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DEMINERALIZATION CONCENTRATE OCEAN OUTFALL FEASIBILITY STUDY: EVALUATION OF ADDITIONAL INFORMATION NEEDS

Demineralization Concentrate Ocean Outfall Feasibility Study: Evaluation of Additional Information Needs

Prepared for

St. Johns River Water Management District

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EXECUTIVE SUMMARY

The District Water Supply Plan (DWSP) completed by St. Johns River Water Management District (SJRWMD) in 2000 identified alternative strategies for meeting projected 2020 water supply demands for municipal, agricultural, and industrial uses. Particularly for the utilities located in planning areas along the coast, high levels of interest exist regarding potential application of demineralization treatment technologies for potable water production with concentrate disposal via ocean outfalls.

To better define the feasibility of ocean outfall disposal of concentrate, SJRWMD initiated investigations to help utilities understand relevant outfall implementation issues. SJRWMD designed the subject investigations in collaboration with the Atlantic Oceanographic and Meteorological Laboratory (AOML) of the National Oceanographic and Atmospheric Administration. AOML was retained to conduct these studies focused on understanding oceanographic conditions that might either favor or preclude ocean outfall feasibility.

Under Phase 1 of the feasibility study, AOML conducted an oceanographic information inventory and literature review regarding topics relevant to assessment of concentrate ocean outfall feasibility. AOML conducted these activities from April 2004 to January 2005. In May 2005, SJRWMD retained CH2M HILL to review AOML's draft Task 2 deliverable, and summarize the key findings in a separate technical memorandum. For the final Phase 1 activity, SJRWMD directed CH2M HILL and AOML to collaborate in evaluating additional data needs. This current document is a synthesis of the oceanographic information AOML summarized, and a consolidation of recommendations for Phase 2 feasibility study elements that have been proposed by AOML, CH2M HILL, SJRWMD, and/or representatives of the Florida Department of Environmental Protection (FDEP).

Regulatory requirements for outfall-related infrastructure design and construction are not unique to concentrate disposal, and the simplifying assumption applied for this feasibility study is that siting and design can be accomplished in a manner that addresses all impact avoidance, minimization, and mitigation requirements. Operationally, however, there are special regulatory considerations, and these are what the oceanographic evaluations have focused on. In Florida, FDEP has regulatory jurisdiction in coastal waters out to 3 miles beyond the mean high water mark. For this evaluation, it has been assumed that any prospective outfalls developed for concentrate disposal would discharge within this narrow band of the coastal ocean, and that the key issues pertain to whether the physical oceanographic conditions exist to support mixing zone definition in accordance with FDEP rules detailed in Section 62-4.244 of the *Florida Administrative Code (F.A.C.)*.

The AOML information inventory and literature review targeted physical oceanographic information categories considered most relevant to mixing zone modeling evaluations typically conducted during the course of ocean outfall permitting by FDEP. Key parameters that were the focus of the search included:

- Depth
- Water column temperature and salinity conditions (leading to ambient water column density profile)
- Prevailing current speed and direction

The fragmentary data identified by AOML during its information inventory led it to conclude that physical, chemical, and biological information for the overall study area was sparse. Sufficient bathymetry is available to support the feasibility study, and substrate characteristics are known for a reasonably representative portion of the near shore environment. Some meaningful and potentially representative data sets regarding depth-distributed current speed and direction are available, but only for a limited number of sites. Adequate data are not available regarding typical water column stratification. This information is needed to support modeling of how concentrate plumes are likely to be diluted or dispersed following concentrate discharge.

On the basis of these findings, AOML recommended that multi-year field investigations be integrated into SJRWMD's Phase 2 ocean outfall feasibility studies. The currently proposed elements of this field program are summarized in Table Es-1.

Table Es-1. Conceptual Phase 2 field investigation study elements and duration proposed by AOML

Period	Field Study Element	Activity Description
Year 1	Interagency Consultations to Discuss Study Zones and Data Gathering Locations	Conduct during sampling plan development.
	Review Existing ADCP Data (Current Speed and Direction) for Melbourne Beach and Cape Canaveral (Cocoa Beach) Sites	Conduct as soon as possible.
	Review Existing Benthic Invertebrate and Fisheries Data, and Ancillary Water Quality Records	Conduct during sampling plan development.
	Current Speed and Direction (Two ADCP Deployments at Melbourne Beach)	Deploy. Service Monthly.
	Bottom-Mounted Water Quality Data Logging Instruments Co-located with ADCP Units (Three Units Deployed at Melbourne Beach)	Deploy. Service Monthly.
	Water Column Profiles (Field Measurements)	Conduct Monthly
	Surface, Mid-Depth, and Bottom Water Sampling for Chemical Analysis of Prioritized Parameters; Corresponding Field Measures	Conduct Monthly
Year 2	Continue the Year 1 study elements and sampling frequencies for the first half of Year 2. During this period, analyze the Year 1 data and generate a technical report on Year 1 study results, with recommendations for program refinements. Implement changes mid-year, as applicable. Deploy up to three additional ADCP and Water Quality Data Logging Instruments at each of the other two study zones to provide concurrent time series data at all three study zones for at least part of Year 2.	Revise Field Activities, as appropriate.
Year 3	Continue Year 2 study elements and sampling frequencies for the first half of Year 3. During this period, analyze the Year 1 and 2 data and generate a technical report on the cumulative study results, with recommendations for program refinements. Implement changes mid-year, as applicable.	Revise Field Activities, as appropriate.

Table Es-1—*Continued*

Period	Field Study Element	Activity Description
Year 4	Continue Year 3 study elements and sampling frequencies for the first half of Year 4. During this period, analyze the Year 1, 2, and 3 data and generate a technical report on the cumulative study results, with recommendations for program refinements. Implement changes mid-year, as applicable.	Revise Field Activities, as appropriate.
Year 5 and Beyond	Continue Year 4 study elements and sampling frequencies for the first half of Year 4. During this period, analyze the multi-year data sets and generate a technical report on the cumulative study results, with recommendations for program refinements. Implement changes mid-year, as applicable.	Revise Field Activities, as appropriate.

In addition to the candidate field study elements outlined above, the following activities are recommended for SJRWMD's consideration as elements of the Phase 2 feasibility study.

- Concentrate plume dilution modeling. Planning-level application of mixing zone models to demonstrate technical feasibility of achieving compliance with the applicable surface water standards with the proper combination of outfall diffuser design coupled with a range of discharge variables, including concentrate water quality, discharge rate, water column depth at the outfall diffuser ports, water column density conditions, and ambient current speed and velocity conditions.
- Evaluation of nitrogen levels in demineralization concentrate generated by facilities in Florida. For those utilities which are currently designing or operating demineralization water treatment plants (WTPs) using brackish groundwater, estuarine water, or even fresh surface water as their source water, this evaluation would help define whether outfall implementation will need to include either detailed receiving water quality modeling, or concentrate treatment technologies.
- Review of existing databases to determine if ancillary records of temperature, salinity, dissolved oxygen, or other relevant parameters are retrievable, and specifically if such information exists for different depths within the water

column. If sufficient historical records can be retrieved and compiled, use these historical records to improve our understanding of the temporal and spatial variability in the physical and water quality conditions of this overall study area.

- Conceptual design of engineering project elements for concentrate conveyance to the ocean outfall(s). Use the conceptual designs to provide the basis for planning-level cost estimation for design, permitting, and construction of such facilities for representative scenarios and geographies within SJRWMD. Additionally, use these conceptual designs to more clearly define potential environmental impact concerns regarding pipeline and outfall siting.

These general suggestions are synthesized into a series of recommended tasks falling into two groupings, Phases 2a and 2b. The proposed Phase 2a study elements consist of the preparatory tasks leading up to implementation of the field studies under Phase 2b. The Phase 2b study elements consist of the field study implementation tasks, data management, results documentation, and interagency coordination and communications.

On the basis of the information presented in this document, and the collective input from AOML, CH2M HILL, SJRWMD, and FDEP representatives, the following recommendations for management action are offered.

1. SJRWMD should proceed with having detailed scopes of work prepared for proposed Phases 2a and 2b as separate planning documents. The scopes of work should be designed to produce a field study sampling plan as well as task definition for the other proposed Phase 2 study elements.
2. The Phase 2b sampling plan should be designed with input from FDEP and other agency participants. It should contain detailed text and tabular summaries providing clear definition of, as a minimum, the following:
    - Study zones and stations within each zone, where applicable
    - Targeted data to be generated and rationale for each set of parameters (e.g., physical, chemical, and biological oceanographic information)

- Instrumentation to be used and associated programming (if applicable)
- Standard operating procedures for all field activities
- Field and analytical quality control measures
- Frequency of sampling/field surveys
- Data management plans
- Data interpretation and documentation schedules, including plans for adaptively managing field study scope elements and schedule

The sampling plan should include, as appendices, candidate vendor information and detailed cost estimates for each field study element. Costing information corresponding to the conceptual study elements will be needed for SJRWMD to determine what elements are to be incorporated into Phase 2b.

3. The scopes of work for the other Phase 2 activities outlined in this technical memorandum (TM) should be prepared to the level of detail needed for SJRWMD management review and determination regarding which of these activities can be included under Phase 2a.

