million (Au) facility is housed in an odor-controlled building with a footprint of 180 sq m (1,900 sq ft) and has a process train consisting of lime assisted primary settling, fixed film reactor biological treatment with nitrification, microfiltration and hypochlorite dosing for disinfection. Its annual operating budget is

$100,000 (Au). The solids removed during treatment are returned to the sewer and flow to the Lower Molonglo Water Quality Control Centre.

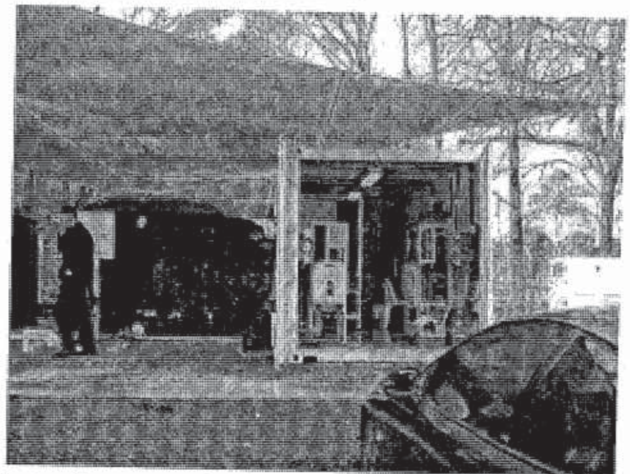

Figure 5-13. Flemington Racecourse Satellite Water Reclamation Facility (Waste Technologies of Australia 2006).

5.4.9 Summary

Satellite water reclamation facilities have been integrated into regional wastewater management systems since 1962. Most of the facilities use conventional process trains that include preliminary treatment to remove screenable materials and grit, primary settling, activated sludge, filtration, and disinfection with chlorine or UV. A few facilities with membrane bioreactors substituting for activated sludge and filtration are in operation, ranging in size from a 9 MGD plant in Tempe, Arizona to 0.01 MGD units demonstrated in Melbourne, Australia. Satellite water reclamation facilities greatly expand the potential for supplying reclaimed water to users throughout the sewer collection system at reasonable distribution costs. They also allow the continued use of regional biosolids management facilities and can improve the quality of reclaimed water over that produced at a regional water reclamation plant.

5.5 Potential for Traditional Water Reuse in Southeast Florida

Consumptive Use Permit data was obtained from the South Florida Water Management District and was used to determine the larger irrigation users who have separate permits for their water use. Attention was focused on the Consumptive Use Permit holders that are located in or near the service areas of the six wastewater districts that discharge to ocean outfalls. Analysis of data from the Consumptive Use Permits enables effective identification of such users.

All Consumptive Use Permit users were first arranged by land use. Six types of land uses were initially analyzed from the South Florida Water Management District data: golf courses, landscaped areas, agricultural areas, aquaculture areas, nurseries, and industrial uses. This study focused on golf courses and landscaped areas that constitute a relatively large proportion of the Consumptive Use Permits and tend to be located closer in distance to the wastewater treatment plants than other water-demanding activities. Industrial users, such as the Turkey Point Power Plant located in Princeton, are also attractive in the development of a reuse network. The potential industrial demand is concentrated in the two Miami-Dade wastewater districts as Consumptive Use Permit data indicate a demand of approximately 33 MGD, of which 17 MGD is located within 12 miles of the two WWTPs. However, industrial users need to be evaluated on a case by case basis due to their diverse needs and widely varied demand flow data as reported in the Consumptive Use Permit Database. Furthermore, the majority of the demand (12 MGD) is in the service area of the Miami-Dade/Central WWTP, which has saline inflow. The remaining golf and landscape areas were arranged by daily allocation. For the purposes of this study, a golf course or landscaped area was considered a "large user" if its demand was 0.05 MGD or higher. Urban users with unit demands of 0.05 MGD or more comprise 80-90% of the total Consumptive Use Permit demand.

The large users were entered into a GIS database along with the service areas of the six wastewater treatment plants that use ocean outfalls, and can be seen in Figures 5-14 through Figures 5-16. The service areas were described in reuse feasibility studies for the Boynton-Delray WWTP in Delray Beach (Brown and Caldwell 1995), the Boca Raton WWTP (Brown and Caldwell 1993), the Broward/North WWTP (Hazen and Sawyer 2004), the Hollywood WWTP (Public Utility Management and Planning Services and Hazen and Sawyer 2001), and the Miami-Dade/North and Miami-Dade/Central WWTPs (PBS&J 1992).

The large users were categorized according to their location. The first category includes users that are located within the service areas of one of the six WWTPs under consideration, with two exceptions. The Town of Davie and Cooper City in Broward County were considered part of the Hollywood WWTP service area. According to FL DEP (2002), these two areas send wastewater to the Hollywood WWTP. Similarly, Boynton Beach in Palm Beach County was included as part of the Boynton-Delray WWTP (Brown and Caldwell 1995).

The next category of large users included those lying outside these boundaries, but still within areas that could be served by traditional water reuse. Most of these outlying areas are now served by wells, but upcoming legislation could limit the availability of this water source. An area was considered as a possible annexation target for traditional water reuse provided that it did not lie within the service area of another wastewater treatment plant. The expanded service areas can be seen as part of Figures 5-14 through 5-16. Palm Beach County has several users in this outlying area that are candidates to receive reclaimed water. Broward County has fewer expansion candidates because there are several other wastewater treatment plants in this area. The service areas of Miami-Dade/North and Miami-Dade/Central WWTPs encompassed all large users.

Large users occupy 18% of the area of the Broward/North WWTP reuse district in Broward County, which consists of the defined WWTP service area plus the expanded area. Palm Beach County has the second largest proportion of large users; 13% of the reuse districts of the Boynton-Delray and Boca Raton WWTPs are occupied by large users. In contrast, only 5% of the reuse district of the Hollywood WWTP is occupied by large users. The reuse districts of the two WWTPs in Miami-Dade County that are under consideration have the lowest proportion of large users (2%).

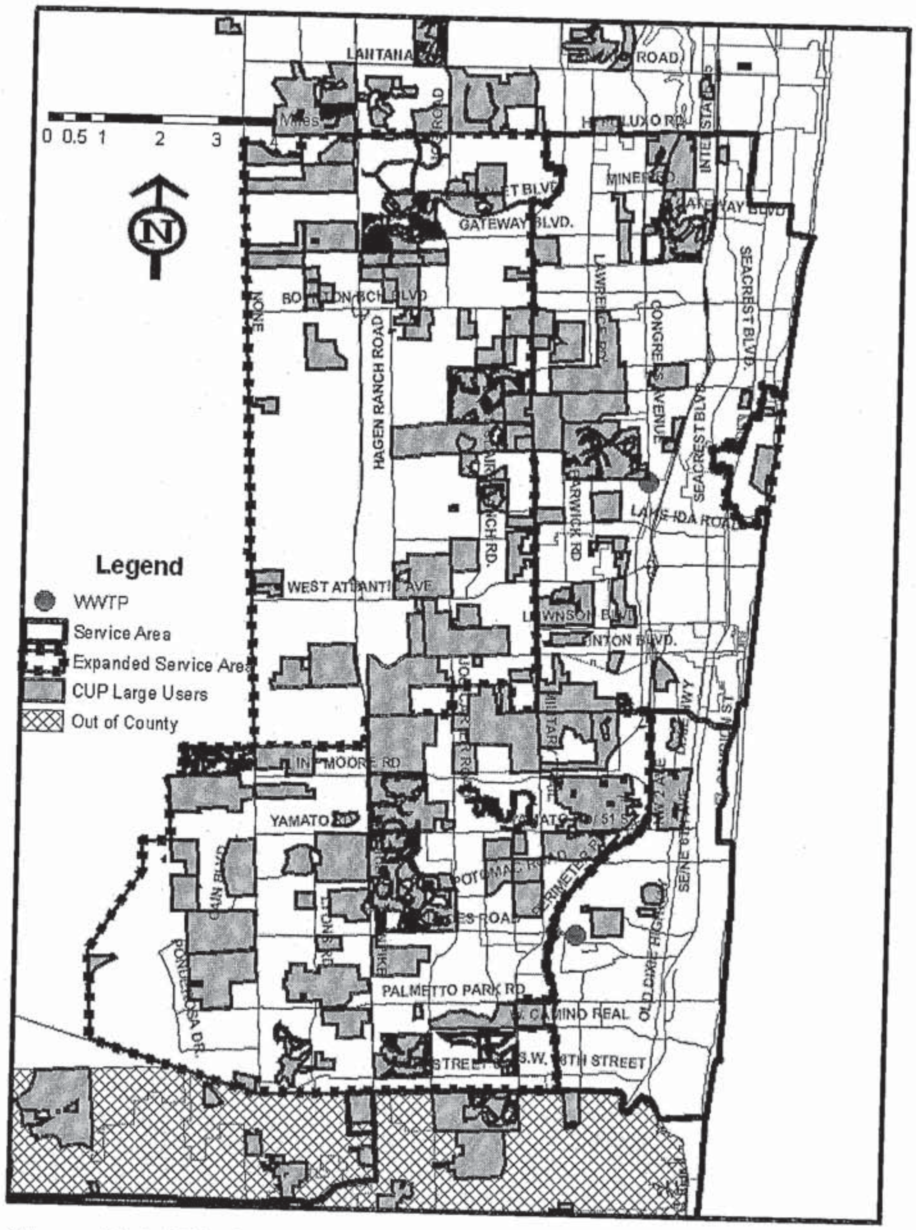

Figure 5-14. Palm Beach County Large Water Users with Separate Permits

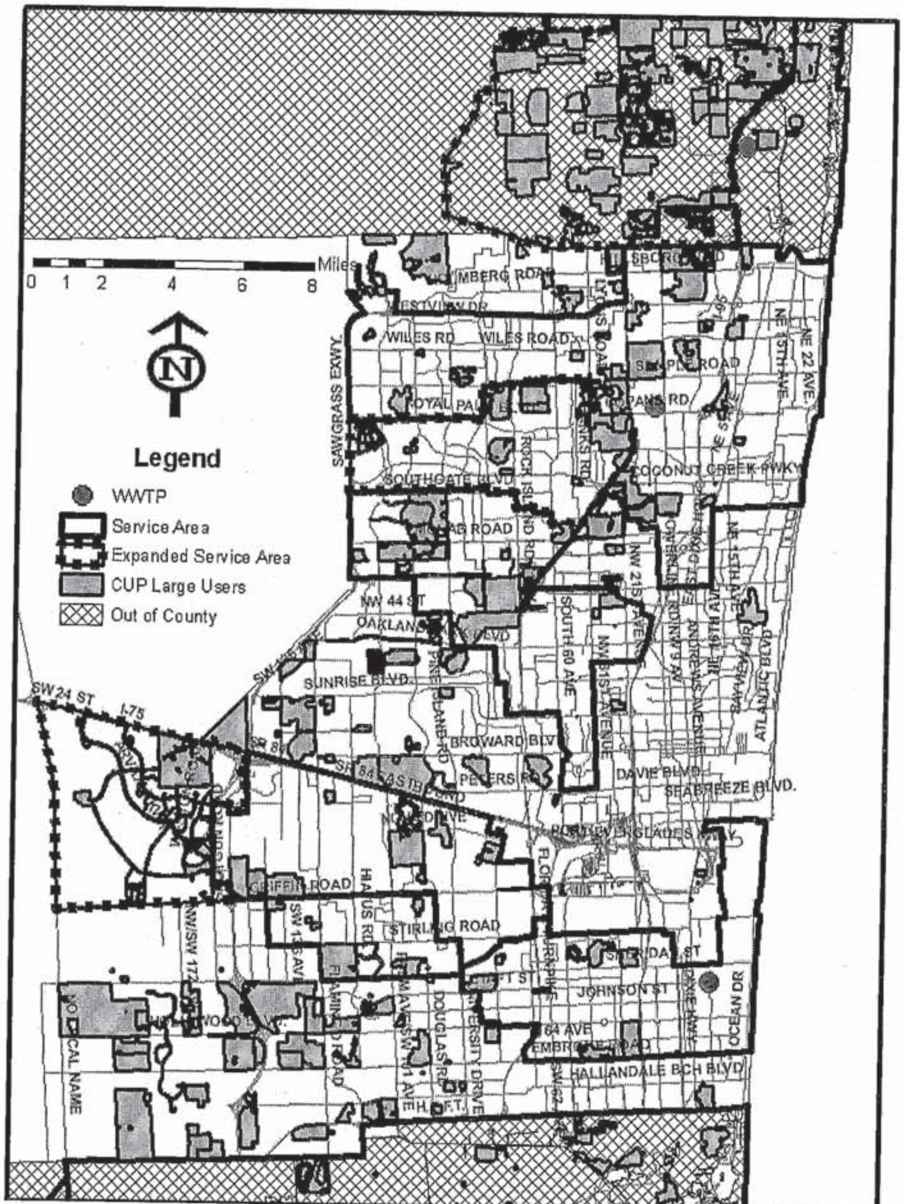

Figure 5-15. Broward County Large Water Users with Separate Permits

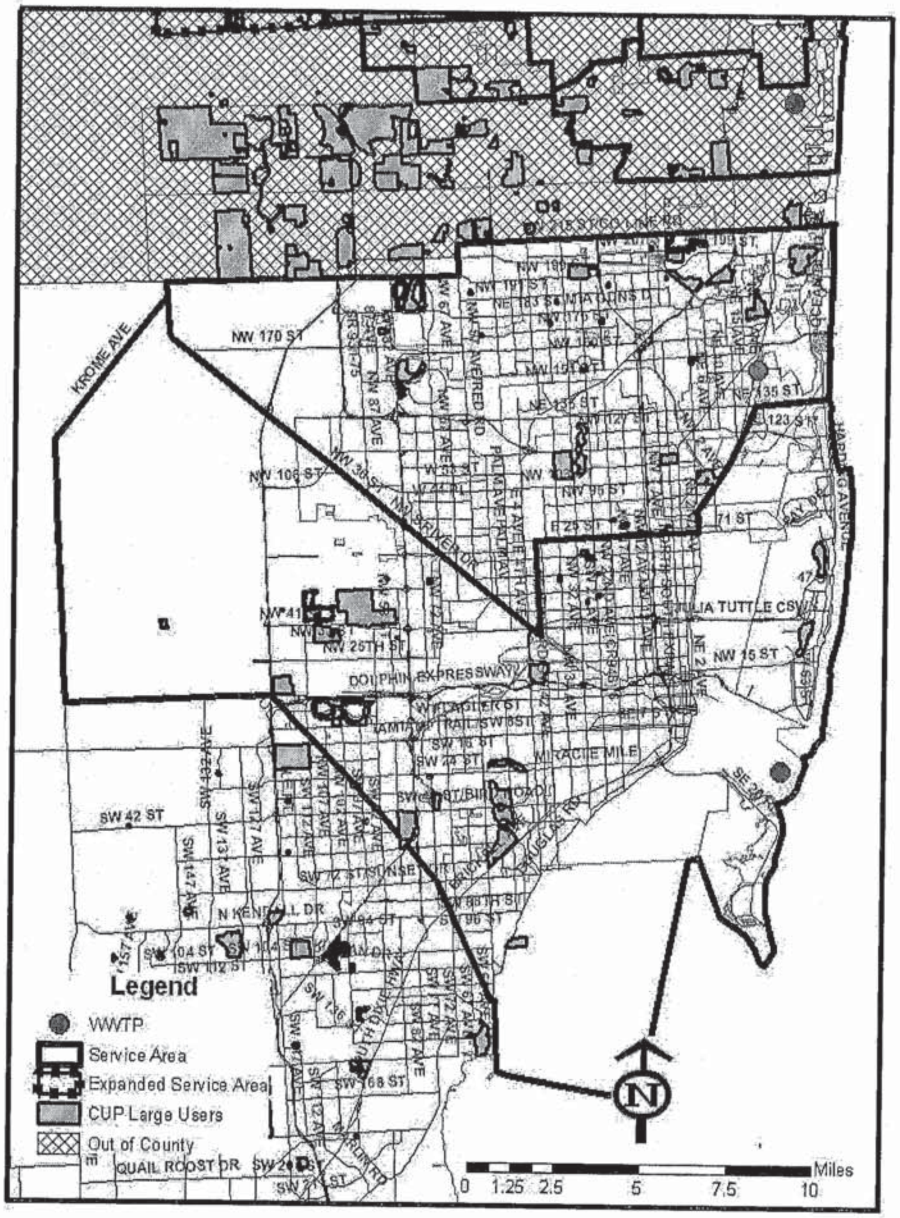

Figure 5-16. Miami-Dade County Large Water Users with Separate Permits

Large users are located randomly throughout the reuse districts, as evident by Figure 5-17. The histogram shows a breakdown of distance from the wastewater treatment plant for all large users in the three-county area.

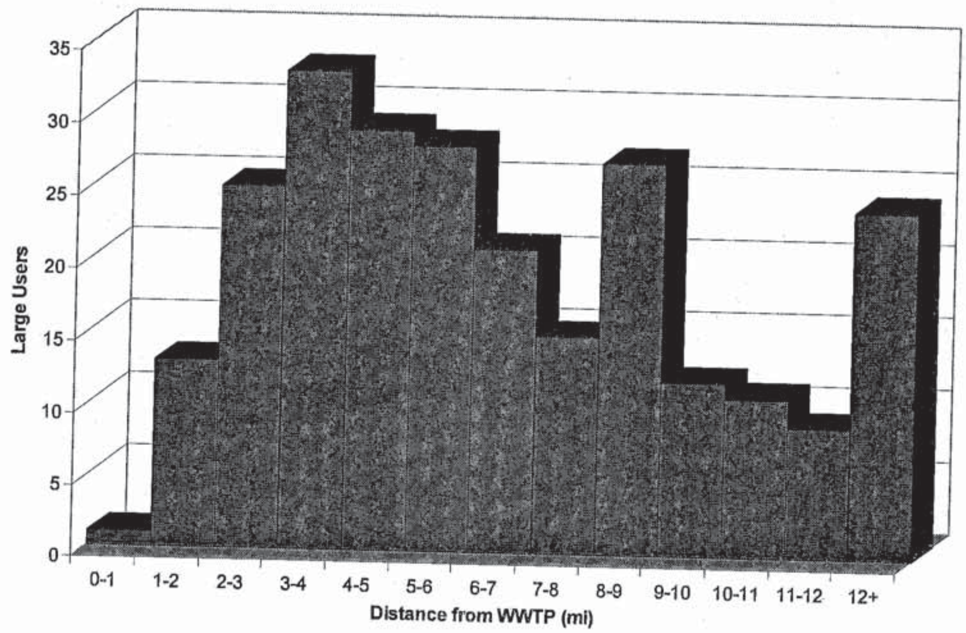

Figure 5-17. Distribution of Large Users' Distance from Wastewater Treatment Plant

The cumulative average demand of the large users, as given by permit data, was then plotted versus metropolitan distance[1] from the large users' respective wastewater treatment plants (Fig. 5-18). The reuse districts served by the Boynton-Delray, Boca Raton, and Broward/North WWTPs have much higher increments of water demand per mile than the districts served by the other three plants.

The slopes of the lines (MGD/mile) in Figure 5-18 fall into two groups. The cumulative demand of large users within 10 miles of the Boynton-Delray WWTP is 20 MGD. Cumulative demands for the reuse districts around the Boca Raton and Broward/North WWTPs have similar slopes. In contrast, the cumulative demand of large users within 10 miles of the Hollywood WWTP is only 3 MGD, or 15% of Delray Beach value. Similar relationships are seen for reuse districts around the Miami-Dade/North and Miami-Dade/Central WWTPs. Accordingly, the more promising opportunities for traditional water reuse are in Palm Beach County and northern Broward County.

[1] Distance measured in the directions of the street grid

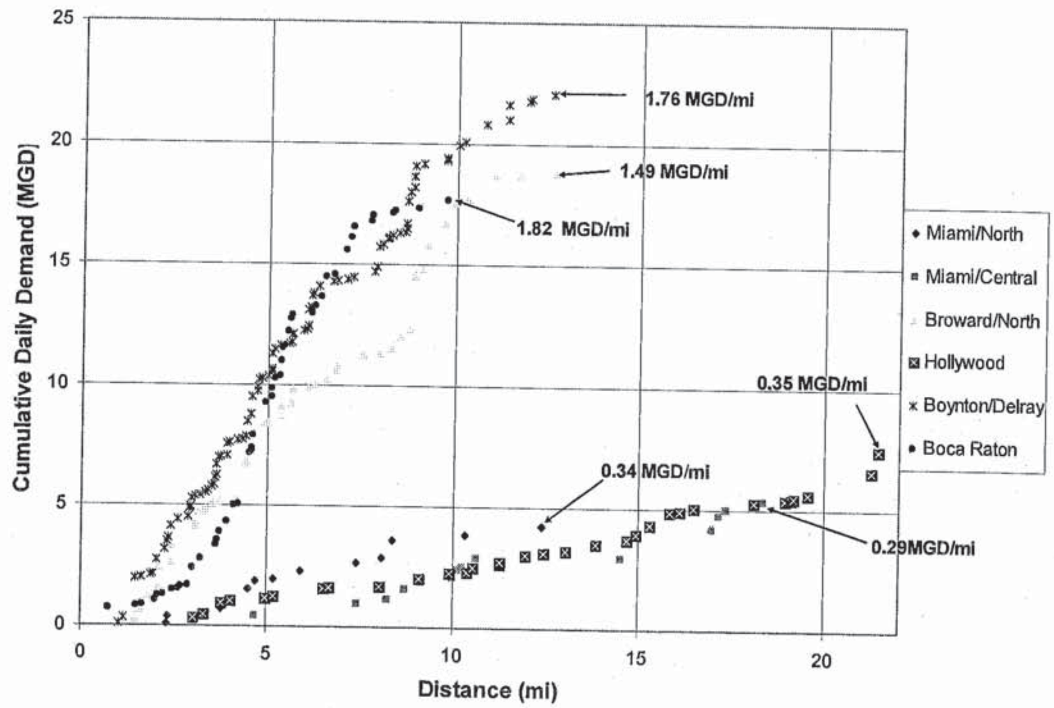

Figure 5-18. Cumulative Daily Demand versus Metropolitan Distance from the Wastewater Treatment Plants

5.6 Summary

Wastewater treatment in the United States has trended towards the construction of centralized treatment systems during the past 40 years for a number of reasons:

- Economies of scale from constructing larger treatment units offset the added piping costs associated with centralized systems
- Generous construction grants from the federal government during the 1970's and 1980's that favored centralized systems
- Problems with performance and reliability in smaller WWTPs.

The cost-effectiveness calculations for these systems did not typically include the possibility of water reuse. The case studies presented in this chapter illustrate how selected communities have integrated reuse systems into their overall wastewater management programs. These cities tend to be in areas where the demand for water is high and supplies are relatively scarce. As competition for water intensifies, more communities can be expected to incorporate reuse into retrofit and expansion plans for wastewater systems including evaluations of the best blend of centralized and decentralized WWTPs and reuse facilities.

As the case studies of water reuse indicate, irrigation of publicly accessible areas such as golf courses is a major application of reclaimed water. Augmentation of ground and surface water supplies with reclaimed water is growing in importance as areas subject to water deficits expand. Satellite water reclamation facilities greatly expand the potential for supplying reclaimed water to users throughout regional wastewater collection systems at reasonable distribution costs, while retaining the economy of scale of regional biosolids management systems. Satellite facilities also have the potential to improve the quality of reclaimed water by withdrawing wastewater upstream of areas that are impacted by inflow and infiltration of saline groundwater.

Traditional reuse (nonpotable reuse for public access applications) is seen from the analysis in Section 5.5 to have the greatest demand potential in Palm Beach County and the northern part of Broward County. A paucity of large urban irrigators lessens the demand potential of traditional reuse in southern Broward County and central and northern Miami-Dade County. There are opportunities to add industrial users in all three counties, although the potential is greatest in Miami-Dade County. Consumptive Use Permit data indicate a total industrial water demand of approximately 33 MGD, of which approximately half is located in proximity of the two WWTPs. The feasibility of adding these users would depend on the individual needs of the industries. Furthermore, the majority of the demand is in the Miami-Dade/Central service area, which has saline inflow. A further analysis would need to be conducted in order to evaluate the needs of large industrial users.

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6. Costs of Traditional Water Reuse and Groundwater Recharge in Southeast Florida

6.1 Introduction

Water reuse is an attractive option when it comes to saving water and reducing the amount of wastewater that is discharged to the ocean. This chapter studies groundwater recharge and traditional land irrigation, two of the more popular methods of water reuse. Several reports provide excellent cost information for the construction, operation and maintenance of the infrastructure required to provide water reuse. This information is used to estimate the costs of well fields for groundwater recharge. In addition, a case study for traditional water reuse is presented to determine if it is cost effective to implement. The results of this case study are used in projecting feasible traditional reclaimed water flows for the remaining five service areas with ocean outfalls, taking advantage of the methodology described in the previous chapter. These projections are used in Chapter 7 as part of the ocean outfall alternatives.

6.2 Methodology for Estimating Costs of Water Reuse Systems

The Florida Department of Environmental Protection (FL DEP 1991) requires that those responsible for domestic wastewater management provide a feasibility study of providing reclaimed water for reuse. The feasibility studies must assess different alternatives in providing water reuse, along with their present costs, costs that will be associated with the user, and the associated environmental and technical impacts.

The FL DEP (1991) guidelines prescribe four alternatives to evaluate:

1. No Action,
2. Minimal Reuse - less than 40% of the average wastewater flow
3. Medium Reuse - 40-75% of the average wastewater flow
4. Maximum Reuse - greater than 75% of the average wastewater flow

The guidelines present several options for reclaimed water, including irrigation of golf courses and other landscaped areas, agricultural uses, recharging groundwater, and industrial uses. Each of these uses requires that the wastewater be processed through secondary treatment and disinfection. Additional requirements for particulate matter and nutrients will be summarized in Chapter Seven.

The FL DEP (1991) methodology uses a net present value analysis, in which all revenues and costs that will be incurred over a twenty-year study period are brought back to the current year's dollar amount using the discount rate published by the United States Environmental Protection Agency. The costs that are to be considered include the capital costs to provide the required level of treatment to the wastewater, the transmission costs to provide water reuse to the users, and the operation and maintenance costs of these systems. A contingency is provided by taking a percentage of capital costs. The cost to pump and store the reclaimed water is identified in the capital costs. The guidelines consider treatment facilities already in operation as sunk costs. Salvage and replacement values are determined using the straightline depreciation method. Finally, revenues from the sale of reclaimed water, connection fees, crops produced, or lease of lands are considered in the net present value analysis.

This initial present value is compared to a present value resulting from the amount of water saved by using reclaimed water. The water usage from a reuse alternative is subtracted from the water usage from the No Action alternative. This flow is multiplied by the average residential rate to produce a cost savings. This present value is subtracted from the present value of the costs described above to determine the final net present value.

6.3 Cost Estimation

6.3.1 Water Reclamation

The costs of treatment to produce reclaimed water suitable for discharge through ocean outfalls, deep well injection, traditional (public access) reuse, or groundwater recharge were evaluated using CapdetWorks 2.1 (Hydromantis Inc., Hamilton, Ontario, Canada) as well as information from the literature.

a) Methodology for estimating wastewater treatment costs using CapdetWorks. CapdetWorks computes land, equipment, and operation and maintenance requirements for a wastewater treatment process train and estimates costs using the 1977 CAPDET database (Harris et al. 1982) or a U.S. July 2000 database. Information required by the program includes average daily, maximum, and minimum flow, influent wastewater characteristics, unit operations and processes to include in the treatment train, and desired effluent quality. The user can provide values for allowable loadings, unit costs, and cost indices or rely on default values.

The general procedure in CapdetWorks was to input certain general factors such as cost indices and then construct a process flow train by assembling and connecting objects representing various unit operations and processes. Details of the methodology are given below. A detailed step by step example is provided in Appendix 1.

i) General. Costs are estimated in 2005 dollars throughout the present report. Cost index values between January 2005 and September 2005 were collected from *Engineering News Record* and *Chemical Engineering* and averaged. The averages were 7410 for the ENR 20-City Construction Cost, 1250 for the Marshall & Swift Index, and 620 for the Pipe Cost Index. These values were input to CapdetWorks.

CapdetWorks inflates unit costs based on inputs for the three cost indices specified above. However, the program does not inflate land costs. A representative land cost of \$100,000/acre in 1996 dollars was listed for urban areas by LEES (1997). The Marshall and Swift Index was used to inflate this cost to 2005 dollars (\$120,000/acre). The latter value was input to CapdetWorks.

The cost report produced by the program includes the total project cost (construction, land, and interest paid during construction) and the operation and maintenance cost (materials and supplies, energy, and labor). Land cost is also available. The difference between the total project cost and the land cost (i.e., capital cost excluding land) was annualized on the basis of a discount rate of 7% and process life of 20 years. The corresponding capital recovery factor was 0.094. The values of discount rate and process life are the same as those employed by LEES (1997). The land cost reported by CapdetWorks was annualized by applying the discount rate directly. The total annualized cost of wastewater treatment by a particular system was the sum of the annualized net capital cost, annualized land cost, and the operation and maintenance cost.

ii) Influent object. The CapdetWorks influent object allows the user to characterize the influent wastewater in terms of flow and composition. The maximum flow was computed as the product of the average daily flow and the peak hour peaking factor. The peaking factor was found in the consultants' reports. The value of the minimum flow was set equal to the average daily flow. This setting did not alter the value of project cost estimated by Capdetworks. This was verified for minimum flows of 10–100% of the average daily flow.

Design concentrations of influent five-day carbonaceous biochemical oxygen demand ($CBOD_5$) and total suspended solids (TSS) were found in consultants' reports, as summarized in Table 6-1. Design concentrations of influent total Kjeldahl nitrogen (TKN) and total phosphorus (TP) were generally not available in the reports. These concentrations were therefore estimated based on the TKN/BOD_5 ratio (40/220) and TP/BOD_5 ratio (8/220) in medium strength domestic wastewater (Metcalf & Eddy 1991). The estimated concentrations of TKN and total P are also included in Table 6-1. Concentrations of soluble BOD, chemical oxygen demand, soluble chemical oxygen demand, soluble TKN, and ammonia in the influent object were set to zero. The results of preliminary simulations indicated that this approach gave appropriate results.