Demineralization processes will be a part of the long-term water supply strategy for achieving sustainable development within at least some parts of SJRWMD. Therefore, continued engineering and environmental investigations aligned with the candidate study elements identified in this TM are worthy of serious consideration, particularly if collaborative Phase 2 study element implementation can be arranged. This feasibility study is an important element of SJRWMD's technical support services being provided to its constituents responsible for long-term water supply planning and implementation. Continued commitment to these project activities is warranted.

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ACRONYMS AND ABBREVIATIONS

ADCP	acoustic Doppler current profiler
AOML	Atlantic Oceanographic and Meteorological Laboratory
AwwaRF	American Water Works Association Research Foundation
cm/sec	centimeter(s) per second
CTD	conductivity temperature density
DWSP	District Water Supply Plan
ED/EDR	electrodialysis/electrodialysis reversal
EFDC	Environmental Fluid Dynamics Code
EPA	U.S. Environmental Protection Agency
EFH	essential fish habitat
FDEP	Florida Department of Environmental Protection
FAC	*Florida Administrative Code*
FWCC	Florida Fish and Wildlife Conservation Commission
GIS	Geographic Information System
MSIIT	major seawater ion imbalance toxicity
mm/sec	millimeter(s) per second
NF	nanofiltration
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmosphere Administration
NPDES	National Pollutant Discharge Elimination System
NWRI	National Water Research Institute
PWRCA	priority water resources caution areas
QAPP	quality assurance project plan

RO	reverse osmosis
SJRWMD	St. Johns River Water Management District
TM	technical memorandum
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WERF	Water Environment Research Foundation
WET	whole effluent toxicity
WQBELs	water-quality-based effluent limits
WRF	Water Reuse Foundation
WTP	water treatment plant
WWTP	wastewater treatment plant

INTRODUCTION

The St. Johns River Water Management District (SJRWMD) completed the District Water Supply Plan (DWSP) in 2000. This document addresses alternative approaches to meeting municipal, agricultural, and industrial water supply demands projected within SJRWMD through the year 2020. Pursuant to the requirements of Subparagraph 373.536, *Florida Statutes*, SJRWMD is currently engaged in generating a 5-year update for the DWSP.

Early in the water supply planning process, SJRWMD identified priority water resources caution areas (PWRCA) within which development of alternative water supply strategies was considered critically needed to meet demands projected through 2020 (Figure 1). The planning process has been collaborative and stakeholder focused.

The demineralization of brackish groundwater , surface water, and seawater have been identified by SJRWMD as alternative water supply strategies. For municipal water suppliers located in SJRWMD counties adjacent to the Atlantic Ocean coastline, fairly high levels of interest exist regarding potential application of membrane-based, demineralization treatment technologies for potable water production.

Demineralization membrane processes include reverse osmosis (RO), nanofiltration (NF), and electrodialysis/electrodialysis reversal (ED/EDR). The fastest growing segment has been RO, for salt removal in brackish water resources and seawater (NRC 2004). ED/EDR technology provides separation of ionic constituents through the use of electrical potential, and NF provides water softening (removal of divalent cations such as Ca and Mg), and removal of organics, sulfate, and some viruses (NRC 2004). Demineralization, or membrane, will be used here as a general abbreviation for RO, NF, or ED/EDR treatment technologies, which are the major technologies used in the United States for desalination.

In the State of Florida, there currently are approximately 170 demineralization water treatment plants, and of these roughly 130 use brackish groundwater as the raw water supply (FDEP, personal communication July 2005). In SJRWMD, this same pattern of primary reliance on brackish groundwater prevails.

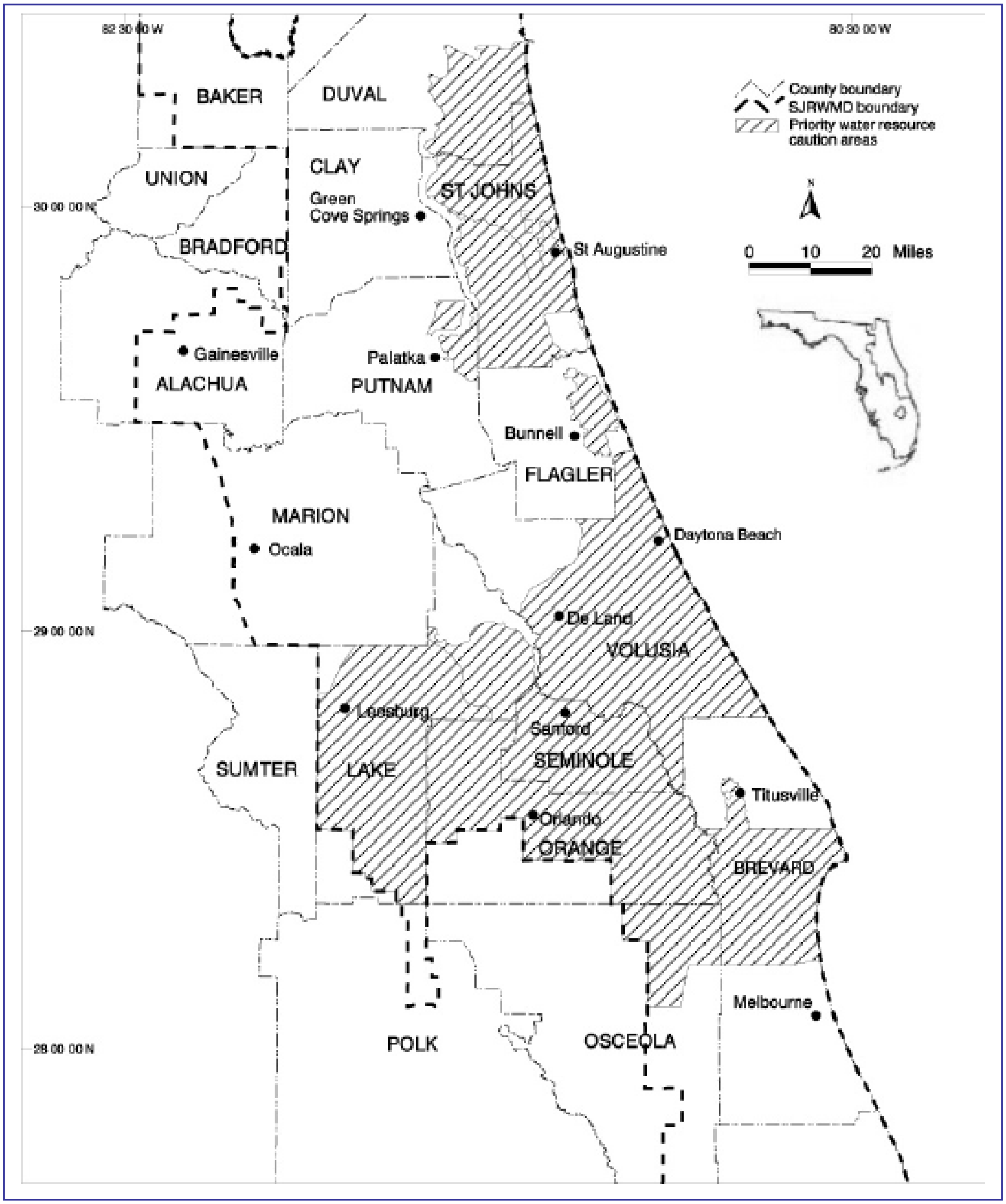

Figure 1. SJRWMD Priority Water Resource Caution Areas (Source: SJRWMD 2000)

Raw water sources for demineralization facilities have primarily been brackish groundwater, with a few systems based in part or entirely on membrane treatment of fresh surface waters.

In light of the relative proximity to the ocean for utilities located along the coast, interest is substantive in the option of developing water treatment plants (WTPs) designed to convert seawater to potable water. The anticipated higher treatment costs might be warranted in light of the benefits of unlimited supply, and lower risk of raw water source contamination over time.

Regardless of what the raw water source is, membrane-based treatment technologies generate potable waters, which comply with the drinking water standards through processes that physically separate undesired water quality constituents in the raw source water from the finished potable water. In the separation process, demineralization methods produce a wastewater concentrate containing elevated concentrations of minerals and any other constituents that are present in the raw water source.

Identifying an environmentally acceptable concentrate disposal method is the primary impediment to gaining necessary regulatory approvals for demineralization treatment plant installation and operation. Water suppliers nationwide are investigating concentrate management alternatives, and there are ongoing reviews of potential innovative beneficial uses of concentrate in progress on behalf of the Joint Water Reuse Task Force, consisting of the Water Reuse Foundation (WRF), American Water Works Association Research Foundation (AwwaRF), Water Environment Research Foundation (WERF), National Water Research Institute (NWRI), and Bureau of Reclamation (CH2M HILL 2005a).

Issues associated with concentrate management options in northeast Florida were evaluated in prior phases of SJRWMD's water supply planning process (R. W. Beck 2002; Reiss Environmental 2003a). For utilities located inland within SJRWMD, concentrate disposal options will likely focus on release to shallow groundwater following dilution to the level necessary to achieve compliance with aquifer protection regulations. Alternatively, concentrate can be discharged to saline aquifers via deep injection wells. Additionally, concentrate blending with stormwater, treated wastewater, or other potential waters, prior to surface water discharge remains an option.