Table 6-1. Influent Wastewater Parameters Entered for WWTPs

Parameter	Boynton-Delray	Boca Raton	Broward/ North	Holly-wood	Miami Dade/ North	Miami Dade/ Central
Peaking Factor (max. hour)	2.26	2.28	2.3	2.28	2.26	2.28
TSS (mg/L)	250	150	248	150	250	150
BOD (mg/L)	225	200	142	150	225	150
TKN (mg/L)	40.9	36.4	26	27.3	41	27.3
TP (mg/L)	8.2	7.3	5	5.5	8	5.5

iii) Primary clarifier object. A primary clarifier object was included in the process trains of facilities that currently use this unit operation and omitted from the process trains of facilities that do not employ this unit operation. Design factors such as surface overflow rate and tank depth were left at the default settings when this object was used.

iv) SRT-based plug flow activated sludge object. The SRT-based plug flow activated sludge object was used to represent the activated sludge process employed at the six WWTPs with ocean outfalls to provide secondary treatment. The mixed liquor suspended solids was set at 2,000 mg/L and fine bubble aeration was selected unless design information for a facility indicated that coarse bubble aeration was in place. The solids residence time (SRT) was estimated using design information given in the consultants' reports.

v) Biological nutrient removal–3/5 stage object. The biological nutrient removal–3/5 stage object with 3 stages was employed to estimate costs of intermediate nutrient removal. An example of a 3 stage process is the A^2/O process (Metcalf & Eddy 1991). The object with 5 stages was used to estimate the costs of advanced nutrient removal. An example of a 5 stage process is the Bardenpho process (Metcalf & Eddy 1991). The treated effluent qualities associated with these levels of nutrient removal are described in Chapter 7. The mixed liquor suspended solids concentrations for both the 3 stage and 5 stage biological nutrient removal processes were set at 3,000 mg/L. Fine bubble aeration was selected. The solids residence time for nutrient removal was fixed at 6 days for 3 stage treatment and 9 days for 5 stage treatment. The values of solids residence time were selected based on default nitrification kinetics from the International Water Association activated sludge Model 2d (Henze et al. 2000). These solids residence times give simulated effluent ammonia levels of 0.2 mg/L, which provides a satisfactory safety factor for nitrification and also allow sufficient anoxic tank volume for adequate denitrification.

vi) Secondary clarifier object. The secondary clarifier is an integral component of the activated sludge process and was included in all of the process flow trains. The design factors were left at the default values.

vii) Filtration object. The object representing granular media filtration was used with default values for all design factors.

viii) Chlorination object. A contact time of 15 minutes at maximum flow and chlorine dose of 10 mg/L were input to the chlorination object to represent basic level chlorine disinfection. The contact time and chlorine dose were raised to 45 minutes and 16 mg/L, respectively, to represent high-level chlorine disinfection. All other design factors were left at the default values.

ix) Ultra-Violet disinfection object. The CapdetWorks model for UV disinfection requires that the allowable effluent concentration of coliforms be expressed in terms of total coliforms. The California Title 22 requirements for high-level disinfection, which limit maximum effluent total coliforms to 2.2/100 mL, may be considered equivalent to the FL DEP requirements for high-level disinfection, which specify that 75% or more of effluent samples should contain no detectable fecal coliforms. Therefore, a target effluent concentration of 2.2 total coliforms/100 mL after disinfection was employed in the CapdetWorks UV disinfection module. All other design factors were left at their default values.

x) Sludge processing and disposal. Objects representing unit operations and processes for sludge handling and disposal were not included in the wastewater treatment process trains. This is because the quantities of sludge produced by the alternative process trains are anticipated to change by an insignificant amount relative to the quantities produced by the secondary treatment processes now in operation. Upgrading biological treatment processes from secondary treatment to nitrogen removal generally decreases sludge production due to higher solids residence time. This would tend to offset a slight increase in solids production due to chemical precipitation of phosphorus remaining following application of processes for biological enhanced phosphate uptake.

b) Comparison of treatment upgrade costs obtained with CapdetWorks to costs reported by LEES (1997). A comparison of cost estimates for treatment upgrades obtained with CapdetWorks to those given by LEES (1997) was carried out. LEES (1997) gave annualized costs in 1996 dollars for adding a granular media filtration system to a secondary wastewater treatment system and for upgrading basic level chlorine disinfection to high level chlorine disinfection system. These two upgrades were simulated with CapdetWorks. To obtain a correct basis for comparison between the two approaches, the cost index values for 1996 (Marshall and Swift Index = 1040, ENR Cost Index = 5620, Pipe Cost Index = 514) were input to the program. The land value was input as $100,000/acre. Annualized costs estimated by the two approaches were very close at a flow rate of 20 MGD, but were off by a factor of 2 or more at the 1 MGD flow rate (Table 6-2). The capacities of the WWTPs evaluated are 15 MGD or higher. Hence, we would expect generally good agreement between costs estimated using CapdetWorks and costs estimated using the methodology of LEES (1997).

Table 6-2. Comparison of Costs for Adding Granular Media Filtration to a Process Train and Upgrading from Basic-Level to High-Level Chlorine Disinfection

	Filtration		Disinfection		
	1 mgd	20 mgd	1 mgd	20 mgd	
Law Engineering	0.33	0.11	0.098	0.044	$/1000 gal
CapdetWorks	0.17	0.10	0.040	0.041	$/1000 gal
Law Engineering/Capdetworks	1.9	1.1	2.4	1.1	

c) Estimation of costs for membrane filtration and reverse osmosis. CapdetWorks does not include objects for membrane filtration or reverse osmosis. A report by CDM (1998) that estimated the costs to add membrane filtration and reverse osmosis to a secondary wastewater treatment plant was used to find costs for these two unit operations. The capital and operation and maintenance costs of upgrading were estimated by the consulting engineers for a 10 MGD influent flow rate (Table 6-3). The capital cost was annualized using a discount rate of 7% and service life of 20 years. The annualized capital cost and operation and maintenance costs were added to give the total annualized cost of membrane filtration and reverse osmosis as $1.52/1000 gal. The base year for costing was not stated in the report. It was assumed that the costs were in 1997 dollars, since the report was published in 1998. The ENR Cost Indices for 2005 (7405) and 1997 (5825) were applied to inflate the annual cost to $1.93/1000 gal in terms of 2005 dollars.

The annual cost expressed in $/1000 gal was scaled in relation to flow. A scaling factor of 0.85 was determined on the basis of costs for a reverse osmosis process treating potable water (LEES 1997), which were given at several flow rates. The equation for estimating the unit cost of upgrading a secondary wastewater treatment plant with membrane filtration and reverse osmosis is thus

$$C = 0.272\,Q^{0.85} \tag{6-1}$$

where C is the cost is expressed in 2005 dollars/1000 gal and Q is the flow rate in MGD.

d) Estimation of costs for advanced oxidation. The Florida DEP suggested the use of advanced oxidation in a treatment train for full treatment and disinfection. However, costs for advanced oxidation were not available in either CapdetWorks or in LEES (1997). Daugherty et al. (2005) dosed 3 ppm of H_2O_2 immediately upstream of a UV disinfection system to achieve advanced oxidation of reclaimed water in Orange County, California. An H_2O_2 cost of $0.50/lb (Brown 2004; Burridge 2004) and a dose of 3 ppm were used to compute annualized chemical costs associated with advanced oxidation.

6.3.2 Traditional Water Reuse

The methods used to estimate costs for this project follow the general concepts outlined in the FL DEP (1991) guidelines with one major change. Instead of using a prespecified percentage of wastewater reuse for the calculations, the net present value was determined for a variety of reuse percentages. As shown in the previous chapter, the relative importance of large users varies widely across the six wastewater treatment plants. Accordingly, the cost-effectiveness of traditional reuse for these six wastewater treatment plants will also vary widely. The addition of more points along a net cost function graph will show to what degree the option is cost effective. The method of how traditional reuse flow levels were determined and their names differs from the FL DEP (1991) report. The "Status Quo" alternative describes a plant that is providing its current amount of reclaimed water. The "Low" alternative finds additional users to take the plant to its existing traditional reuse capacity. The "Medium" alternative encompasses all "large users" in the plant's service area. Large users are identified as having a demand greater than 0.05 MGD based on the Consumptive Use Permits and for application to golf courses and landscaped areas. Finally, the "Large" alternative is a combination of the large users in the service area combined with a selected amount of residential users. The residential users were determined by the Hazen and Sawyer (2004) report, based on their proximity to the traditional reuse line being designed to serve the large users.

Table 6-3. Estimated Costs for Adding Membrane Filtration and Reverse Osmosis to an Existing Secondary Treatment Facility, Based on Data from a 10 MGD pilot plant[1,2].

Construction	
Effluent Pump Station (Pump + Transmission)	690,000
Microfiltration Equipment (Equipment + MF Portion)	10,560,000
RO Feedwater Storage (Pump + Tanks)	425,000
RO Equipment (Membrane + Cartridge+RO Pump + Cleaning System + Building)	6,575,000
Degasification System (Tower + Blower + Pump)	935,000
Concrete Disposal	50,000
Reclaimed Water (Storage Tank + Water Pump Station)	1,110,000
Chemical Feed System (Sulfuric Acid + Antiscalent + Caustic Soda)	240,000
Site Facilities	770,000
Subtotal (Construction)	21,355,000
Other direct costs I	
Site Work (@5% Net Construction Cost)	1,067,750
Yard Piping (@5% Net Construction Cost)	1,067,750
Electrical and Instrumentation (@15% Net Construction Cost)	3,203,250
Subtotal (Construction + Other Direct Cost I)	26,693,750
Other direct costs II	
Bonds, Premiums, Mobilization, Indemnification, Demobilization, Insurance (8% (Net Construction + Other Direct Cost)	2,135,500
Subtotal (Construction + Other Direct Costs I, II)	28,829,250
Indirect costs	
Engineering, Legal and Administration (15% of Subtotal (Construction + Other Direct Cost I, II)	4,324,388
Contingency (10% of Subtotal (Construction + Other Direct Cost I, II)	2,882,925
Grand Total (Capital Cost) for MF/RO	36,036,563
Annualized capital cost	3,387,437 /yr
Operations and Maintenance	
Chemicals (MF Cleaning + Sulfuric Acid + Antiscalent + Caustic Soda + Chlorine)	296,380
Power	583,900
Labor	300,000
Replacement / Repair	968,380
Grand Total (O & M) for MF/RO	2,148,660 /yr
Total annual cost	5,536,097 /yr
Unit costs	
1997 basis	1.52 /1000 gal
2005 basis	1.93 /1000 gal

[1]All costs that feature in the table are in \$. All annualized costs reported in the table are in \$/yr. All unit costs reported in the table are in \$/1000 gal.
[2]Data from CDM (1998)

Water and wastewater infrastructure is very capital intensive with long service lives that extend to 100 years for some transmission systems. For this project, excellent information is available on how costs should be calculated. The LEES (1997) report incorporates estimation techniques for all costs sought after by the FL DEP (1991) report. These cost estimates were updated by SFWMD (2004). In addition, Hazen and Sawyer (2004) created a database from several reuse treatment facilities that is used to calculate treatment costs. The reuse facilities in this database include the Broward/North, Boynton-Delray, Hollywood, and Boca Raton Wastewater Treatment Plants.

The capital costs determined in this project include the cost to expand the capacity of the traditional reuse facility, the cost to pump the water on-site and throughout the traditional reuse network, the cost of storage tanks, if needed, along with booster stations throughout the service area, the cost of transmission lines required to provide the traditional reuse demand, and land costs for the booster stations. A contingency cost is added to these capital costs.

The cost to expand traditional reuse capacity is based on data from Hazen and Sawyer (2004) and is summarized in Table 6-4. In calculating these costs, the wastewater treatment plant's capacity to treat reclaimed water is subtracted from the alternative demand flow to account for the sunk cost of the plant. The costs presented in Table 6-4 represent the infrastructure required to treat the reclaimed water. It includes the cost to equalize the flow during peak flow events, the cost of a filter feed pumping station to transfer effluent from secondary treatment to the filtration process, and the cost to provide the facilities for chemical pre-treatment, filtration, and disinfection through chlorination. The unit costs used for materials and energy were held constant for all reclaimed water demands.

Table 6-4. Traditional Reuse Expansion Costs (Hazen and Sawyer 2004)

Item	Cost ($/gal)
Facility Structures	0.825
Process Equipment	0.220
Auxiliary Equipment	0.055

The costs to pump the reclaimed water through the treatment process and the reuse network are combined into one category. These costs, along with the cost to store this reclaimed water, are found in a similar fashion. For a 45 MGD capacity system, Hazen and Sawyer (2004) found that a pump station would cost $7.3 million. Additionally, Hazen and Sawyer (2004) estimated that storage for this system would total $30 million. A cost function was implemented to determine the costs for all other flows demanded. The flow and the cost of this larger system are known. Costs are usually estimated using a power function, as shown in Equation 6-2. Using a typical exponent value of 0.7 for treatment systems (Heaney et al. 2002), and using the total cost and flow demand of the treatment system, the value of *a* can be calculated, where *a* in Equation 6-2 represents the cost of pumping or storing 1 MGD of this reclaimed water.

$$C = aQ^b \qquad (6\text{-}2)$$

where C equals cost in dollars, Q equals flow in MGD, and a and b are parameters. This function can be used to obtain pumping and storage costs for any flow desired.

Booster stations and storage tanks are placed throughout the service area. It is assumed that the plant can store reclaimed water up to its current flow, and that storage tanks throughout the system need to be designed to hold 40% of the daily demand (Hazen and Sawyer 2004). In these calculations, 2.5 MG storage tanks are assumed. The amount of booster stations required is any flow above the "Status Quo" multiplied by 40% and then divided by 2.5 MG. Each booster station was estimated to cost $750,000 and is to be situated on a one-acre plot of land that is estimated to cost $250,000 (Hazen and Sawyer 2004). However, because land is assumed not to depreciate, the standard way to cost it out is the foregone revenue for using it during the twenty-year study period, or 7% of the land value per year. Therefore, the cost to use an acre of land is $17,500 per year, which is then calculated as a present value.

Transmission costs are based on the diameter of pipe required, the type of installation required, and the cost of crossing roadways and canals (Hazen and Sawyer 2004). Table 6-5 summarizes these transmission costs.

Table 6-5. Transmission System Unit Construction Costs (Hazen and Sawyer 2004)

Pipe Diameter (in)	Pipe Installation-Paved ($/ft)	Pipe Installation-Unpaved ($/ft)	Roadway Crossings ($/ft)	Canal Crossings ($/ft)
6	75	37.50		
8	100	50.00		
10	125	62.50		
12	150	75.00	1140	1240
16	200	100.00	1330	1330
18	225	112.50	1370	1520
20	250	125.00	1600	1770
24	300	150.00	1670	2150
30	375	187.50	1980	2280
36	450	225.00	2280	2510
42	525	262.50	2340	2730
48	600	300.00	2520	2960

The pipe costs shown in Table 6-5 can be put into equation form as follows:

$C_u = 6.25*D$ for unpaved areas, and (6-3)

$C_p = 12.50*D$ for paved areas (6-4)

where C = pipe installation costs in $/foot and D = diameter in inches.

These transmission costs estimates are higher than those reported in South Florida Water Management District (2004), because the latter values, while including the cost to jack and bore underneath a roadway and the costs of valves, do not distinguish between paved and unpaved roadway installation. Finally, engineering, permitting, and administration costs are taken to be 25% of all capital costs.

Operation and maintenance costs are also calculated in Hazen and Sawyer (2004). These costs are shown in Table 6-6. This estimate takes into account that a larger distribution network capable of handling larger flows will require more maintenance. These costs also take into account that operation and maintenance costs historically increase throughout the service life. The percentage increases for years 6–10, 11–15, and 15–20 are 20%, 16%, and 14%, respectively.

Table 6-6. Annual Operation and Maintenance Cost Estimates (Hazen and Sawyer 2004)

	O&M Costs ($/1000 gal)			
Alternatives	**Years 1-5**	**Years 6-10**	**Years 11-15**	**Years 16-20**
Status Quo & Low	0.175	0.210	0.244	0.278
Medium & Large	0.215	0.258	0.299	0.341

The operation and maintenance costs are annualized over the twenty-year study period and brought back to a present value using a 7.0% discount rate. This rate corresponds to the value used in the LEES (1997) report. This value is combined with all capital costs to produce the present value of costs.

FL DEP (1991) regulations require a comparison of present cost values to a present value of savings enjoyed by the large users. Whitcomb (2005) provides water and sewer rates for Miami-Dade and Palm Beach Counties shown in Table 6-7.

Table 6-7. Miami-Dade and Palm Beach Counties Sewer and Water Service Costs (Whitcomb 2005)

Utility	Range in 1,000 gal./mo.	Water $/1,000 gal.	Sewer $/1,000 gal.	Total $/1,000 gal.
Miami-Dade	0 to 3.75	$ 0.50	$ 1.85	$ 2.35
Miami-Dade	3.75 to 7.5	$ 1.60	$ 2.90	$ 4.50
Miami-Dade	7.5 to 12.75	$ 2.20	$ 3.60	$ 5.80
Miami-Dade	> 12.75	$ 3.05	$ 3.60	$ 6.65
Palm Beach	0 to 4	$ 0.75	$ 1.00	$ 1.75
Palm Beach	4 to 10	$ 1.60	$ 2.00	$ 3.60
Palm Beach	> 10	$ 3.80	$ -	$ 3.80

Indoor water use for a typical family would correspond to the first rate category shown in Table 6-7. Irrigation use would be in the remaining categories. Assuming that outdoor water use is in the second category, the relevant savings are $4.50 per 1,000 gallons for Miami-Dade County and $3.60 per 1,000 gallons for Palm Beach County.

Hazen and Sawyer (2004) provide rates for Broward County. A residential customer using 7,000 gallons per month in 2002 was charged $2.35 per thousand gallons for sewer service and $1.69 per 1,000 gallons for water service, or a total of $4.04 per 1,000 gallons. These values are used to estimate the cost savings of implementing a traditional water reuse plan.

Sales of reclaimed water were not quantified in this report. In addition, salvage and replacement values for all capital costs were not calculated. This differs from FL DEP regulations, but is consistent with the methods used in the LEES (1997) report.

6.3.3 Groundwater Recharge

This section develops the groundwater recharge costs for the WWTPs with ocean outfalls. The groundwater recharge construction costs include the cost of the shallow injection wells and valves and the transmission costs from the WWTP to the injection site including pipe costs, jack and bore and canal crossings. Operation and maintenance costs include monitoring, as well as operation and maintenance, plus pumping through the transmission system.

The PBS&J (1992) reuse feasibility study reviewed the drainage wells in Miami-Dade County. The wells are located seaward of the salt front at locations where they will not interfere with other supply wells. The drainage wells, usually 14 to 16 inches in diameter, are typically drilled 60 to 80 feet deep near the coast into the most permeable strata of the aquifer and can drain up to an average of 2,000 gal/min (2.88 MGD) under a head of 1 to 3 ft, depending on site conditions and location. Background water level conditions are usually found at a distance of 500 feet from the recharge well. Under the worst conditions, the background water levels might not be reached in 800 to 1000 feet from the well. From this information it was found that a ten-well string spread 500 feet apart (ten to a mile) could recharge as much as 30,000 gal/min (43.2 MGD), and a system of several of these mile-long strings could be installed to control a wide frontal area of the coast. A pressurized system would allow for additional recharge. The study also mentioned where the shallow injection wells would be most beneficial. Injection wells could be spread along a broad front or concentrated where problems are occurring, such as near the coast where the salt front threatens existing well fields. They could also be installed near and around the control structures in canals to help increase the canal water levels.

The characteristics of the shallow injection wells and transmission lines at the six WWTPs are shown in Table 6-8. A shallow injection well AADF capacity of 2.0–2.85 MGD and an internal diameter of 12–16 inches were chosen for the six WWTPs based on the information presented in PBS&J (1992). The distance between the wells was set at 500 feet, as measured from the center of each well. Where possible, the injection wells were sited along a canal or where saltwater intrusion could be prevented. The locations of shallow injection wells at the respective WWTPs were determined after reviewing appropriate reports for each WWTP.

Table 6-8. Characteristics of the Shallow Injection Wells and Transmission Line

Plant	No, of wells	AADF per well (MGD)	Dia. of wells (inch)	TransTr mission length (feet)	ans- mission pipe dia. (inch)	Description of Transmission Line
Boynton-Delray	6	2	12	14,001	36	11,500 feet along the L-30 Canal, injection wells along the Military Trail
Boca Raton	4	2.15	14	1,501	36	Injection wells between the WWTP and I-95 Freeway
Broward/North	15	2.7	14	8,001	66	1,000 feet from the WWTP to the C-3 Canal, injection wells along the C-3 Canal
Hollywood	14	2.8	14	16,587	66	10,086 feet from the WWTP to I-95 Freeway along Taft Street, injection wells along I-95 Freeway
Miami-Dade/North	34	2.85	16	16,751	108	250 feet from the WWTP to Snake Creek Canal, injection wells along Snake Creek Canal and Sunny Isles Blvd.
Miami-Dade/Central	40	2.8	14	Up to 35 miles	60	See Figure 6-1

The location of the injection well system for the Boynton-Delray WWTP in Delray Beach is based on the Brown & Caldwell (1993) reclaimed water system feasibility study that evaluated the costs for aquifer recharge through canal recharge and wetlands construction. The Boca Raton WWTP is located next to the I-95 Expressway; therefore the injection wells will be located between the WWTP and I-95 Expressway. The location of the injection well system for the Broward/North WWTP is based on the Hazen & Sawyer (1994) reuse feasibility study that evaluated the costs for canal recharge to C-3 Canal. The location of the injection well system for the Miami-Dade/North is based on the PBS&J (1992) and (1998) Reuse Feasibility Studies which evaluated the costs for canal recharge to Snake Creek Canal. The Miami-Dade/Central includes four transmission lines from the Miami-Dade/Central WWTP to four shallow injection well sites. The Miami-Dade/Central WWTP is located on Virginia Island. The injection well sites were chosen on the mainland, which requires a long transmission line through Miami. The PBS&J (1992) reuse feasibility study found that several well fields would benefit from a seaward movement of the salt front. These included the Miami Springs Well Field, the Hialeah Well Field, the Alexander Orr Well Field, the Homestead Air Force Base Well Field and Leisure City Well Field, mentioned in the order of importance to the overall public water supply. Four sites that would benefit from a program to reduce saltwater intrusion were chosen, as shown in Figure 6-1.

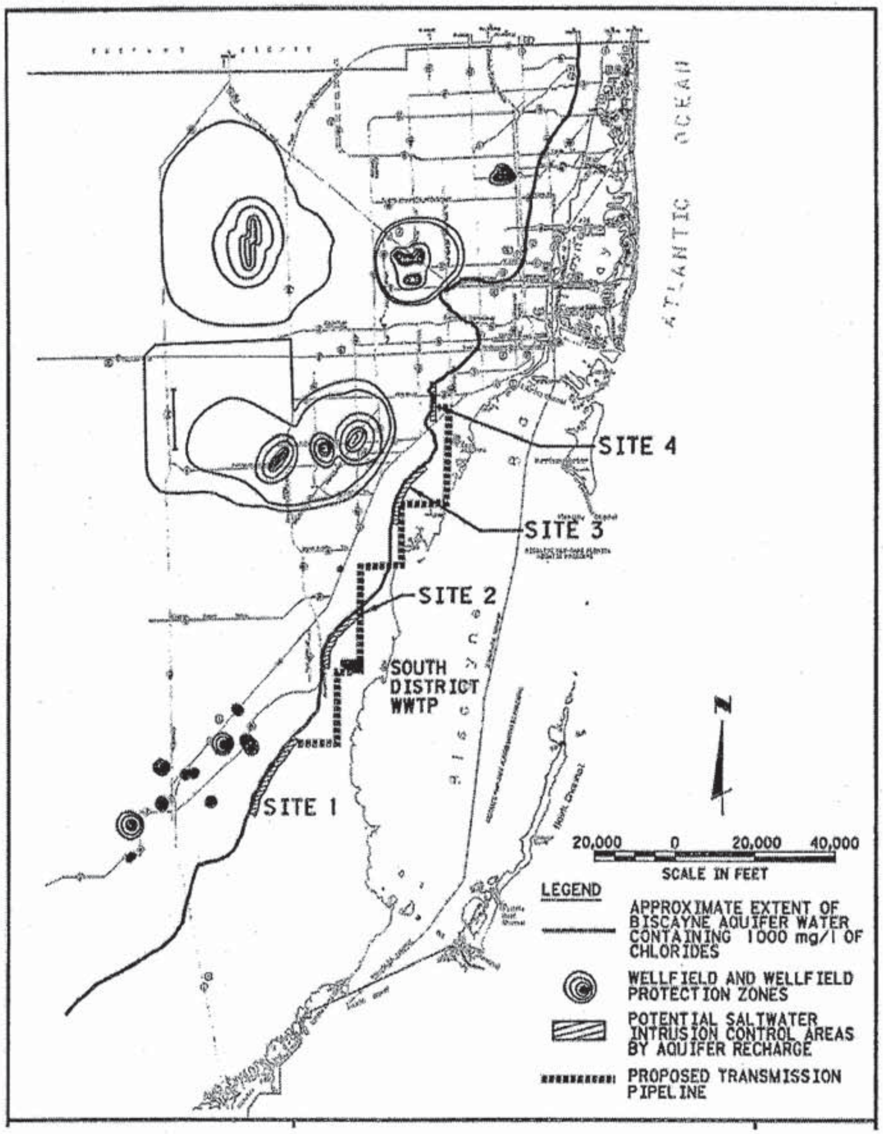

Figure 6-1. Miami-Dade/Central Shallow Injection Well Sites (PBS&J 1992)

A summary of the unit costs for shallow injection wells and transmission is given in Table 6-9. These unit costs were converted to 2005 dollars using the Engineering News Record Index. The injection well construction costs were calculated using values of \$9,000/MGD/well and \$5,000 for the automatic shut off valve at each well (PBS&J 1992). Transmission pipe costs were calculated from information in the Hazen & Sawyer (2004) reuse feasibility study. The unit cost of pipe installation through urban areas is given by Equation 6-4 (above). Roadway and canal crossing costs were calculated using values of \$80,000/roadway crossing and \$60,000/canal crossing (PBS&J 1992). Transmission pipes were sized based on information from Hazen and Sawyer (2004) and Brown and Caldwell (1993). The latter study examined a discharge of 12 MGD through a 36 inch transmission pipe to a pumping Station along E-3 canal. Hazen and Sawyer (2004) studied a discharge of about 69 MGD of reclaimed water through a 78 inch transmission pipe to C-3 Canal.

Table 6-9. Unit Costs for Shallow Injection Wells and Transmission

Item	Units	Unit Costs	Source
Injection wells	$/MGD/well	**9,000** (1992 Dollars)	PBS&J (1992)
Valves	$/valve	**5,000** (1992 Dollars)	PBS&J (1992)
Transmission Pipe for paved areas	$/feet	**12.50*Diameter** of pipe in inches (2004 Dollars)	Hazen & Sawyer (2004)
Jack & Bore	$/ roadway crossing	**80,000** (1992 Dollars)	PBS&J (1992)
Canal Crossing	$/ canal crossing	**60,000** (1992 Dollars)	PBS&J (1992)

The lengths of transmission line for five of the injection well systems were calculated by adding the length of transmission line from the WWTP to the injection site and the length of transmission line between the wells, as shown in Equation 6-5.

$$Trans\ Length = Trans\ Line\ from\ WWTP\ to\ Site + 500 * (No.Wells - 1) + \frac{Well\ Dia}{12} \qquad (6\text{-}5)$$

The transmission costs for the Miami-Dade/Central WWTP were calculated using the information given in the PBS&J (1992) study. The transmission length given in Table 6-8 applies to transmission of reclaimed water from the Miami-Dade/South WWTP to the injection sites. Since the source of reclaimed water would actually be the Miami-Dade/Central WWTP, transmission costs were increased by $16,000,000, as suggested by PBS&J (1992).

Operation and maintenance costs were estimated from information in reuse studies by Brown and Caldwell (1993) and Hazen and Sawyer (1992). The latter study gave costs for 56 injection wells with a total capacity of 8.25 MGD to recharge Dixie Wellfield using reclaimed water from the Plantation WWTP. The construction costs of $6.69 million included the injection wells, manifold and the transmission pipeline. The operation and maintenance costs of $0.16 million/yr included electricity for pumping and maintenance of the transmission lines and injection wells. The operation and maintenance costs were 2.41% of the construction costs. The Brown and Caldwell (1993) study gave costs for canal recharge of 12 MGD of reclaimed water from the Boynton-Delray WWTP. The construction costs of $4.40 million included the canal discharge structure construction costs, transmission costs, canal use fee, valves and 15% contingency. The operation and maintenance costs of $0.07 million/yr included operation, repair and replacement and monitoring costs. Operation and maintenance costs were 1.59% of the construction costs. Operation and maintenance costs were therefore calculated as 2.5% of the construction costs on an annual basis.

The calculations for the total construction and operation and maintenance costs in 2005 dollars are given for each plant in Tables 6-10 through Table 6-15. The total construction and operation and maintenance costs for each plant are summarized in Table 6-16. The annualized costs assuming a 7% discount rate over 20-year period are shown in Table 6-17.

The annualized costs in $million/yr were scaled according to flow using the relationship shown in Equation 6-6.

$$\text{Cost} = aQ^b \tag{6-6}$$

where Q is the design capacity of the system in MGD, b is a scaling coefficient, and a is a site-specific parameter. The value of b was assumed to be 0.7, which is appropriate for water and wastewater transmission systems. A cost scaling relationship is given for each system in Table 6-18.