For utilities located along the coast, while groundwater-based disposal options also are applicable, other options may warrant investigation, such as:

- Surface discharge to estuarine waters
- Use of concentrate to support coastal wetland habitat creation or restoration
- Discharge to ocean waters

Discharge of concentrate to surface waters through ocean outfalls was identified as an option warranting further investigation regarding technical, regulatory, and economic feasibility. To better define the feasibility of ocean outfall disposal of concentrate generated by utilities located along the coast, SJRWMD initiated phased investigations designed to help utilities understand relevant implementation issues.

The investigations were to generate information to assist utilities as they develop, and subsequently implement their respective long-term water supply plans. SJRWMD designed the investigations in collaboration with the Atlantic Oceanographic and Meteorological Laboratory (AOML) of the National Oceanographic and Atmospheric Administration (NOAA).

AOML's study plan included the following phases and tasks:

- Phase 1 – Information Development and Planning

    Task 1 – Project Kickoff Meeting
    Task 2 – Literature and Data Review
    Task 3 – Evaluation of Additional Information Needs

- Phase 2 – Initial Data Acquisition and Related Technical Activities

    Task 4 – Planning and Deployment of Instruments
    Task 5 – Data Acquisition
    Task 6 – Phase 2 Report Preparation

An interagency agreement detailing the scope and budget allocation for these preliminary investigations was executed in early 2004. Tasks 1 and 2 were performed by AOML from April 2004 to January 2005. In May 2005, SJRWMD retained

CH2M HILL to review AOML's draft Task 2 deliverable; the results of that review were presented in a technical memorandum (TM) (CH2M HILL 2005b).

This current document is a CH2M HILL project deliverable assembled with significant input from AOML aligned with its original scope elements of *Phase 1, Task 3 – Evaluation of Additional Information Needs* (Appendix A). Constructive technical review and support by FDEP and SJRWMD staff also are acknowledged. AOML prepared the majority of the recommendations specifically addressing proposed field investigations for Phase 2 of this feasibility study. All other portions of this document were generated through CH2M HILL's synthesis of information and suggestions provided by CH2M HILL team members as well as the referenced agency participants.

REGULATORY REQUIREMENTS AND KEY WATER QUALITY CONCERNS

REGULATORY PERSPECTIVES

Regulatory requirements specifically focused on ocean outfalls as a means of disposal of demineralization concentrate were summarized in R.W. Beck's report to SJRWMD in 2002 (R. W. Beck 2002). They generally fall into two major categories:

- Environmental permits required to construct the land-based pipeline to shore, those required to construct the seafloor-based pipeline leading offshore, and those associated with. a high-rate outfall diffuser system
- Environmental permits required to operate the ocean outfall system for concentrate discharge purposes

The first category requires issuance of federal, state, and local permits for construction impacting wetlands, navigable waters, and protected species and their habitats. The permits required are not specifically aligned with concentrate issues, but rather are generically focused on any infrastructure project-related environmental impact avoidance, minimization, or mitigation in that order of priority.

This category of regulatory requirements is not addressed further in this document because these permit issues will be project site-specific. At the time that specific proposed facilities can be identified, prospective unavoidable local and regional impacts and associated mitigative measures will need to be addressed in detail. These issues impact feasibility of a given proposal, but not the overall feasibility of the conceptual use of ocean outfalls for demineralization concentrate disposal in northeast Florida. For the purposes of this study, it has been assumed that any specific concentrate ocean outfall project can be sited, designed, and permitted to adequately address all regulatory concerns linked to siting and construction impacts.

Of greater significance for this feasibility study is the second category of regulatory requirements – those pertaining to ocean outfall discharge operations. These are directly linked to the chemical and physical relationships between the water to be discharged, in this case some form of concentrate, and the receiving water's compliance with the applicable surface water criteria used by the State of Florida for the protection of the designated uses of that water body.

The U.S. Environmental Protection Agency (EPA) is the federal agency responsible for administering the National Pollutant Discharge Elimination System (NPDES) permit program under which discharges of wastewater and stormwater to surface waters are regulated. In Florida, however, EPA has delegated authority to FDEP to manage the NPDES permitting program for any facilities discharging to Waters of the State. While a number of other resource management and regulatory agencies at the federal, state, regional, and/or local level provide supporting review, FDEP is the key agency with jurisdiction over operation of ocean outfall facilities in State waters within 3 miles of shoreline.

FDEP rules governing permitting of facilities discharging to surface waters of the State are found primarily in three key chapters of the *Florida Administrative Code (F.A.C.)*:

- Chapter 62-302, *F.A.C.*, defines the designated uses assigned to the various surface waters of the State, and specifies minimum water quality criteria that must be maintained in surface waters. Concentrate discharges that do not meet surface water quality criteria under worst-case conditions (maximum discharge, minimal conditions promoting discharge dilution) will not be permittable without some form of regulatory relief under the mixing zone rule, or via other relief mechanisms provided under *F.A.C.* In terms of concentrate ocean outfalls, the mixing zone provisions are the only form of relief considered viable for long-term authorization to operate facilities that might not meet end of pipe standards.
- Chapter 62-4, *F.A.C.*, outlines the procedures for obtaining a permit from FDEP. Sections 62-4.200 through 62-4-250, *F.A.C.*, specify criteria for determining the viability of any discharge to surface waters, including a concentrate discharge. Key provisions of this rule include Section 62-4.242, *F.A.C.*, which establishes criteria under which any new or expanded discharges to surface waters are reviewed in terms of the State's Antidegradation Policy. Any new ocean outfall for concentrate disposal will have to meet the demonstrations

listed in that section of the rule. Additionally, there are regulatory provisions addressed under Section 62-4.244, *F.A.C.*, which allow a permittee to apply for mixing zones should a specific constituent in the concentrate not comply with applicable surface water standards at the end of pipe. In recognition of the special case of demineralization concentrate disposal, the Florida Legislature modified Chapter 403, *Florida Statutes* (Appendix B), and directed FDEP to modify Section 62-4.244, *F.A.C.*, to address special conditions for concentrate mixing zones. FDEP has indicated that the *"…proposed rule amendment will modify Rule 62-4.244, F.A.C., to provide for a limited mixing zone for demineralization concentrate discharges. This mixing zone will allow in the receiving waters for a small area of acute toxicity due to naturally occurring constituents that cause ionic imbalance (e.g., calcium, sodium, magnesium, chloride, bromide, etc.). All water quality standards must be met at the edge of this limited mixing zone, although other relief mechanisms may be requested by the permit applicant*." Other concurrent and relevant rule modifications pertain to Section 62-620.623(6), *F.A.C*. The proposed rule modifications remain in draft form, but could be finalized and approved as early as fall of 2005 (Appendix C).

- Chapter 62-650, *F.A.C.*, addresses water quality based effluent limitations (WQBELs). Where a given discharge may not meet end of pipe standards, FDEP has the latitude granted under this chapter to allow the discharge after establishing WQBELs, identified through scientific demonstration studies, which would adequately protect the designated uses of the water body despite the end of pipe exceedance of the specific parameter's standard(s). In addressing new or expanded surface water discharges, FDEP typically requires WQBEL evaluations as a major component of providing the agency reasonable assurance that the discharge will not cause or contribute to water quality violations leading to non-compliance with the surface water body's designated uses. WQBELs can focus solely on achieving compliance through discharge mixing with the receiving water, but also may address the fate and effects of the parameter(s) of concern if these are subject to biological or chemical change in the receiving water.

FDEP requires engineering and scientific demonstration studies in support of construction and operating permit applications for facilities comparable to the conceptual concentrate ocean outfalls under consideration. Those demonstration studies must address the requirements of the previously described portions of *F.A.C.* Regulatory feasibility of this concentrate management strategy will be defined by the ability to provide FDEP "reasonable assurance" that the discharge will not cause or contribute to water quality violations.

Concentrate Characteristics and Water Quality Concerns

A number of different demineralization treatment processes are available for production of potable water. These vary in a number of ways, including their relative reliance on use of chemical additions during the treatment process, and in terms of the number of treatment cycles applied in achieving finished water that complies with the drinking water standards. In particular, chemical additions if used in the treatment process can measurably influence the water quality characteristics of the resultant concentrate.

Further, as described previously, the raw water sources used to feed these types of WTPs can be quite varied, ranging from fresh surface water, to brackish groundwater, to full-strength seawater. For any given plant, design would normally be based on a single source water quality of reasonably consistent quality. Demineralization of seawater is routinely done on some island nations in the Caribbean, and by cruise ships providing water for their residents and visitors. However, other than the Florida Keys Aqueduct Authority's water plants in Marathon and Key West, there are no seawater-based WTPs on Florida's mainland.

FDEP has indicated that most of the currently existing demineralization WTPs in Florida use brackish groundwater as the raw water source (FDEP, personal communication 2005). Some draw source water from shallow brackish aquifers while others have their source water wells installed to deeper aquifers or zones. The Tampa Bay Water RO plant uses estuarine waters drawn from the bay as its source water supply. Source waters for WTPs across the state vary markedly in their mineral content, and variability in concentrate water quality characteristics is the rule rather than the exception.