Table 6-10. Boynton-Delray Shallow Injection Well Costs

Item	Units	Value	Item	Value
Flowrate	MGD	12	ENR (2005)	7405.3
Flowrate per well	MGD	2	ENR (2004)	7115
Total # of wells		6	ENR (1993)	5210
Distance between wells	LF	500	ENR (1992)	4985
Diameter of injection wells	Inches	12		
Diameter of transmission pipe	Inches	36		

Item	Quantity	Units	Unit Cost	Item Cost
CONSTRUCTION COST				
Injection Wells	6	EA	$26,739	$160,436
Valves	6	EA	7,428	$44,565
Total Injection Wells				**$205,001**
TRANSMISSION COST				
Transmission Pipe	14,001	LF	$468	$6,557,515
Jack and Bore	1	EA	$118,841	$118,841
Canal Crossing	1	EA	$89,131	$89,131
Total Transmission				**$6,765,488**
TOTAL COST				**$6,970,489**
O&M COST ($/year)				**$174,262**

Table 6-11. Boca Raton Shallow Injection Well Costs

Item	Units	Value	Item	Value
Flowrate	MGD	8.6	ENR (2005)	7405.3
Flowrate per well	MGD	2.15	ENR (2004)	7115
Total # of wells		4	ENR (1993)	5210
Distance between wells	LF	500	ENR (1992)	4985
Diameter of injection wells	Inches	14		
Diameter of transmission pipe	Inches	36		

Item	Quantity	Units	Unit Cost	Item Cost
CONSTRUCTION COST				
Injection Wells	4	EA	$28,745	$114,979
Valves	4	EA	7,428	$29,710
Total Injection Wells				**$144,689**
TRANSMISSION COST				
Transmission Pipe	1,501	LF	$468	$703,087
Jack and Bore	1	EA	$118,841	$118,841
Canal Crossing	0	EA	$89,131	$0
Total Transmission				**$821,929**
TOTAL COST				**$966,618**
O&M COST ($/year)				**$24,165**

Table 6-12. Broward/North Shallow Injection Well Costs

Item	Units	Value	Item	Value
Flowrate	MGD	40.5	ENR (2005)	7405.3
Flowrate per well	MGD	2.7	ENR (2004)	7115
Total # of wells		15	ENR (1993)	5210
Distance between wells	LF	500	ENR (1992)	4985
Diameter of injection wells	Inches	14		
Diameter of transmission pipe	Inches	66		

Item	Quantity	Units	Unit Cost	Item Cost
CONSTRUCTION COST				
Injection Wells	15	EA	$36,098	$541,471
Valves	15	EA	7,428	$111,414
Total Injection Wells				**$652,885**
TRANSMISSION COST				
Transmission Pipe	8,001	LF	$859	$6,870,289
Jack and Bore	1	EA	$118,841	$118,841
Canal Crossing	0	EA	$89,131	$0
Total Transmission				**$6,989,131**
TOTAL COST				**$7,642,015**
O&M COST ($/year)				**$191,050**

Table 6-13. Hollywood Shallow Injection Well Costs

Item	Units	Value	Item	Value
Flowrate	MGD	39.2	ENR (2005)	7405.3
Flowrate per well	MGD	2.8	ENR (2004)	7115
Total # of wells		14	ENR (1993)	5210
Distance between wells	LF	500	ENR (1992)	4985
Diameter of injection wells	Inches	14		
Diameter of transmission pipe	Inches	66		

Item	Quantity	Units	Unit Cost	Item Cost
CONSTRUCTION COST				
Injection Wells	14	EA	$37,435	$524,090
Valves	14	EA	7,428	$103,986
Total Injection Wells				**$628,076**
TRANSMISSION COST				
Transmission Pipe	16,587	LF	$859	$14,242,752
Jack and Bore	7	EA	$118,841	$831,889
Canal Crossing	2	EA	$89,131	$178,262
Total Transmission				**$15,252,903**
TOTAL COST				**$15,880,980**
O&M COST ($/year)				**$397,024**

Table 6-14. Miami-Dade/North Shallow Injection Well Costs

Item	Units	Value	Item	Value
Flowrate	MGD	96.9	ENR (2005)	7405.3
Flowrate per well	MGD	2.85	ENR (2004)	7115
Total # of wells		34	ENR (1993)	5210
Distance between wells	LF	500	ENR (1992)	4985
Diameter of injection wells	Inches	16		
Diameter of transmission pipe	Inches	108		

Item	Quantity	Units	Unit Cost	Item Cost
CONSTRUCTION COST				
Injection Wells	34	EA	$38,103	$1,295,519
Valves	34	EA	7,428	$252,538
Total Injection Wells				**$1,548,057**
TRANSMISSION COST				
Transmission Pipe	16,751	LF	$1,405	$23,536,989
Jack and Bore	1	EA	$118,841	$118,841
Canal Crossing	1	EA	$89,131	$89,131
Total Transmission				**$23,744,961**
TOTAL COST				**$25,293,018**
O&M COST ($/year)				**$632,325**

Table 6-15. Miami-Dade/Central Shallow Injection Well Costs

Item	Units	Value	Item	Value
Flowrate	MGD	112	ENR (2005)	7405.3
Flowrate per well	MGD	2.8	ENR (2004)	7115
Total # of wells		40	ENR (1993)	5210
Distance between wells	LF	500	ENR (1992)	4985
Diameter of injection wells	Inches	14		
Diameter of transmission pipe	Inches	60		

Item	Quantity	Units	Unit Cost	Item Cost
CONSTRUCTION COST				
Injection Wells	40	EA	$37,435	$1,497,401
Valves	40	EA	7,428	$297,103
Injection Wells Cost per site				$448,626
Total Injection Wells				**$1,794,504**
TRANSMISSION COST				
Transmission Pipe-Site 1	60,000	LF	$781	$46,836,051
Transmission Pipe-Site 2	19,000	LF	$781	$14,831,416
Transmission Pipe-Site 3	97,000	LF	$781	$75,718,282
Transmission Pipe-Site 4	127,400	LF	$781	$99,448,547
Jack and Bore-Site 1	1	EA	$118,841	$118,841
Jack and Bore-Site 2	1	EA	$118,841	$118,841
Jack and Bore-Site 3	1	EA	$118,841	$118,841
Jack and Bore-Site 4	2	EA	$118,841	$237,683
Canal Crossing-Site 1	1	EA	$89,131	$89,131
Canal Crossing-Site 2	2	EA	$89,131	$178,262
Canal Crossing-Site 3	6	EA	$89,131	$534,786
Canal Crossing-Site 4	8	EA	$89,131	$713,048
Transmission Cost-Site 1				$70,812,288
Transmission Cost-Site 2				$38,896,784
Transmission Cost-Site 3				$100,140,174
Transmission Cost-Site 4				$124,167,543
Total Transmission				**$334,016,789**
O&M Cost-Site 1				$1,781,523
O&M Cost-Site 2				$983,635
O&M Cost-Site 3				$2,514,720
O&M Cost-Site 4				$3,115,404
Total O&M Cost				**$8,395,282**
TOTAL COST				**$335,811,293**
O&M COST ($/year)				**$8,395,282**

Table 6-16. Summary Table for Shallow Injection Well Costs

Plant	AADF (MGD)	Construction Cost ($ million)	Capital Cost* ($ million)	O&M Cost ($million/yr)
Boynton-Delray	12	$6.97	$9.06	$0.17
Boca Raton	8.6	$0.97	$1.26	$0.02
Broward/North	40.5	$7.64	$9.93	$0.19
Hollywood	39.2	$15.88	$20.65	$0.40
Miami-Dade/North	96.9	$25.29	$32.88	$0.63
Miami-Dade/Central	112	$335.81	$436.55	$8.40

* 1.3 times the construction cost to account for engineering, legal, administrative and contingencies

Table 6-17. Annualized Shallow Injection Well Costs

Plant	AADF (MGD)	Annualized Capital Cost* ($ million/yr)	O&M Cost ($ million/yr)	Total Cost ($ million/yr)	Cost ($/1000 gal)
Boynton-Delray	12	$0.86	$0.17	$1.03	0.24
Boca Raton	8.6	$0.12	$0.02	$0.14	0.05
Broward/North	40.5	$0.94	$0.19	$1.13	0.08
Hollywood	39.2	$1.95	$0.40	$2.35	0.16
Miami-Dade/North	96.9	$3.10	$0.63	$3.74	0.11
Miami-Dade/Central	112	$41.21	$8.40	$49.60	1.21

Table 6-18. Shallow Injection Well Total Cost Equations for the Six Plants

Plant	Cost Equation ($million/yr)
Boynton-Delray	$0.1808*Q^{0.7}$
Boca Raton	$0.0317*Q^{0.7}$
Broward/North	$0.0846*Q^{0.7}$
Hollywood	$0.1799*Q^{0.7}$
Miami-Dade/North	$0.1520*Q^{0.7}$
Miami-Dade/Central	$1.8241*Q^{0.7}$

6.2.4 Reverse Osmosis Concentrate Disposal by Deep Well Injection

The procedure for estimating the concentrate costs from the reverse osmosis process for the WWTPs with ocean outfalls are described in this section. The concentrate construction costs include the costs for a conventional pump station that houses the pumps and drives and the costs for deep injection wells through which to dispose of the concentrate. It is assumed that the deep injection wells will be located at the plant sites and therefore no land costs were included. Injection wells are periodically taken out of service and tested to ensure their integrity. Accordingly, operation and maintenance costs include the costs for mechanical integrity testing of the wells. Testing procedures require a well to be out of service from 2 to 8 weeks, depending upon field conditions and status of the well (Hazen and Sawyer 1999).

The characteristics of the deep injection wells that would be required at the respective WWTPs are shown in Table 6-19. A criterion in the selection of the number of deep injection wells at each plant was to have sufficient capacity during non-peak events when one of the wells is out of service during the performance of mechanical integrity testing.

Table 6-19. Characteristics of the Deep Injection Wells for Concentrate Disposal

Plant	**Number of wells**	**AADF per well** (MGD)	**Diameter of wells** (inch)	**Capacity per well** (MGD)*
Boynton-Delray	2	1.5	12	4.6
Boca Raton	2	1.1	12	4.6
Broward/North	2	5.1	24	18.5
Hollywood	2	4.9	24	18.5
Miami-Dade/North	3	8.0	24	18.5
Miami-Dade/Central	3	9.3	24	18.5

* FDEP allows a peak hourly flow of 18.5 MGD to a 24 inch well (maximum velocity of 10 feet/sec)

The capital costs in 1998 dollars for the construction of a conventional pump station and one or two 24 inch deep injection wells were estimated as $11.1 million and $15.9 million, respectively according to the Hazen and Sawyer (1999) study. The engineering, legal, administrative and contingencies were assumed to be 20% of the construction costs. Based on this information, the construction costs were estimated at each plant and converted to 2005 dollars using the Engineering News Record Index.

Operation and maintenance costs in 2004 dollars were estimated from the Hazen and Sawyer (1992) reuse feasibility study. Mechanical integrity testing costs of four 16 inch wells were estimated as $0.12 million per year for the disposal system, assuming a full mechanical integrity test every 5 yrs and a partial test every 2.5 yrs. The amount needed for each well is therefore $30,000/year.

The total construction and operation and maintenance costs for each plant are summarized in Table 6-20. The annualized costs assuming a 7% discount rate over 20-year period are shown in Table 6-21. The annualized costs in $million/yr were scaled in relation to annual average daily flow using an expression having the form of Equation 6-6 (above). A cost scaling relationship is given for each system in Table 6-22.

Table 6-20. Summary Table for Deep Injection Well Costs

Plant	**AADF** (MGD)	**Construction Cost** ($ million)	**Capital Cost*** ($ million)	**O&M Cost** ($ million/yr)
Boynton-Delray	3	4.14	4.97	0.06
Boca Raton	2.1	4.14	4.97	0.06
Broward/North	10.1	16.57	19.89	0.06
Hollywood	9.7	16.57	19.89	0.06
Miami-Dade/North	24.1	21.58	25.89	0.09
Miami-Dade/Central	27.9	21.58	25.89	0.09

* 1.2 times the construction cost to account for engineering, legal, administrative and contingencies

Table 6-21. Annualized Deep Injection Well Costs

Plant	**AADF** (MGD)	**Annualized Capital Cost*** ($ million/yr)	**O&M Cost** ($ million/yr)	**Total Cost** ($ million/yr)	**Cost** ($/1000 gal)
Boynton-Delray	3	$0.47	$0.06	$0.53	0.49
Boca Raton	2.1	$0.47	$0.06	$0.53	0.69
Broward/North	10.1	$1.88	$0.06	$1.94	0.53
Hollywood	9.7	$1.88	$0.06	$1.94	0.55
Miami-Dade/North	24.1	$2.44	$0.09	$2.54	0.29
Miami-Dade/Central	27.9	$2.44	$0.09	$2.54	0.25

Table 6-22. Deep Injection Well Total Cost Equations for the Six Plants

Plant	**Cost equation** ($million/yr)
Boynton-Delray	$0.2465*Q^{0.7}$
Boca Raton	$0.3164*Q^{0.7}$
Broward/North	$0.3844*Q^{0.7}$
Hollywood	$0.3954*Q^{0.7}$
Miami-Dade/North	$0.2736*Q^{0.7}$
Miami-Dade/Central	$0.2469*Q^{0.7}$

6.4 Case Study of the Broward/North Wastewater Treatment Plant

A case study was performed on the Broward/North Wastewater Treatment Plant. Excellent cost estimation data was available for this service area as Hazen and Sawyer (2004) had conducted a feasibility study on this plant. In addition, this study identified large users that are compatible for traditional water reuse.

As mentioned before, this report differs when naming different levels of reuse in order to provide more data points to examine. Six different traditional reuse levels were examined in this report, including the "Status Quo," "Low," "Medium," and "Large" options. The

"Medium" alternative was subsequently broken up into smaller subgroups to show the effect that distance away from the wastewater treatment plant has in determining when an option become less cost effective. The "Status Quo" alternative is the current level of traditional water reuse being provided in the service area, which is approximately 4.5 MGD. The "Low" alternative takes the plant to near capacity at 9.34 MGD. The "Medium" alternative includes the addition of several large users determined by Hazen and Sawyer (2004), situated throughout the service area. The "Medium Reuse: Large Users North" includes large users that are situated to the north of the treatment plant, and takes the demand flow past the current capacity to 11.34 MGD. The "Medium Reuse: Large Users" option includes all of the large users identified by Hazen and Sawyer (2004) as suitable for traditional water reuse. The demand for this alternative is 19.31 MGD. The "Medium Reuse: Additional Large Users" alternative is an additional point to show a higher demand of traditional water reuse. This point includes all large users identified in the Hazen and Sawyer report, but shows a higher demand flow to account for users not identified but feasible for traditional water reuse as determined from Consumptive Use Permit data. Finally the "Large Reuse" option includes just the large users identified in Hazen and Sawyer (2004) along with a group of residential users that are in close proximity to the traditional reuse network setup. This takes the demand to 41.98 MGD. The different traditional reuse levels and their corresponding flows can be seen in Table 6-23.

Table 6-23. Traditional Reuse Flow Levels with Corresponding Flow Demands for Broward/North Reuse District

Description	Flow Demanded (MGD)
Status Quo	4.46
Low	9.34
Medium Reuse: Large Users North	11.34
Medium Reuse:Large Users	19.31
Medium Reuse:Addl Large Users	30.00
Large Reuse	41.98

The names of the large users and their traditional reuse level are presented in Table 6-24. The locations of these users can be seen in Figure 6-2 with an approximate location of the traditional reuse network. The Broward/North WWTP is located at the intersection of Copans Road and Powerline Road. The large Consumptive User Permit users constitute nearly 18% of the area within 12 miles of the WWTP. Thus, many opportunities exist for traditional water reuse.