Without knowing the specific water quality characteristics of a given source, and the nature of the treatment processes to be applied to achieve finished water compliance with the drinking water standards, projection of specific concentrate water quality issues of concern is not possible. However, on the basis of multiple discussions with FDEP, as well as review of representative concentrate water quality data sets (including Reiss 2003b), the following general statements are reasonably applicable in Florida assuming a brackish groundwater source and a conceptual discharge to the Atlantic Ocean:

- Minerals and other water quality constituents present in the raw water source are concentrated 3 to 7 times higher than the raw water with multiple passes through the treatment system (AWWA 2004). Noncompliance with one or several of Florida's surface water quality standards at the end of pipe is likely to occur. However, the amount of dilution needed to achieve compliance with those standards is not very large, and physical mixing in the ocean near the outfall diffuser is likely to provide the needed dilution to achieve compliance with standards. Mixing zone demonstration studies will be needed in support of project-specific applications for permits.
- Assuming a brackish groundwater source, concentrate salinities less than 15 parts per thousand (ppt) are likely (FDEP, personal communication 2005). A discharge of the brackish concentrate to the ocean would result in a buoyant plume; standard mixing zone models should be applicable. Assuming water quality constituents in the concentrate do not meet all applicable end of pipe standards, engineering studies would be required by FDEP to demonstrate compliance within mixing zones allowable under *F.A.C.*
- Even if compliance with numerical criteria were demonstrated, either with or without a mixing zone, discharge of concentrations of ions above the background levels might create regulatory concerns regarding consistency with the Antidegradation Policy applicable to any new or expanded discharge to surface waters. Studies to address antidegradation issues are likely to be needed as elements of project-specific applications for permits.
- The concentrate from demineralization plants may contain water quality constituents that only slightly exceed the

applicable standards. In concept, even slight dilution (prior to discharge) using surface water, reclaimed water, stormwater, or pumped groundwater might be enough to eliminate the compliance issue. One of these forms of pre-discharge blending might be allowable depending on the facility site location, and the availability and water quality of the prospective dilution waters. Studies to demonstrate regulatory viability of these types of strategies might be worthy of consideration in some cases.

- Whole effluent toxicity (WET) tests of concentrate from a variety of demineralization plants in Florida have demonstrated that some concentrates are acutely or chronically toxic to laboratory test organisms considered representative of fish and invertebrates likely present in marine receiving waters. As reflected in Table 1, for non-seawater source waters, it appears that some or all of the test organism mortality often can be attributed to major seawater ion imbalance causing osmotic stress to the organisms. However, in some cases, treatment process chemical additions or presence of other constituents in the concentrate may cause the observed mortality of test organisms. WET tests are likely to be integral elements of any concentrate discharge permitting reviews regarding specific proposed outfalls. If concentrate toxicity can be shown to be attributable solely to major seawater ionic imbalances, provisions of the proposed modifications to Chapter 62-4.244, *F.A.C.*, will be applicable.

- In some parts of the State, brackish groundwater levels of nitrogen (primarily in the form of ammonia) have at times been high enough to be of regulatory concern regarding potential concentrate discharge effects on receiving water body eutrophication. FDEP may require either nitrogen removal through treatment prior to discharge, or studies to demonstrate that concentrate discharge would not cause or contribute to receiving water noncompliance with designated uses. Studies addressing concentrate constituent fate and transport in the receiving water body may be required if source waters have substantive nitrogen concentrations.

These general statements also are applicable to scenarios where freshwaters or estuarine waters might be used as source waters for a demineralization WTP. The last option, use of seawater as the raw water source, might offer the following advantages:

- Less likely that water supply volume issues would ever be a problem
- No likelihood of major seawater ionic imbalance as a cause of WET test issues
- Lower likelihood of nitrogen or other man-related pollutant presence and therefore concentration during the water production process

Table 1. Representative results of major seawater ion imbalance toxicity (MSIIT) testing of Florida demineralization plant concentrates

Facility	Source Water	Facility or Pilot	MSIIT Testing Results
Fort Myers*	Surface Water polishing	Facility	MSIIT to mysids, no toxicity to C. dubia
Vero Beach*	Groundwater†	Facility	Toxicity predominately other than MSIIT, but some MSIIT possible
Venice*	Groundwater†	Facility	MSIIT
Gasparilla*	Groundwater†	Facility	MSIIT and other unidentified toxicant(s)
Sailfish Point*	Groundwater†	Facility	MSIIT and other unidentified toxicant(s)
Jupiter*	Groundwater†	Facility	Toxicity predominately other than MSIIT, but some MSIIT possible
Village of Tequesta	Groundwater†	Pilot	Toxicity predominately other than MSIIT, but some MSIIT possible
Sarasota	Groundwater†	Facility	MSIIT and fluoride toxicity
IRCUD/South Co.	Groundwater†	Pilot	Toxicity predominately other than MSIIT
Palm Coast	Groundwater†	Facility	MSIIT and other unidentified toxicant(s)
Melbourne	Groundwater†	Facility	MSIIT and other unidentified toxicant(s)

Table 1—*Continued*

Facility	Source Water	Facility or Pilot	MSIIT Testing Results
Oldsmar	Groundwater†	Pilot	MSIIT
South Martin Regional	Groundwater†	Facility	MSIIT and other unidentified toxicant(s)

Note:

* = Results of 1994 FDEP MSIIT Testing Protocol Study

† = Brackish Groundwater

Source: FDEP, personal communication 2005

However, all of these concerns regarding compliance with surface water quality standards and the State's Antidegradation Policy remain applicable. Additionally, because demineralization of the seawater would result in a concentrate having a higher density than the ocean water, mixing zone and fate and transport studies would need to address the prospect of a negatively-buoyant plume. If these studies indicate probable settling of the plume to the bottom, the nature of potential acute or chronic effects on bottom-associated invertebrates, fish, or higher vertebrate wildlife forms would require specific evaluation (FDEP, personal communication 2005).

FEASIBILITY STUDY ASSUMPTIONS

With these regulatory perspectives and water quality concerns in mind, the following feasibility study assumptions were developed to help prioritize the focus areas for this continued investigation.

- Environmental concerns regarding conceptual ocean outfalls for concentrate disposal fall into two categories: effects of siting and construction of the outfall pipeline and diffuser, and effects of concentrate discharge. Only the latter concerns are to be further addressed in this document. Siting and construction related impacts can be avoided, minimized, or mitigated during site-specific investigations that would be undertaken as elements of actual permit application and review.
- There are two categories of potential source waters and resultant concentrates. Demineralization processes applied to

seawater will generate concentrate denser than ocean water. However, this concentrate is less likely to contain man-related pollutants. In contrast, demineralization processes applied to freshwater, estuarine water, or brackish groundwater will generate a concentrate that is positively buoyant in ocean water. This category of concentrate, however, has a higher probability of bearing pollutants that may make ocean outfall permitting more difficult. Phase 2 of this feasibility study should address both categories of source water and concentrate types.

- Where possible, use of chemical additions during the water treatment process should be minimized where concentrate discharge to surface waters is contemplated. If this can not be avoided, plans should include constituent minimization in the concentrate, possibly through treatment processes. It has been assumed that demineralization concentrates to be disposed of through ocean outfalls do not contain treatment-introduced constituents that would preclude surface discharge to the ocean.
- Consistency with the State's Antidegradation Policy must be demonstrated through achieving compliance with water quality standards within permitable mixing zones meeting the specifications listed in Chapter 62-4.244, F.A.C. Additionally, fate and transport issues must be addressed regarding potential for the concentrate to cause or contribute to non-achievement of designated uses.

With these key assumptions in mind, AOML conducted an information inventory and literature review focused on oceanographic conditions pertinent to the evaluation of mixing zones within the study area. AOML's information review is detailed in AOML (AOML 2005a), and summarized in CH2M HILL (2005b). Key findings are highlighted in the following section of this technical memorandum.

ASSESSMENT OF KEY OCEANOGRAPHIC DATA AVAILABILITY

The AOML information inventory and literature review (AOML 2005a) targeted physical oceanographic information categories considered most relevant to mixing zone modeling evaluations typically conducted during the course of ocean outfall permitting by FDEP. Key parameters that were the focus of the search included:

- Depth
- Water column temperature and salinity conditions (leading to ambient water column density profile)
- Tidal influence
- Prevailing current speed and direction

Long-term and continuous receiving water data records were preferred over short-term and sporadic periods of record. The long-term records were viewed as needed to address seasonal as well as monthly variability in these critically important physical oceanographic parameters. The AOML data review prioritized information with sufficient robustness to allow statistical analysis of these key parameters to define “worst-case” values that FDEP would typically require be applied in outfall modeling evaluations.

AOML’s internet searches, peer-reviewed literature searches, university and research institution contacts, federal government contacts, and state government contacts, revealed the existence of several datasets it considered of value to SJRWMD’s study. The availability and adequacy of these datasets are highlighted below.

BATHYMETRY

One of the key sets of information available for SJRWMD’s entire coastal waters is bathymetry. AOML’s geographic information system (GIS) contains a comprehensive set of information regarding depth of water from the Atlantic coastline to out beyond the continental shelf. Figure 2 depicts these composite data drawn from multiple surveys conducted over time for the study area ranging from Nassau County to Indian River County. This figure depicts that in the southern portions of the study area, the shelf is relatively narrow, and there are some locations south of Cape Canaveral where potentially favorable depths occur reasonably close to shore. North of Cape Canaveral, one needs to move much further offshore to find deeper waters.

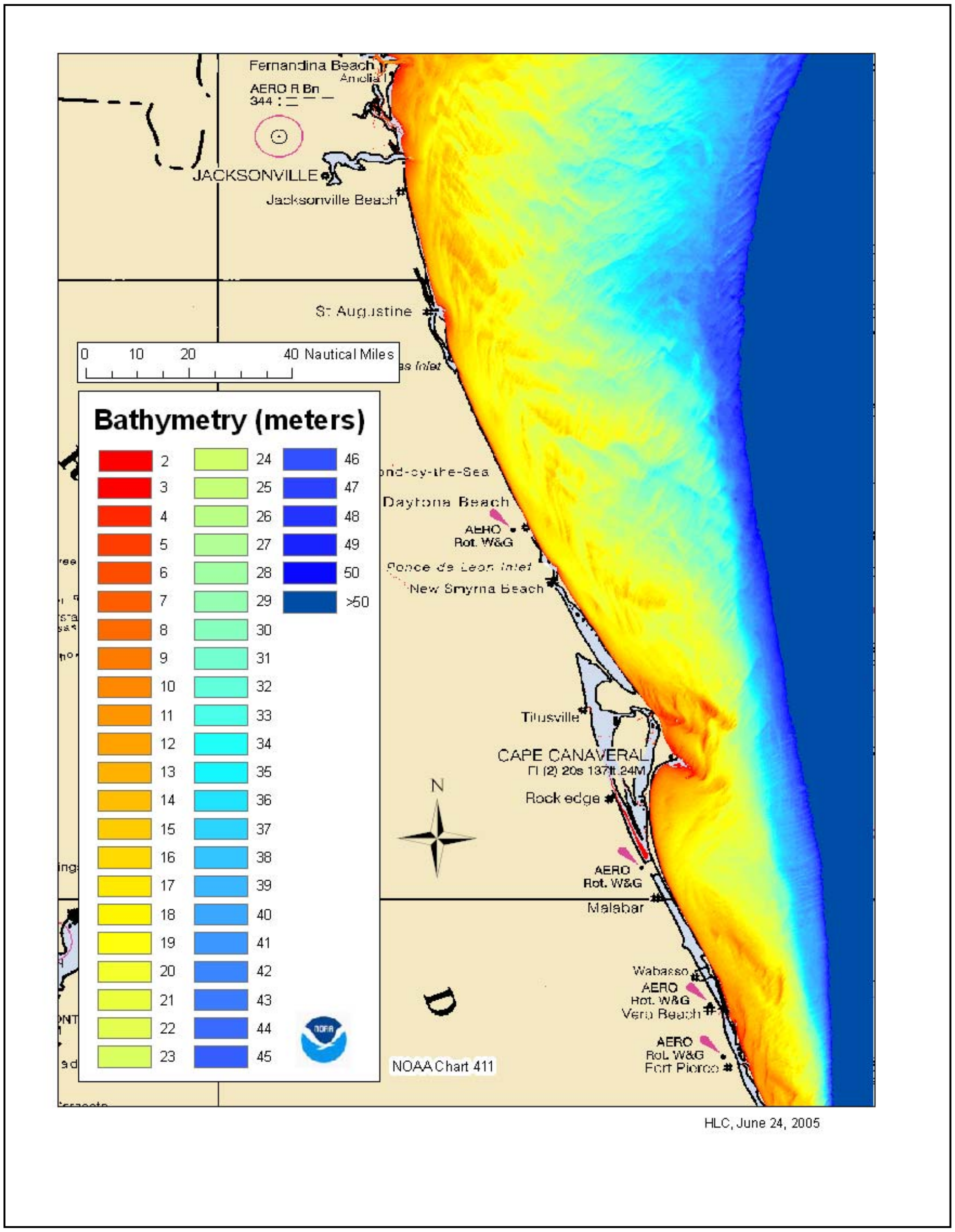

Figure 2. Bathymetry of near shore waters off of the St. Johns River Water Management District, Nassau to Indian River Counties, Florida (Source: Hector Casanova, personal communication, AOML)

Figure 3 is a depiction of relevant bathymetry data within 10 nautical miles from shore. Deeper areas near the shore might be among the candidate zones where new ocean outfalls might be more cost-effective because of the shorter outfall pipe lengths needed. Also, deeper waters translate to more favorable outfall conditions because of the larger water volume within which concentrate dilution and dispersion is possible.

In short, adequate bathymetry data are available for the entire study area for nearshore waters within approximately 3 nautical miles from shore. These records are viewed as key in terms of contributing toward understanding how either a positively or negatively buoyant plume will behave after discharge to the ocean. While proximity of deeper waters closer to shore is a factor likely to influence economic feasibility review at some point in the future, the most important linkage to technical and regulatory feasibility is with regard to the impact of water column depth on modeling evaluations of plume fate and transport.

Bottom Substrate Characteristics

Because of its regional role in understanding oceanographic conditions, AOML maintains an integrated inventory of bottom substrate characterization records that includes the current study area. Figure 4 reflects the information available in the applicable GIS database. This figure summarizes sediment characteristics that will likely be relevant to future siting and construction-related impact avoidance, minimization, and mitigation. In general, within the nearshore zone within roughly 3 nautical miles from shore, the preponderance of the data indicates habitats are characterized by sandy substrates. Such areas normally are not viewed as essential fish habitat or nursery grounds for commercially- or recreationally-valued finfish or invertebrates. On the basis of this preliminary review, no constraints on installation of ocean outfalls within the study area were identified linked to substrate characteristics. More detailed investigations of local benthic habitats might be needed at the time specific outfall projects are proposed.

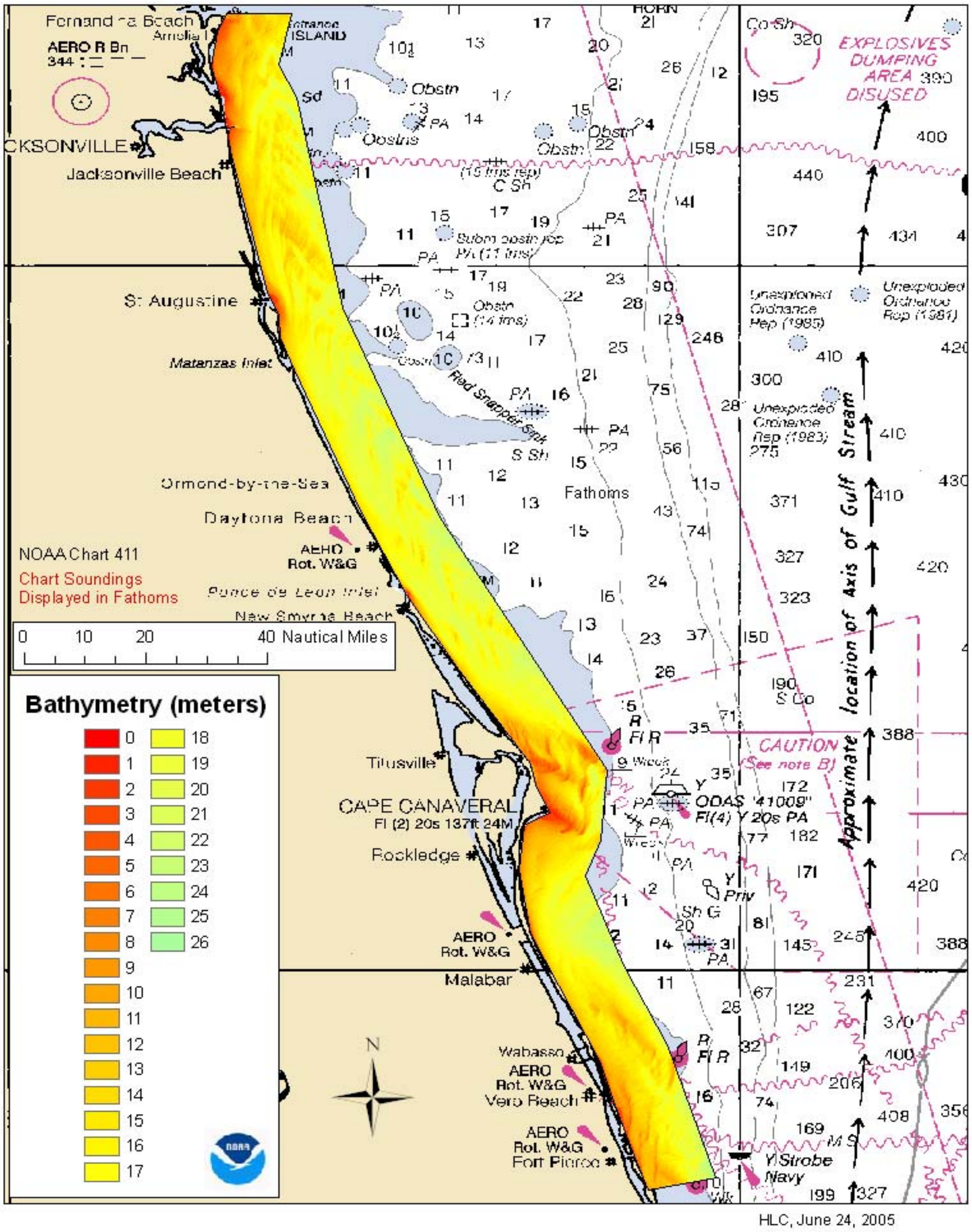

Figure 3. Bathymetry of near shore waters off of the St. Johns River Water Management District within 10 nautical miles off shore, Nassau to Indian River Counties, Florida (Source: Hector Casanova, personal communication, AOML)