Table 6-24. Large Users in Broward/North Reuse District

Status Quo	**Medium Reuse: Large Users**
NRWWTP On-site	Tradewinds Park
WES	Wynmoor Golf Course
Pompano Commerce Park	Palm Aire
Low	Pompano Race Track
NRWWTP On-site	Oriole Golf Course
WES	Palm Lakes Executive Golf Club
Pompano Commerce	Carolina Golf Club
Tam O'Shanter Golf Club	Brokenwoods (Continental) Golf Club
Crystal Lake Country Club	Mullins Park
Medium Reuse: Large Users North	Coral Springs Golf Club
Adios Golf Club	Coral Springs Cypress Park
Quiet Waters Park	Eagle Trace Golf Club
Deer Creek Golf Course	Woodmont Golf Club
Century Village Golf Club	Colony West Golf Club

The irrigation demand data from the Hazen and Sawyer (2004) feasibility study are based on an average annual demand of 1.5 inches per week. This application rate differs from the allocated flow in the Consumptive Use Permit data, but for the case study, the Hazen and Sawyer (2004) estimates were used. These flows will be compared to the flows from the permit data for the Broward/North Regional to show that the flows obtained are comparable and can be extrapolated to the other five ocean outfall regions.

Treatment and pumping costs are shown in Table 6-25 and were estimated using methods discussed before. The "Status Quo" and "Low" alternatives show no additional cost because the treatment plant can process the demand flow.

Storage costs, shown in Table 6-26, were estimated by the power function for the medium and large alternatives, as discussed previously. The "Low" alternative used a value found from Hazen and Sawyer (2004). The required volume of the storage tanks for the remaining alternatives was based on 40% of the daily demand. The "Low" scenario assumes that storage is handled on-site and therefore no booster stations or land costs were calculated for this option. The tanks required for the "Medium" and "Large" options take into account that the treatment plant can handle the flow that it currently processes. Also for the "Medium" and "Large" scenarios, no additional storage construction was assumed at the treatment plant as in the "Low" alternative. Instead, these storage tanks with booster stations are to be distributed throughout the service area.

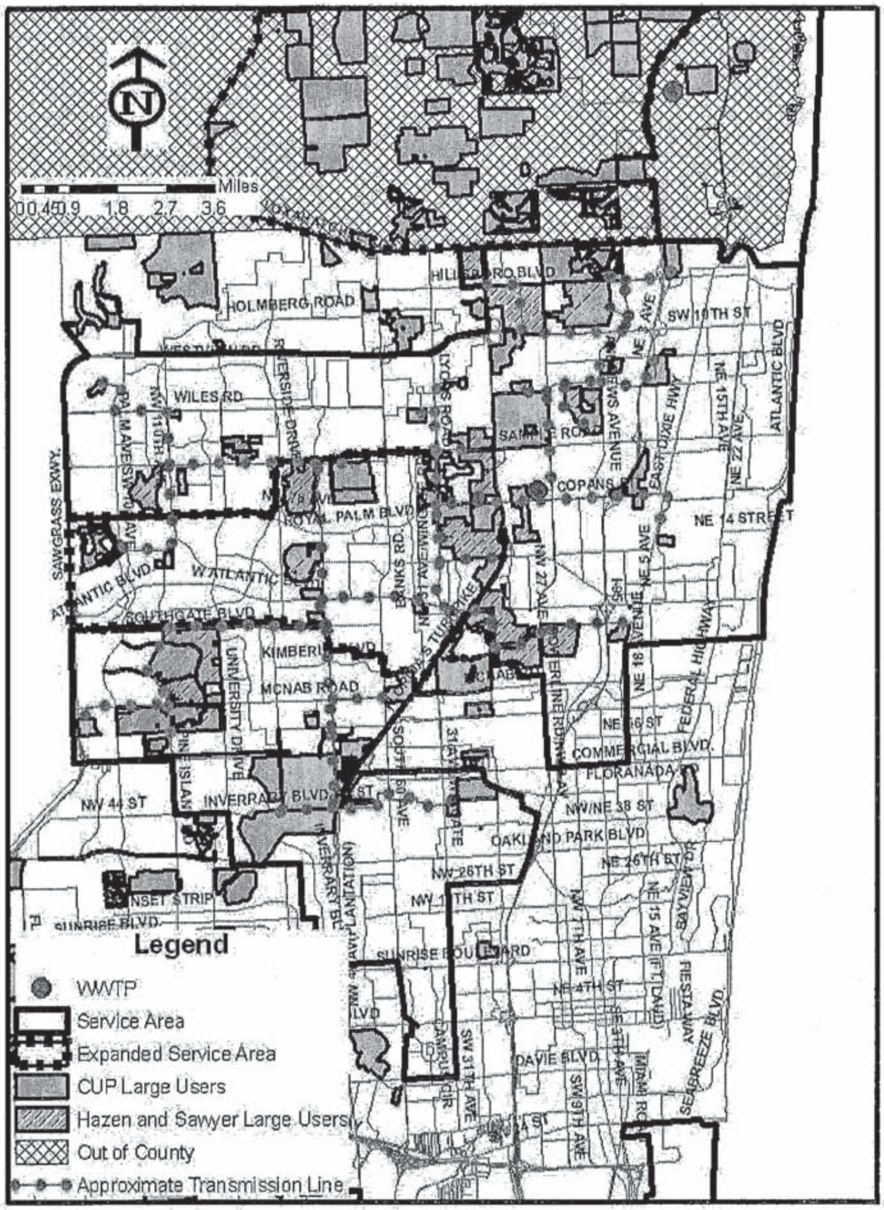

Figure 6-2. Broward/North Large Users and Transmission Line

Table 6-25. Treatment and Pumping Costs for Various Levels of Reuse

Description	Reclaimed Water Treatment	Process Equipment	Auxiliary Equipment	Pumps
Status Quo	$0	$0	$0	$0
Low	$0	$0	$0	$0
Medium Reuse: Large Users North	$1,105,500	$294,800	$73,700	$2,781,655
Medium Reuse:Large Users	$7,680,750	$2,048,200	$512,050	$4,037,585
Medium Reuse:Addl Large Users	$16,500,000	$4,400,000	$1,100,000	$5,496,155
Large Reuse	$26,383,500	$7,035,600	$1,758,900	$6,953,506

Table 6-26. Storage and Land Costs

Description	Storage	Tanks Reqd	Reuse and Booster Pump	Land
Status Quo	$0	0	$0	$0
Low	$1,250,000	0	$0	$0
Medium Reuse: Large Users North	$11,431,458	2	$1,500,000	$370,790
Medium Reuse:Large Users	$16,592,816	3	$2,250,000	$556,186
Medium Reuse:Addl Large Users	$22,586,939	5	$3,750,000	$926,976
Large Reuse	$28,576,050	6	$4,500,000	$1,112,371

Transmission costs are estimated based on the approximate location of the distribution network shown in Figure 6-2 (above). The values for the "Low," "Medium Reuse: Large Users North," and "Large Reuse" were calculated in Hazen and Sawyer (2004). A total of 55,000 residential users were used in the "Large Reuse" category, with an estimated cost of $4,800 per connection used (Hazen and Sawyer 2004). This price includes fifty feet of distribution pipe, a meter, and a dual check valve. The "Medium Reuse: Large Users" and the "Medium Reuse: Additional Large Users" options had the pipes downsized to account for the absence of residential flow. In completing this calculation, a velocity of five feet per second was assumed. These costs, along with the engineering, permitting, and administration costs, can be seen in Table 6-27. These added costs were estimated as 25% of all of the capital costs, not including land.

Table 6-27. Transmission and Engineering Costs

Description	Transmission and Distribution Cost	Engineering, Permitting, and Administration
Status Quo	$0	$0
Low	$1,231,500	$620,375
Medium Reuse: Large Users North	$9,419,866	$6,651,745
Medium Reuse:Large Users	$44,351,236	$19,368,159
Medium Reuse:Addl Large Users	$76,764,865	$32,649,490
Large Reuse	$349,886,170	$106,273,431

Finally, annual operation and maintenance costs were separated into five-year blocks and estimated as described previously. The values, seen in Table 6-28, were then brought back to a present value, which is 2004 dollars, using a discount rate of 7%.

Table 6-28. Annual Operation and Maintenance Costs

Description	O&M				
	1-5 years	6-10 years	11-15 years	16-20 years	PV @ i=7.0%
Status Quo	$284,883	$341,859	$396,556	$452,074	$3,665,843
Low	$596,593	$715,911	$830,457	$946,721	$7,676,900
Medium Reuse: Large Users North	$889,907	$1,067,888	$1,238,750	$1,412,175	$11,451,238
Medium Reuse:Large Users	$1,515,352	$1,818,423	$2,109,370	$2,404,682	$19,499,419
Medium Reuse:Addl Large Users	$2,354,250	$2,825,100	$3,277,116	$3,735,912	$30,294,282
Large Reuse	$3,294,381	$3,953,257	$4,585,778	$5,227,787	$42,391,798

All costs in 2004 dollars are added, and are converted to 2005 dollars using the Engineering News Record index. The present worth over the twenty-year period is calculated using a 7% discount rate in Table 6-29 and can then be converted to a daily cost and plotted against flow in thousands of gallons per day.

Table 6-29. Present Value and Equivalent Uniform Annual Costs

Description	Q (kgd)	Total Cost (2004$)	Total Cost (2005$)	Annual Costs, i=7.0%, N=20	Daily Cost
Status Quo	4,460	$3,665,843	$3,815,259	$360,133	$987
Low	9,340	$10,778,775	$11,218,106	$1,058,910	$2,901
Medium Reuse: Large Users North	11,340	$45,080,753	$46,918,197	$4,428,746	$12,134
Medium Reuse:Large Users	19,310	$116,896,401	$121,660,977	$11,483,936	$31,463
Medium Reuse:Addl Large Users	30,000	$194,468,706	$202,395,049	$19,104,661	$52,342
Large Reuse	41,980	$574,871,327	$598,302,484	$56,475,522	$154,727

The resulting graph, shown as Figure 6-3, has an excellent coefficient of determination (R^2) when a power function is fit to the data. The cost function was also plotted using the same users identified in the Hazen and Sawyer (2004) report, but with flows obtained from Consumptive Use Permit data. As mentioned before, the difference between the two data sets does not result in a large difference when calculating marginal costs.

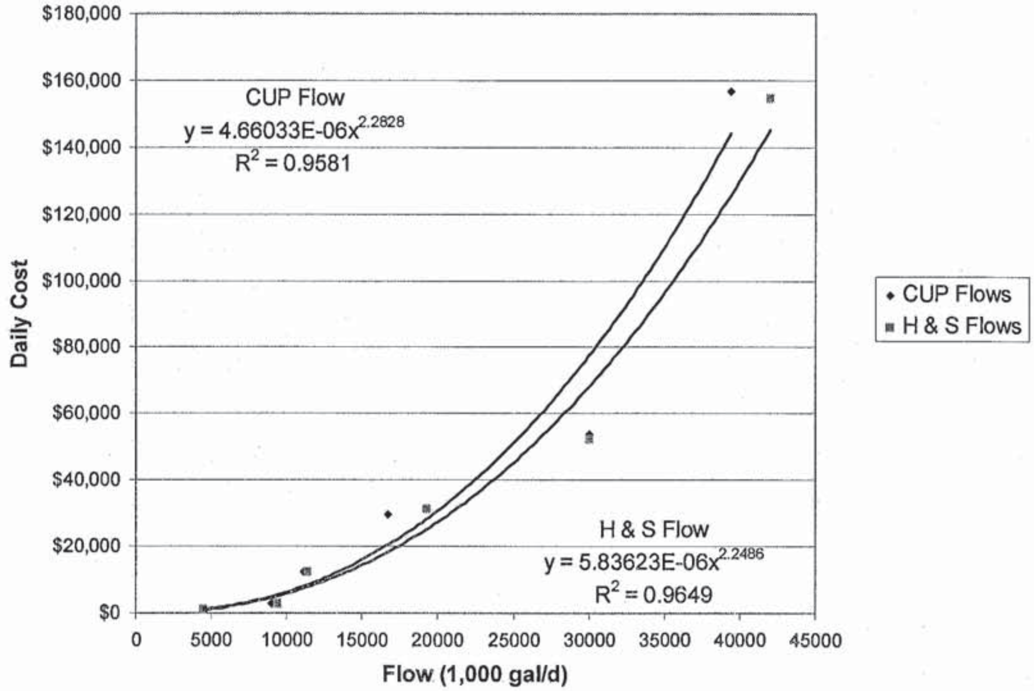

Figure 6-3. Daily Cost versus Flow

The resulting power function for the Hazen and Sawyer data was found to be:

$$C = .00000583623Q^{2.24859} \tag{6-7}$$

where C equals total daily costs and Q equals flow in thousand gallons per day.

The derivative of this total cost function gives the marginal cost curve, as seen in Equation 6-8.

$$MC = ab*Q^{b-1} \tag{6-8}$$

Using the parameters from the total cost function, i.e., a = 5.83623 E-06 and b = 2.24859, the equation for the marginal cost is

$$MC = 1.29901\ E\text{-}05*Q^{1.24859} \tag{6-9}$$

where MC = marginal cost, \$/1,000 gallons, and Q = demand in 1,000 gal/day.

In economics parlance, the marginal cost curve is the supply curve. Customers who decrease irrigation demand on the central water system save an estimated \$4.04 per 1,000 gallons in 2002 dollars, or \$4.58 in 2005 dollars. Thus, the optimal amount of water reuse to provide in this case is about 26.5 MGD as shown in Figure 6-4. If user savings are \$2.00 per 1,000 gallons, then the optimal amount is about 14 MGD. Similarly, if the user savings are \$6.00 per 1,000 gallons, then the optimal amount of reuse is about 34 MGD. The use of intermediate data points allows these total and marginal cost curves to be generated more accurately.

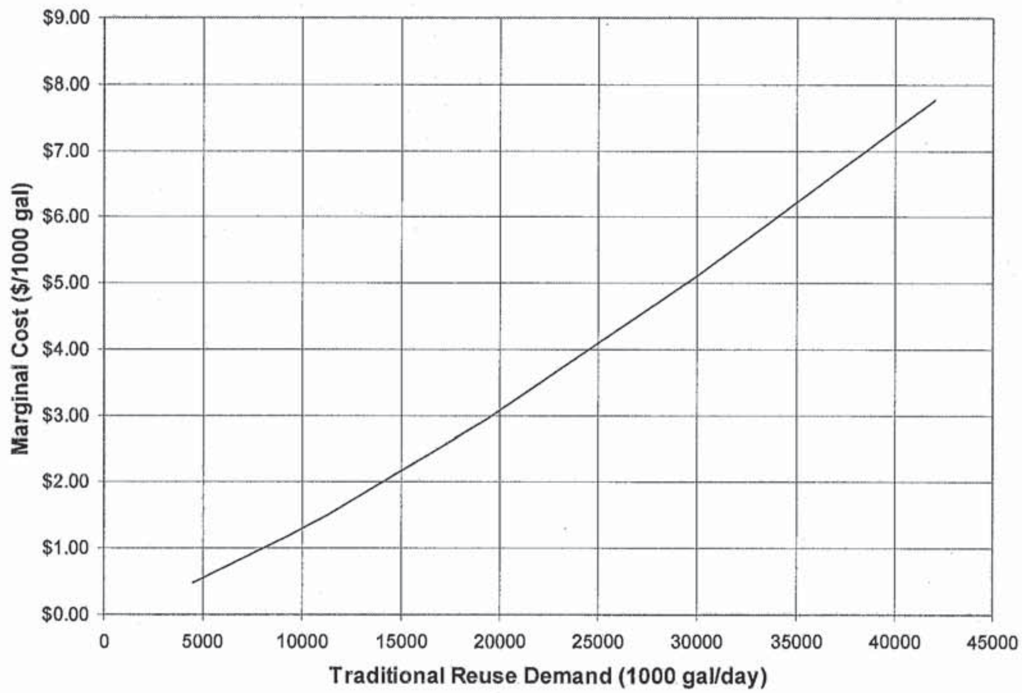

Figure 6-4. Marginal Cost of Providing Water Reuse.