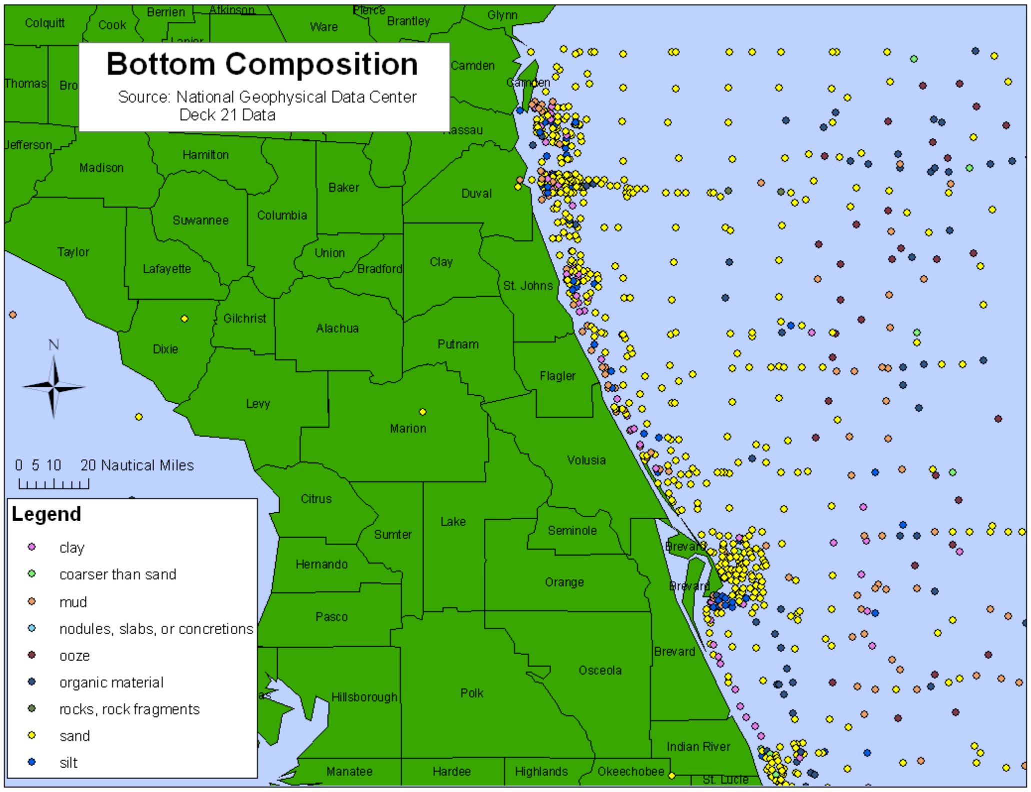

Figure 4. Sediment characteristics offshore of the St. Johns River Water Management District (Source: AOML)

CURRENT SPEED AND DIRECTION

One of the most critically needed data sets supporting ocean outfall plume behavior evaluation is the full range of current speed and direction over a long-enough period of time to allow statistical definition of "worst-case" conditions leading to minimal plume dilution. On the basis of the AOML information inventory, robust data sets regarding these key parameters were found to be available for three specific sites in the vicinity of the study area. These data were available for the following locations:

- A location 2.6 miles offshore of Cocoa Beach near Cape Canaveral. Data are available for a period from January 2003 to January 2004, and are considered representative of conditions off of Cocoa Beach at a coastal ocean water depth of approximately 15 meters. These records were collected by

EPA in support of evaluations of proposed offshore dredged material disposal areas.

- A location approximately 0.5 miles offshore of Melbourne Beach. Data are available for a 3-year period beginning in 2001, and were obtained from instrumentation deployed at a depth of approximately 8 meters. These records were collected by a contractor working on behalf of the FDEP Division of Beaches and Shores, with the intent of supporting future beach re-nourishment projects for Melbourne Beach.
- A site located approximately 1 mile from Ft. Pierce Inlet. Data were gathered for 1-month period in 2000 and for 2 months in 2002 at a water depth of approximately 15 meters. These records were collected by AOML in support of U.S. Army Corps of Engineers (USACE) evaluations of proposed offshore dredged material disposal areas.

Technically, the third site is located outside of the study area under review. However, physical oceanographic conditions near Ft. Pierce may be expected to be relevant to conditions off of Indian River County immediately to the north. For this reason, these data are viewed as relevant.

The three data collection programs generated similar types of datasets pertaining to physical oceanographic metrics relevant to potential concentrate plume fate and transport. For example, Figure 5 depicts the depth-averaged prevailing current speed and direction generated for a 1-year continuous acoustic Doppler current profiler (ADCP) record for the site offshore of Cape Canaveral near Cocoa Beach using the time series data for current speed and direction. This data presentation indicates that at this site, ambient currents are generally directed around 20° east of north and 20° west of south, approximately paralleling the shore.

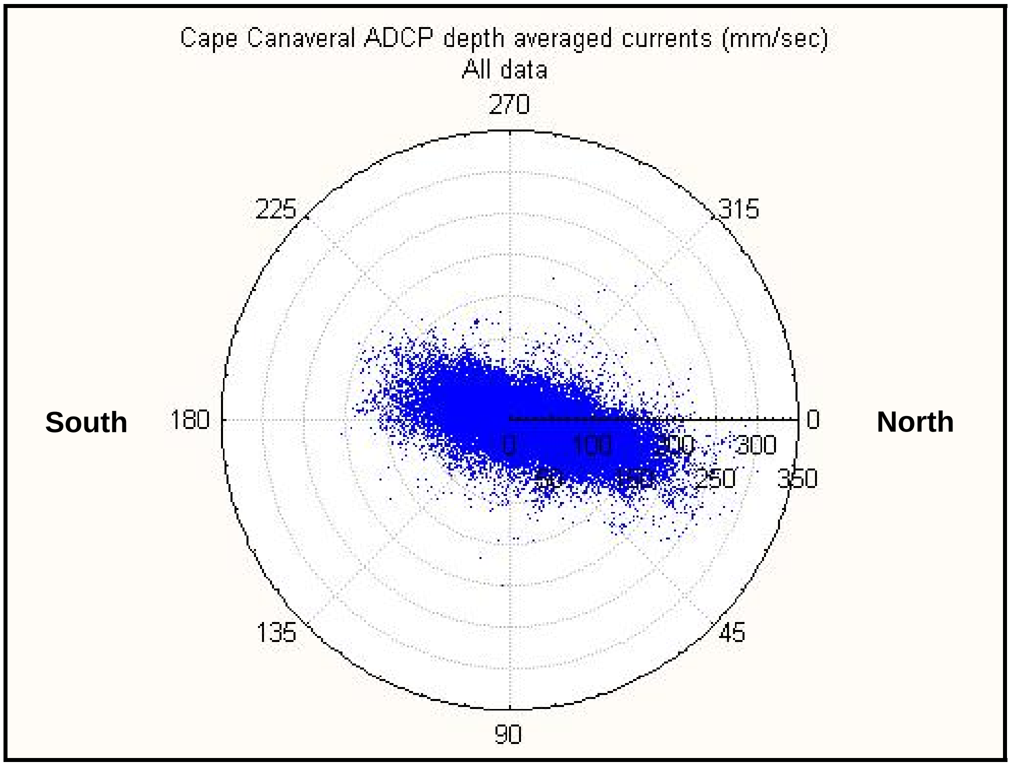

Figure 5. Current velocity and direction rose/scatter plot for a location offshore of Cape Canaveral, January 2003 through January 2004 (Note: Current velocity scale ranges from 0 to 350 mm/sec. Data Source: AOML)

Oceanographic studies typically demonstrate that physical conditions within any given water column vary with depth. An example of velocity magnitude and direction data plots for three different depths at the Ft. Pierce Inlet location is provided in Figure 6.

Ambient current magnitude and direction are shown for three depths (4.3 meters or near surface, 7.9 meters or near mid-depth, and 13.3 meters or near bottom). This figure demonstrates that for this site during the period of data gathering:

- The strongest currents were demonstrated nearer to the surface at the 4.3-meter depth, and
- The ambient current is bi-modal with a slight variation of current direction with depth.

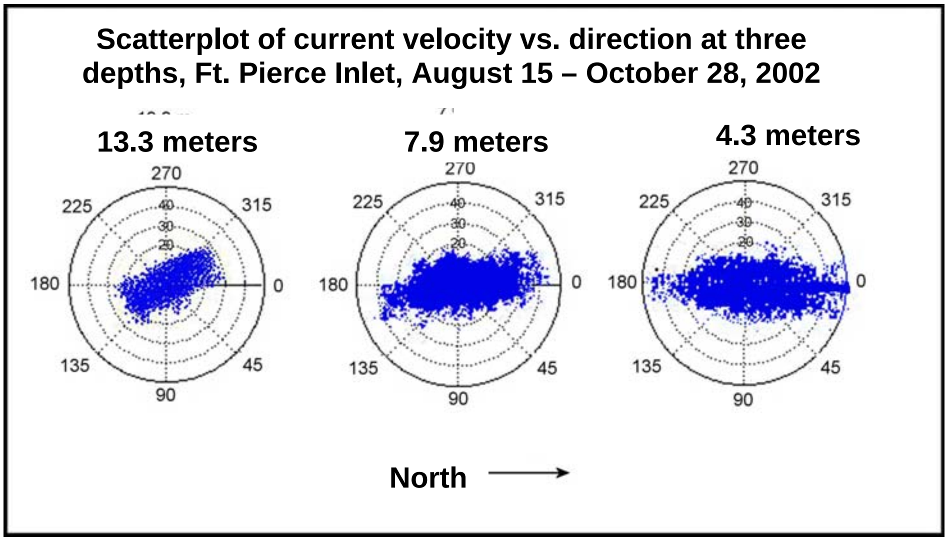

Figure 6. Current velocity and direction data at three depths for a site offshore of Ft. Pierce Inlet, August to October 2002 (Note: Current velocity scale ranges from 0 to 350 mm/sec. Data Source: AOML)

Ramifications for a concentrate ocean outfall are substantive. With a positively buoyant plume, dilution occurs rapidly as effluent rises through the water column; and as greater lateral water column velocity is met with the effluent rise toward the surface, substantive potential dilution is achieved. In contrast, with a negatively buoyant plume, mixing may be dependent on currents found deeper in the water column. If lower velocities typically are present at depth, there is less native energy in the water column to promote further mixing. This condition clearly would be less favorable for a prospective concentrate ocean outfall location.

While these current speed and direction data sets are available for the three locations, it is notable that AOML concludes that they may or may not be representative of the range of conditions that might be found in other locations. It remains unclear whether these values could be used to generalize current speed and direction ranges anywhere in the study area. Logic would indicate that for proposed outfalls sited at or very near these locations, these data sets would be relevant. However, facilities proposed at increasing distances from these locations would be less clearly analyzable using these field measurements. AOML has indicated that similar data sets for more locations and more sites distributed along the depth gradient are needed before any generalizations could be reliably made (AOML 2005c).

TEMPERATURE AND SALINITY RECORDS (DENSITY PROFILES)

Another critically needed data set required for evaluation of concentrate plume behavior in the receiving water is characterization of the water column profile for temperature, salinity, and pressure. These data are used in calculating water density, and it is the relationship between the water column density and that of the discharged concentrate that will have the most important influence on the mixing of the concentrate with the receiving water as it either rises or sinks in the receiving water body. Long-term records spanning seasons if not years are preferable in order to allow statistical analysis and definition of whether the water column is stratified substantively at any time during the year, or whether it remains reasonably well-mixed at all times.

On the basis of its information inventory, AOML concluded that there is a lack of adequate temperature and salinity data to support characterization of density profiles over the course of a typical year for any site within the study area. "*Not a single data set providing monthly water column density profiles for a year or more was identified in the coastal ocean area of interest*" (AOML August 2005).

OVERVIEW

There are substantive gaps in critically important physical oceanographic data sets that preclude conclusive statements regarding the technical feasibility of use of ocean outfalls for concentrate disposal along SJRWMD's Atlantic coastline. The fragmentary data identified by AOML during its information inventory indicates that sufficient bathymetry is understood to support the feasibility study, and substrate characteristics are known for a reasonably representative portion of the nearshore environment.

However, meaningful and potentially representative data sets regarding depth-distributed current speed and direction are available only for a limited number of sites. AOML did not find any information regarding water column stratification with respect to water density. Water column density data are needed to support modeling of how concentrate plumes having varied physical and chemical makeup are likely to be diluted or dispersed in the nearshore study area.

On the basis of these summary statements, AOML has recommended that substantive field investigations be integrated into SJRWMD's Phase 2 ocean outfall feasibility studies. Specific suggestions regarding candidate elements of the Phase 2 field investigations are provided in the following section of this document.

PHASE 2 FIELD INVESTIGATIONS

PARAMETER CONSIDERATIONS

During the course of performing the information inventory and literature review, AOML assessed the availability of a variety of data types. Although the primary focus was on physical oceanographic information, availability of chemical and biological oceanographic data was also considered. In general, the AOML conclusions regarding the relative sparseness of the physical oceanographic data for the study area are also applicable to the water quality and marine biological information categories. AOML recommends implementation of multi-year field investigations addressing physical oceanographic and key water quality parameters, with biological oceanographic studies also suggested as potentially of value. This section summarizes AOML recommendations as supplemented by suggestions from SJRWMD and FDEP representatives.

SJRWMD and AOML discussed prospective field investigations with FDEP during an interagency working meeting held in Tallahassee on July 19, 2005, with the objective of gaining a clearer understanding of the types of information FDEP would prioritize now during the feasibility study. These information categories might be contrasted with data gathering that might more appropriately be deferred until specific utilities are prepared to advance actual ocean outfall project sites and infrastructure proposals.

On the basis of those discussions, the following groupings of prospective field investigation parameters have been identified:

- Physical Oceanographic Measures (Tier 1 Parameters)
- Water Quality Considerations (Tier 2 Parameters)
- Marine Biological Considerations (Tier 3 Parameters)

These are further described below.

Physical Oceanographic Measures (Tier 1 Parameters)

The general consensus reached during this working meeting was that some level of field investigations under Phase 2 of this feasibility study would have particular value in clarifying how homogeneous the overall study area is regarding key physical oceanographic metrics. Prioritized metrics would include current speed and direction, and water column profiles for parameters needed to assess density variation with depth. These types of data could best be acquired through strategic deployment of ADCPs, and other data logging instrumentation, within the study area for extended periods of time. Profile information regarding key water quality parameters would be gathered during site visits to download the instrument recorded parameters.

Water Quality Considerations (Tier 2 Parameters)

A second tier of prioritized data gathering would address key water quality characteristics of ocean waters beyond the water column profiles of temperature and salinity. Particular focus would be warranted on quantifying background levels of chlorides, nutrients, and turbidity. At the referenced interagency working meeting, FDEP indicated that many of the brackish groundwaters serving as the source water for demineralization plants contained concentrations of nitrogen that, once concentrated during the water treatment process, represent levels of potential concern in terms of causing or contributing to algal blooms in receiving waters.

In marine waters, nitrogen is typically the nutrient form that limits the degree of eutrophication. Therefore, for this discussion regarding concentrate disposal, the various nitrogen forms are likely appropriate for inclusion in the Phase 2 investigations.

The rationale for conducting some form of regional background evaluation of nitrogen in nearshore coastal waters is tied to specific discussions with FDEP during the interagency working session. FDEP representatives indicated that mixing zone modeling of “nearfield” dilution and dispersion effects would likely be suitable for addressing most water quality compliance questions linked to demineralization concentrate. This is particularly so for the concept of seawater demineralization and concentrate discharge.

For the alternative case of discharge of concentrate derived from surface water or groundwater sources that contain substantive nutrient levels, “farfield” modeling of the fate and effects of nutrients would likely be required. Typical coastal water quality models that might be applied would need to predict chlorophyll a concentrations, representing algal populations, as a function of nitrogen inputs. To do this, models would need to be generated, calibrated, and subsequently validated to FDEP’s satisfaction.

Detailed discussion of modeling approaches is beyond what is needed for this current technical memorandum. It is sufficient to state, however, that to conduct the model calibration and validation processes, background data time series for nutrients and chlorophyll are required. These are not currently available (AOML 2005b). The Phase 2 field investigations would have value if they could generate sufficient data records to regionally characterize background nutrient and algal concentration conditions and variability in relation to proximity to inlets or other know sources of land-based pollutants, distance offshore, and depth in the water column.

Other key water quality parameters of potential priority include chlorides and turbidity. AOML includes chlorides as a parameter of potential concern because of the water quality standard listed in Chapter 62-302, *F.A.C.*, which stipulates that chlorides shall not be increased more than 10 percent above normal background in Class III marine waters. Determination of what normal background and its associated short-term or seasonal variability are provides a justifiable rationale for inclusion in this planning-level field investigation. Similarly, the turbidity standard indicates that turbidity is not to be increased more than 29 NTUs above background. Attempts to define regionally and seasonally pertinent background turbidity levels could be included in the conceptual planning-level field studies.

Lastly, it is noted that the current draft modifications to Section 62-620.625(6), *F.A.C.*, include specific recommendations regarding parameters that should be monitored in concentrates that are to be discharged to surface waters of the State. It may be reasonable to gather information on these parameters in the receiving water to establish the normal range of baseline conditions for those parameters. The list of parameters is addressed in greater detail below.