Another, and equivalent, way to evaluate the benefits and costs is to look at total values. The total daily benefits and costs are presented in Table 6-30. If total values are used, then the objective function is to maximize total benefits minus total costs. If the value of water reuse is \$4.58/1,000 gallons, then the total benefits of reuse exceed the total costs over the entire range of flows. However, the best solution is where net benefits are maximized. For the indicated data, this occurs at 30 MGD. Using the fitted equation, as was done for the marginal cost analysis, the actual optimal amount turns out to be 26.2 MGD.

However, public utilities typically seek to break even rather than maximizing net revenues, that is, the daily benefits equaling the daily costs. As evident in Table 6-30, additional traditional reuse flow can be added until this situation occurs. Daily costs and daily benefits are plotted as a function of flow in Figure 6-5. If the two regression lines are set equal to one another, the total flow to satisfy a break-even condition is 52.6 MGD. This value should be used with caution, however. If additional residential users are added to achieve this flow, the costs will exceed the benefits before 52.6 MGD as the transmission costs increase greatly for residential use.

Table 6-30. Cost Savings

Description	Flow Demanded (MGD)	Potable Water Cost (2002$/1000gal)	Daily Benefits (2002$/day)	Daily Benefits (2005$/day)	Daily Benefits - Daily Costs ($/day)
Status Quo	4.46	$4.04	$18,018	$20,408	$19,421
Low	9.34	$4.04	$37,734	$42,737	$39,836
Medium Reuse: Large Users North	11.34	$4.04	$45,814	$51,889	$39,755
Medium Reuse:Large Users	19.31	$4.04	$78,012	$88,358	$56,895
Medium Reuse:Addl Large Users	30.00	$4.04	$121,200	$137,272	$84,931
Large Reuse	41.98	$4.04	$169,599	$192,090	$37,362

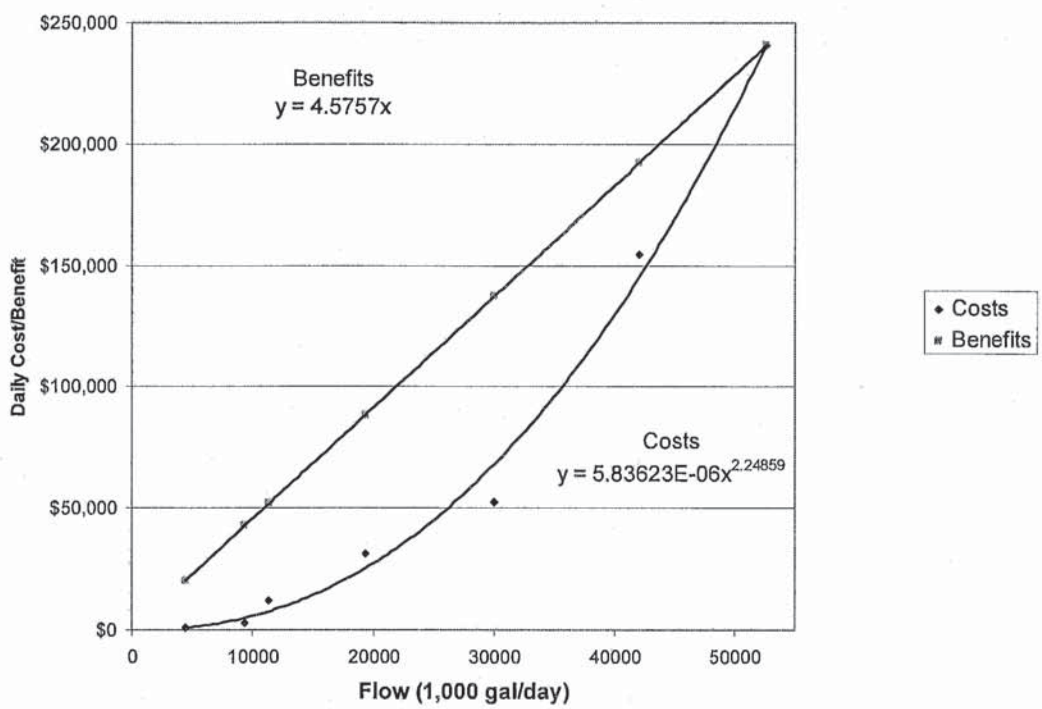

Figure 6-5. Daily Costs and Daily Benefits as a Function of Flow

It was mentioned before that the flows in the Hazen and Sawyer (2004) report were based on an irrigation rate of 1.5 inches per week using the irrigable acres for each of the large users. However, the flow values extracted for use in the other five regions used daily allocation values given in the Consumptive Use Permit data, as discussed earlier. It was discussed how this difference in flow values does not affect marginal cost; however Consumptive Use

Permit data also indicate more large users in the Broward/North Regional environs. In spite of this fact, by comparing the maps in Figure 5-5 and Figure 6-2 (both above), the golf courses and landscaped areas considered to be large users by the new designation are located close to the large users already identified by Hazen and Sawyer. Therefore they can be easily served by the traditional reuse distribution network setup for this case study and will not affect marginal cost values greatly with greater transmission lengths.

By looking at the analysis thus far, it can be seen that transmission costs, and therefore, distance away from the wastewater treatment plant plays a vital role in determining if a user should be considered for reuse. The users and demanded flow determined by Hazen and Sawyer (2004) are spread throughout the Broward/North Regional. However, at $2.95 per thousand gallons to provide traditional water reuse, it is considered quite attractive in spite of the distance from the wastewater treatment plant. It can also be seen from Figure 6-2 that while some users may be at larger distances from the wastewater treatment plant, they tend to be grouped together.

An analysis was conducted on one such group to the north of the Broward/North WWTP in Broward County to determine the effect of distance on marginal costs. Flow data from Consumptive Use Permits, with the exception of on-site use for the treatment plant, WES, and Quiet Waters Park, were employed for the twelve users in this group, as described in Table 6-31.

Table 6-31. Large Users to the North of the Broward/North WWTP

Large User	Flow, MGD
NRWWTP (ON-SITE)	5.390
CENTRAL SANITARY LANDFILL AND RECYCLING CENTER	0.078
WES	2.300
CRYSTAL LAKE COUNTRY CLUB/TAM O'SHANTER GOLF CLUB	0.682
HIGHLAND VILLAGE MOBILE PARK	0.064
DEERFIELD BEACH HIGH SCHOOL	0.050
MEADOWS OF CRYSTAL LAKE	0.055
CENTURY VILLAGE EAST	1.504
DEER CREEK COUNTRY CLUB COMMUNITY	0.316
DEER CREEK GOLF COURSE	0.439
DEERFIELD COUNTRY CLUB	0.224
THE WATERWAYS	0.412
QUIET WATERS PARK	0.330
ADIOS GOLF CLUB	0.242

Estimating the costs of these users was carried out in the same way as the overall cost estimation. The cost was estimated to provide traditional water reuse to one user, and then expanded by adding additional users until all twelve were served to see the effect of adding to the distribution network. The length of the transmission lines was estimated using Figure 6-2 and sized by dividing the demand by an assumed velocity of five feet per second. The costs of the transmission lines were estimated assuming paved construction only. The expansion of the traditional reuse distribution network along with present value costs and annual costs can be seen in Table 6-32. The flows shown in this table are the cumulative total flows and the large users are arranged in increasing distances from the Broward/North Wastewater Treatment Plant.

Table 6-32. Present and Annual Costs for Large Users North of Wastewater Treatment Plant

From Node (i)	To Node (j)	Distance (mi)	Flow Demanded (MGD)	Total Cost (2005$)	Annual Worth, i=7.0%, N=20
NRWWTP	NRWWTP (ON-SITE)	0.000	5.390	$4,610,817	$435,229
NRWWTP	CENTRAL SANITARY LANDFILL AND RECYCLING	1.412	5.468	$14,330,881	$1,352,734
NRWWTP	WES	2.501	7.768	$20,634,402	$1,947,742
NRWWTP	CRYSTAL LAKE COUNTRY CLUB/TAM O'SHANTER	3.560	8.450	$23,344,288	$2,203,536
NRWWTP	MEADOWS OF CRYSTAL LAKE	4.586	8.506	$23,975,514	$2,263,119
NRWWTP	HIGHLAND VILLAGE MOBILE PARK	5.717	8.570	$24,677,764	$2,329,406
NRWWTP	DEERFIELD BEACH HIGH SCHOOL	6.343	8.620	$25,092,357	$2,368,541
NRWWTP	CENTURY VILLAGE EAST	7.907	10.124	$34,708,050	$3,276,194
NRWWTP	DEER CREEK COUNTRY CLUB COMMUNITY	8.874	10.441	$36,798,925	$3,473,558
NRWWTP	DEER CREEK GOLF COURSE	9.036	10.880	$39,732,984	$3,750,513
NRWWTP	DEERFIELD COUNTRY CLUB	10.027	11.104	$41,608,800	$3,927,576
NRWWTP	THE WATERWAYS	12.023	11.517	$44,451,327	$4,195,891
NRWWTP	QUIET WATERS PARK	12.473	11.847	$46,153,783	$4,356,591
NRWWTP	ADIOS GOLF CLUB	13.934	12.088	$47,730,422	$4,505,414

A total cost function can again be plotted using daily cost versus flow in thousands of gallons per day as shown in Figure 6-6.

The power function fit to this equation is shown in Equation 6-10.

$$C = 0.0000108498 Q^{2.22477} \qquad (6\text{-}10)$$

The marginal costs for each expanded segment of the distribution network can be calculated by taking the derivative of this total cost function. The resulting marginal cost equation is Equation 6-11.

$$MC = 0.000024138 Q^{1.22477} \qquad (6\text{-}11)$$

The marginal costs at the various distances are shown in Table 6-33. They range from $0.90/1,000 gallons to $2.41/1,000 gallons at a distance of 13.9 miles. Distances are measured using the metropolitan metric to more accurately represent that pipelines would follow north-south, east-west pathways. Marginal costs increase with metropolitan distance from the wastewater treatment plant. However, due to the density of large users in this area, there are certain places where marginal cost remains relatively constant as distance increases. The large user is considered more attractive to serve if other large users that can share the cost of expanding the plant's traditional water reuse capacity surround it.

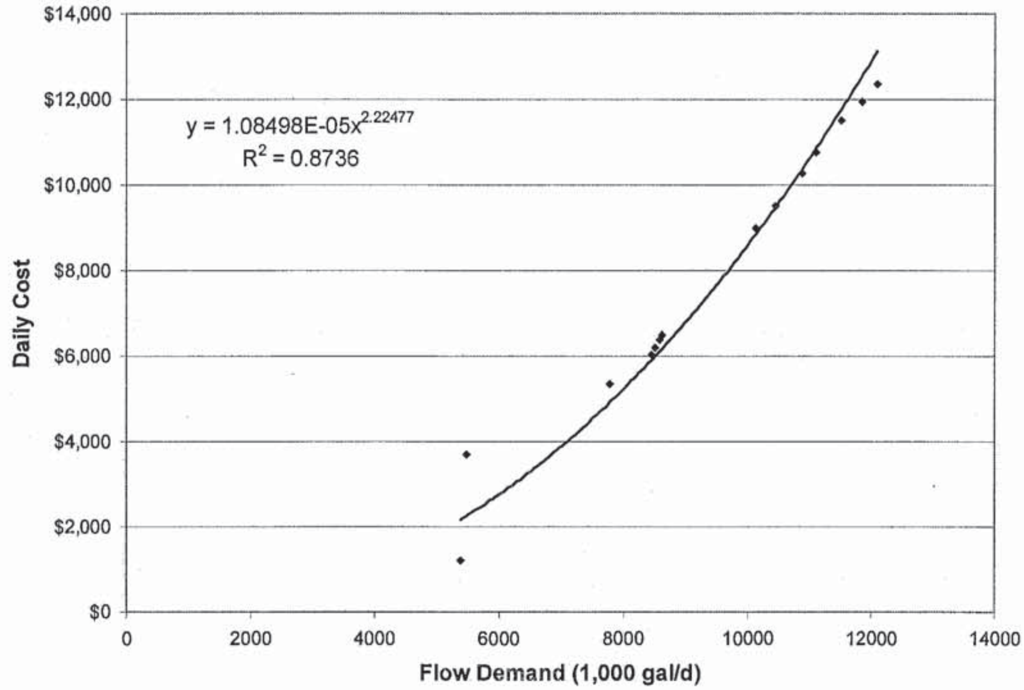

Figure 6-6. Total Cost Function for Users to North of Wastewater Treatment Plant

Table 6-33. Marginal Costs for Large Users North of Wastewater Treatment Plant

From Node (i)	To Node (j)	Distance (mi)	Flow Demanded (MGD)	Marginal $/k gal
NRWWTP	NRWWTP (ON-SITE)	0.000	5.390	$0.90
NRWWTP	CENTRAL SANITARY LANDFILL AND RECYCLING	1.412	5.468	$0.91
NRWWTP	WES	2.501	7.768	$1.40
NRWWTP	CRYSTAL LAKE COUNTRY CLUB/TAM O'SHANTER	3.560	8.450	$1.56
NRWWTP	MEADOWS OF CRYSTAL LAKE	4.586	8.506	$1.57
NRWWTP	HIGHLAND VILLAGE MOBILE PARK	5.717	8.570	$1.58
NRWWTP	DEERFIELD BEACH HIGH SCHOOL	6.343	8.620	$1.60
NRWWTP	CENTURY VILLAGE EAST	7.907	10.124	$1.94
NRWWTP	DEER CREEK COUNTRY CLUB COMMUNITY	8.874	10.441	$2.02
NRWWTP	DEER CREEK GOLF COURSE	9.036	10.880	$2.12
NRWWTP	DEERFIELD COUNTRY CLUB	10.027	11.104	$2.18
NRWWTP	THE WATERWAYS	12.023	11.517	$2.27
NRWWTP	QUIET WATERS PARK	12.473	11.847	$2.35
NRWWTP	ADIOS GOLF CLUB	13.934	12.088	$2.41

6.5 Developing Consumptive Use Permit Flows

The total cost function shown in Figure 6-6 (above) shows that the demand flows for traditional water reuse from Hazen and Sawyer (2004) compare well to the daily allocation values found in the Consumptive Use Permit data. Therefore, it is possible to extrapolate the Consumptive Use Permit data to all six wastewater treatment plants with ocean outfalls. This will permit an evaluation to how much wastewater can be allocated to traditional reuse, thereby reducing the flow discharged to the ocean. The methods discussed in Chapter 5 using Consumptive Use Permit flow data are also used in this evaluation.

Golf courses and landscaped areas within the urban areas of Palm Beach, Broward, and Miami-Dade Counties are summarized in Table 6-34. The first row shows the urbanized area of these counties, as approximated using GIS software. Broward County has the largest area of 386 square miles. The total urbanized area for the three counties is 962 square miles. The number of golf courses with Consumptive Use Permits varies widely, ranging from 98 for Palm Beach County to 26 for Miami-Dade County, and totals 164 among the three counties. Water use per golf course is fairly consistent across the three service areas, averaging 0.47 MGD. The total water demand for golf courses is 77.5 MGD, with Palm Beach County accounting for 47.9 MGD of this total. The 396 landscape large users have a total demand of 70.2 MGD, with an average demand of about 0.18 MGD per user. Palm Beach and Broward Counties account for 35.4 and 30.4 MGD, respectively, of this amount. The total demand for all large users is 148 MGD. Palm Beach County accounts for 83.3 MGD of this total. Broward County has a total large user demand of 49.3 MGD and Miami-Dade has a total large user demand of 15 MGD. These totals indicate that the more promising areas for traditional reuse are Palm Beach and Broward Counties.

Table 6-34. Summary of Urban Users

Attribute	Palm Beach	Broward	Miami-Dade	Total
Approximate Urban Area, sq. mi.	268	386	308	962
Golf Users	98	40	26	164
Golf Demand, MGD	47.949	18.920	10.615	77.484
Golf MGD per course	0.489	0.473	0.408	0.472
Landscape Users	228	140	28	396
Landscape Demand, MGD	35.377	30.423	4.373	70.173
Landscape MGD per user	0.155	0.217	0.156	0.177
Total Users	326	180	54	560
Total Demand, MGD	83.326	49.343	14.988	147.657
Average Irrigation Rate, in/yr	6.537	2.685	1.022	3.225

Traditional reuse flow for each of the six wastewater treatment plants with ocean outfalls is summarized in Table 6-35. The service areas of each wastewater treatment plant as described by their individual consultant reports are reported in the first line. The second portion of each section shows the number of large users as described earlier within each of the six service areas. The service areas for the Broward/North WWTP in Broward County and the Boynton-Delray WWTP in Delray Beach include the greatest amount of large users.

Table 6-35. Summary of Traditional Reuse Demands

Broward/North			Boynton-Delray			Miami-Dade/North		
Approx Area	28	mi^2	Approx Area	46	mi^2	Approx Area	128.95	mi^2
Service Area			**Service Area**			**Service Area**		
Large Users	47		Large Users	40		Large Users	16	
Flow Demand	17.0	MGD	Flow Demand	9.1	MGD	Flow Demand	4.5	MGD
Expanded Service Area			**Expanded Service Area**			**Expanded Service Area**		
Large Users	53		Large Users	90		Large Users	16	
Flow Demand	18.8	MGD	Flow Demand	22.1	MGD	Flow Demand	4.5	MGD
Feasible Users			**Feasible Users**			**Feasible Users**		
Large Users	53		Large Users	90		Large Users	10	
Flow Demand	18.8	MGD	Flow Demand	22.1	MGD	Flow Demand	3.6	MGD
Hollywood			Boca Raton			Miami-Dade/Central		
Approx Area	46.66	mi^2	Approx Area	14.3	mi^2	Approx Area	253.35	mi^2
Service Area			**Service Area**			**Service Area**		
Large Users	26		Large Users	6		Large Users	17	
Flow Demand	4.8	MGD	Flow Demand	1.8	MGD	Flow Demand	5.5	MGD
Expanded Service Area			**Expanded Service Area**			**Expanded Service Area**		
Large Users	34		Large Users	47		Large Users	17	
Flow Demand	7.6	MGD	Flow Demand	17.7	MGD	Flow Demand	5.5	MGD
Feasible Users			**Feasible Users**			**Feasible Users**		
Large Users	17		Large Users	47		Large Users	9	
Flow Demand	3.2	MGD	Flow Demand	17.7	MGD	Flow Demand	2.9	MGD

The next grouping gives the number of large users and reclaimed water demand for the expanded service areas. The two service areas within Palm Beach County have the greatest potential to provide traditional water reuse by expansion. The Boynton-Delray WWTP could add a possible 50 users by expanding its service area, followed by the Boca Raton WWTP with a potential of 41 additional users. The two plants in Broward County are surrounded by other wastewater treatment plants and therefore have lesser potential. The Miami-Dade/North and Miami-Dade/Central WWTPs have no potential as their combined service area encompasses all Consumptive Use Permit holders.

Finally, the last set of values show the demand for users that were considered feasible for traditional water reuse service. This set of values takes into account large users within the defined service areas of the plants as well as the expanded service areas. In order to determine whether these users would be feasible to serve, the case study for the Broward/North WWTP was used. The case study determined that the flows demanded by large users could be met throughout the 28 square mile service area. Transmission costs are a key factor in determining whether it is feasible to serve a large user, as determined by an analysis completed on a group of large users to the north of the treatment plant. The largest distance from a large user to the Broward/North WWTP was twelve miles.

Additionally, cumulative daily demand was plotted against distance from the wastewater treatment plant for all six reuse districts, as originally shown in Chapter 5 (Fig. 5-7). As mentioned before, the Boynton-Delray, Boca Raton, and Broward/North WWTPs exhibit high flow per mile values. In addition, all of the large users could be reached with a transmission line that was less than twelve miles in length. Therefore, all of the large users identified in these service areas were determined to be feasible for traditional water reuse. Several large users in the remaining three reuse districts went beyond twelve miles, as seen in Figure 6-7. Therefore, the highest flow per mile value was found near this twelve-mile mark, and the users outside this mark were considered infeasible and therefore were excluded.

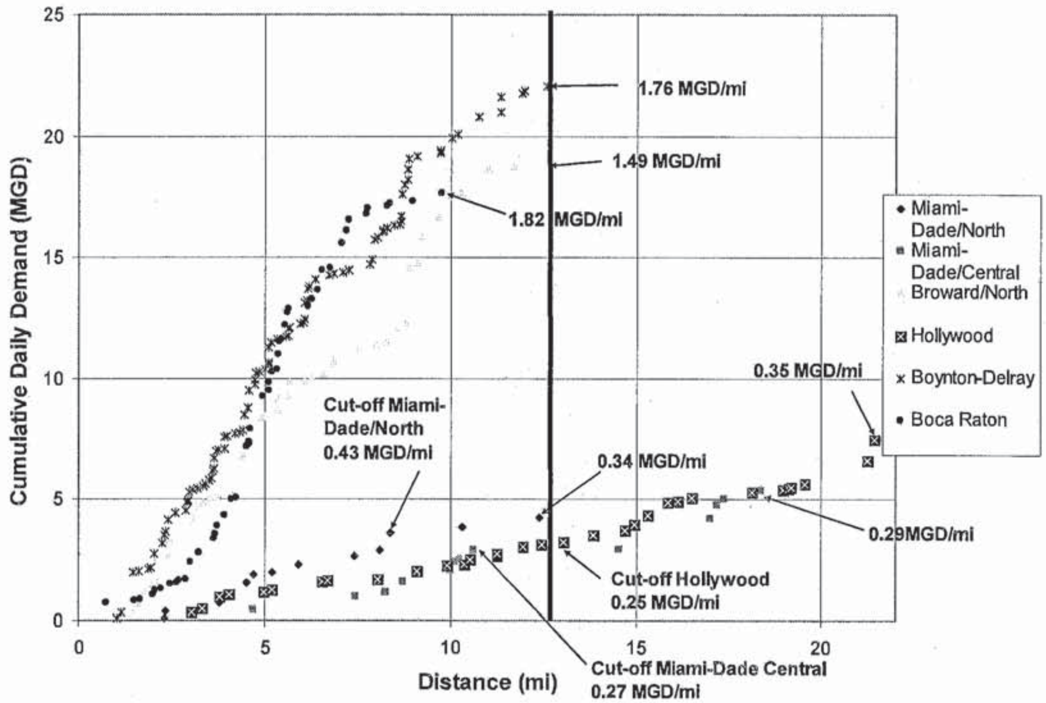

Figure 6-7. Cumulative Daily Demand versus Metropolitan Distance from Wastewater Treatment Plant

The twelve-mile cut-off is based on the marginal cost curve of Figure 6-4 for the Broward/North WWTP. The case study found that the benefits of using traditional water reuse were $4.58 per thousand gallons. If the benefits of using traditional water reuse are higher, as is the case in other counties, the optimal amount of flow would be greater, and the twelve-mile cut-off would be extended.

As evident in Table 6-35, there are large users with potential demand for traditional water reuse that are not feasible to serve from the central plant. The use of satellite treatment facilities could make it feasible to serve these users and the greatest potential lies in the Hollywood, Miami-Dade/North, and Miami-Dade/Central reuse districts. As discussed in Chapter 5, previous experience shows that satellite plants are capable of producing 0.01-35 MGD of reclaimed water with reasonable distribution costs. There is a potential traditional water reuse demand of 4.4 MGD (17 large users), 0.9 MGD (6 large users), and 2.6 MGD (8 large users) in the Hollywood, Miami-Dade/North, and Miami-Dade/Central reuse districts, respectively. Additionally, these large users tend to be grouped together spatially as the longest distance between two large users is less than 10 miles (using the metropolitan distance). Adding to the potential for satellite plants is the possible inclusion of industrial users. As mentioned in Chapter 5, there is industrial user demand in all six reuse districts, although it is mainly concentrated in the Miami-Dade/Central district. Consumptive Use Permit data indicate a total industrial water demand of approximately 27.5 MGD within the Miami-Dade Central reuse district, of which 15.4 MGD is located outside the twelve mile feasibility limit. If a further analysis is conducted in order to evaluate the needs of these large industrial users, the traditional water reuse demand could increase dramatically through the utilization of satellite plants in the Miami-Dade/Central reuse district.

6.6 Summary

This chapter was able to produce cost estimating strategies for groundwater recharge and traditional water reuse, which are two major alternatives to disposing effluent through ocean outfalls. As the data shows, the costs are dependent on the size of the system needed based on flow values and transmission requirements.

The case study in Section 6.4 shows that the large users selected in Chapter 5 can be served in a cost effective manner as the benefits of using a reuse water system minus the costs is at a maximum under that scenario. The introduction of residential users still allows for a breakeven situation, but was proven to not be as effective as the large user only scenario. A further step would be to use a select number of residential users identified by the Hazen and Sawyer (2004) report to find a proportion that does maximize benefits minus costs. An overall optimization problem on all six reuse districts can also be prepared to determine how the reuse network should be setup to maximize cost effectiveness.

The use of satellite plants has a potential to add traditional water reuse demand for the Hollywood, Miami-Dade/North, and Miami-Dade/Central reuse districts. All large users that were deemed infeasible due to their large distance from the central plants are within ten miles (metropolitan distance) of each other in the three districts. A properly placed satellite plant would provide additional water reuse while keeping the costs of distribution at a minimum.

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7. Wastewater Management Options for Alternative Ocean Outfall Strategies

7.1 Alternative Ocean Outfall Strategies

Four alternative ocean outfall strategies were examined under the defined scope of this study. Under the Currently Planned Use alternative (Alt I), ocean outfalls would be used at currently planned levels. Under the Limited Use Alternative (Alt II), ocean outfall disposal would be limited to flows remaining after traditional reuse options were maximized and underground injection flows reached full 2005 permitted capacity. Under the Ocean Outfalls as Backups alternative (Alt III), ocean disposal would only be used during wet weather periods to handle flow that would otherwise go to traditional reuse. Complete elimination of ocean outfalls was considered under the No Use alternative (Alt IV). Florida's 1.2 BGD reuse capacity clearly indicates that reuse is feasible within Florida and that state statutes (403.064 and 373.250, F.S.) encourage and promote water reuse. Therefore, it is assumed that unaccounted for flows will be directed to reuse in alternatives that involve some level of curtailment of ocean outfalls.

The assumption was made that permitted capacities of the ocean outfalls would be maintained at 2005 levels and that no additional ocean outfalls would be permitted. It was also assumed that Class I injection control wells for effluent disposal would be held at 2005 permitted capacities and, furthermore, that Class I injection wells for effluent disposal that were in testing or under construction during 2005 would not receive permits.

7.2 Priorities for Allocating Effluent and Reclaimed Water Flows

Four options for wastewater management in Southeast Florida were considered in this study: disposal of treated effluent through ocean outfalls, disposal of treated effluent through Class I injection wells, traditional reuse of reclaimed water, and groundwater recharge of reclaimed water. Groundwater can be recharged through surface spreading, vadose zone injection wells or direct injection of reclaimed water (CDM 2004). Canals in Southeast Florida can be used to recharge groundwater with reclaimed water. The present study examines only the direct injection method for groundwater recharge. A canal recharge option is being evaluated in another study that is still in progress. The surface water quality constraints on canal recharge may require similar treatment levels to those required for direct injection of reclaimed water.

In consideration of the above criteria, effluent and reclaimed water flows in the four ocean outfall alternatives were allocated as indicated below:

Alternative I—Ocean outfalls used at current levels

- Priority 1: Use utility's projections and plans (supplemented by UF projections) for flows to the existing ocean outfalls—capping flows at 2005 permitted capacities.
- Priority 2: Use utility's projections and plans (supplemented by UF projections) for flows to the existing underground injection wells—capping flows at 2005 permitted capacities.

- Priority 3: Use utility's projections and plans (supplemented by UF projections) for flows to traditional[1] reuse activities.
- Priority 4: Direct flows not allocated in Priorities 1–3 above to groundwater recharge[2].

Alternative II—Ocean outfalls used for flows not expected to be handled by reuse or other disposal options
- Priority 1: Use utility's projections and plans (supplemented by UF projections) for flows to traditional reuse activities.
- Priority 2: Use utility's projections and plans (supplemented by UF projections) for flows to the existing underground injection wells—capping flows at 2005 permitted capacities.
- Priority 3: Use utility's projections and plans (supplemented by UF projections) for flows to existing ocean outfalls—capping flows at 2005 permitted capacities.
- Priority 4: Direct flows not allocated in Priorities 1–3 above to groundwater recharge.

Alternative III—Ocean outfalls used as backups to traditional reuse activities
- Priority 1: Use utility's projections and plans (supplemented by UF projections) for flows to traditional reuse activities.
- Priority 2: Use utility's projections and plans (supplemented by UF projections) for flows to the existing underground injection wells—capping flows at 2005 permitted capacities.
- Priority 3: Use ocean outfalls only as backups to traditional reuse activities (no dry weather flows to the ocean)—capping flows at 2005 permitted capacities.
- Priority 4: Direct flows not allocated in Priorities 1–3 above to groundwater recharge.

Alternative IV—Ocean outfalls not used
- Priority 1: Ocean outfalls are not used.
- Priority 2: Use utility's projections and plans (supplemented by UF projections) for flows to traditional reuse activities.
- Priority 3: Use utility's projections and plans (supplemented by UF projections) for flows to the existing underground injection wells—capping flows at 2005 permitted capacities.
- Priority 4: Direct flows not allocated in Priorities 1–3 above to groundwater recharge.

Each of the four alternatives was evaluated over a 20-year planning period, beginning in 2005, for each of the WWTPs having ocean outfalls.

7.3 Effluent and Reclaimed Water Flow Distributions

Wastewater flow projections for the years 2005–2025 from Chapter 2 were used together with the priorities described above to determine the distributions of effluent and reclaimed water flow under the four alternatives. This exercise was carried out for each of the six WWTPs for the years 2005–2025 in five year increments as shown in Tables 7-3 through 7-8. The progression of flows to the respective reuse and disposal options is not necessarily the

[1] Part III activities—golf courses, parks, residential and Part VII industrial uses

[2] Permitted under Part V, injection to groundwater having TDS < 1000 mg/L