Marine Biological Considerations (Tier 3 Parameters)

If seawater demineralization is selected in the future, the resultant concentrates are expected to be denser than the receiving water, and prospects for plume contact with the bottom increase. Design of outfall diffusers is expected to adequately achieve rapid initial dilution, and minimize risk of plume settling to the bottom. However, this potential concern does exist.

The Biological Integrity criterion for marine waters listed in Chapter 62-302, *F.A.C.*, requires that proposed actions not lower the Shannon-Weaver Diversity Index for benthic invertebrates to less than 75 percent of the established background. In keeping with this logic applied for chlorides and turbidity, there may be justification for attempting to gather sufficient benthic invertebrate community composition and structure data to establish background diversity values for representative bottom types. These studies should focus on benthic conditions located within 3 miles of shore along prioritized segments of the SJRWMD coastline where outfall installations are most likely to be considered.

Benthic invertebrate communities are known to be highly variable both spatially and temporally. The level of investigation needed to adequately characterize "background" in light of both forms of variability may well be beyond the scope of what might reasonably be included in the planning-level field investigations under consideration. As a minimum, however, there may be justification for detailed examination of the marine benthic invertebrate data that may currently exist in the NOAA substrate characteristics database, or other agency databases. This review could confirm whether baseline diversity values might be calculated for at least some representative benthic environments within the study area using data generated by previous studies.

Additional marine biological concerns that may be raised relevant to concentrate disposal via ocean outfalls are likely to fall into two major additional categories. One would focus on the potential for concentrate release to negatively influence the viability of the affected waters to continue to serve as essential fish habitat (EFH). Under the Magnuson-Stevens Act as modified in 1996, the National Marine Fisheries Service (NMFS) is the lead federal agency responsible for determining if proposed actions might impact EFH of prioritized fish species having either recreational or commercial importance. Specific field investigations may not be required under Phase 2, but some level of EFH review and consultation with NMFS would be warranted to identify nearshore habitats within the study area that might need to be avoided during prospective ocean outfall siting activities.

Similarly, the other major category of potential marine biological concerns revolves around mandates provided by another federal level of environmental protection, the Endangered Species Act (ESA). In northeast Florida coastal waters offshore of SJRWMD, the key wildlife species of concern to both the U.S. Fish and Wildlife Service (USFWS) and the Florida Fish and Wildlife Conservation Commission (FWCC) are sea turtles and manatees. Again, while no field investigations appear warranted under Phase 2 of this feasibility study, consultation with these two agencies would be a logical element of follow up project activities under Phase 2 to confirm if there are specific geographies that would receive agency priority in terms of special protection measures. Such measures might preclude ocean outfall siting and it would be reasonable to identify such geographies now during the feasibility stage of planning for new outfalls.

CANDIDATE FIELD STUDY ELEMENTS

The following descriptions of candidate elements of the Phase 2 field investigations are presented to promote study plan discussions and refinement. It is anticipated that interagency review and discussion of these concepts will help refine what elements remain under consideration. The real-life constraint of funding availability will have substantive impact on what is ultimately conducted, when, and for how long.

Conceptual Nearshore Study Zones and Data Gathering Sites

To provide strategic field data for nearshore waters ranging from the north through the south portions of SJRWMD's coastal waters, no less than three representative study zones should be included in the Phase 2 field investigations. For example, three conceptual study zones are reflected in Figure 7. By establishing data collection sites somewhere within each of these study zones, and conducting concurrent studies at each site for at least a portion of the study duration, data generated would provide the comparative time series data to determine if regional generalizations are defensible regarding the key physical oceanographic parameters. If so, future outfall-specific investigations by utilities could utilize these baseline data sets to support more detailed permit-driven demonstration studies addressing FDEP permitting concerns.

The conceptual study zones shown are intended to reflect the desire to have concurrent investigations in locations geographically representative of the nearshore waters off all of the coastal counties within SJRWMD. This will ensure that the results of the studies have value to all prospective constituent utilities. Additionally, the conceptual study zones generally correspond to geographic areas containing the five potential seawater demineralization project sites addressed under prior SJRWMD investigations (R.W. Beck 2004). It may be assumed that the actual data gathering locations would be situated to be as representative as possible of the nearshore waters up to 3 nautical miles from shore.

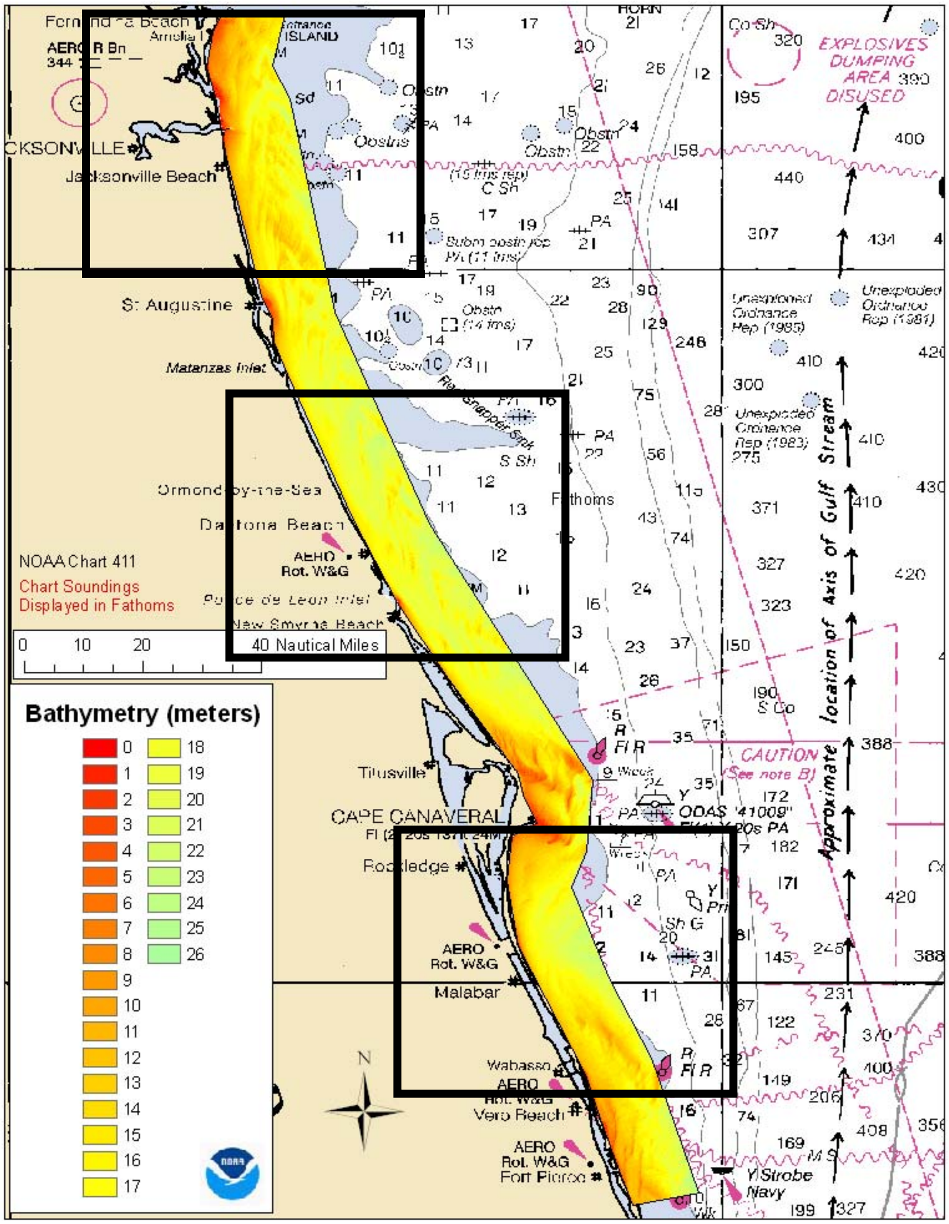

Figure 7. Three conceptual Phase 2 field study zones offshore of St. Johns River Water Management District

For discussion purposes, it may be reasonable to assume that the primary data gathering stations would all be established at comparable depths, and that stations would also be selected on the basis of similarity in substrate composition suggesting similarity in physical conditions. Serious consideration should be given to occupying or reoccupying data collection sites where historical data are available for comparative purposes (e.g, Cape Canaveral, Melbourne, or Ft. Pierce). This would result in a better cumulative time series of data to work with in the future for at least some of the key parameters described below. With these criteria in mind, comparison of the study zones in terms of key physical and water quality parameters would be possible.

For at least one of these study zones, multiple data gathering stations should be occupied for at least a portion of the study period. In simplistic terms, no less than three data gathering stations would be established at predefined distances offshore or alternatively at predetermined depth contours. Data generated along this transect that presumably would be roughly perpendicular to the shoreline would be used to determine how reliable the single point data gathering approach is for generating representative data sets that could support ocean outfall proposals in the future.

It is strongly recommended that interagency meetings with NMFS, USFWS, and FWCC be conducted early during the field study plan refinement process to discuss EFH, ESA, and any other conceptual siting constraints that might have bearing on the final selection of study zones and specific data gathering locations. Presumably, these data gathering efforts should be sited near prospective outfall locations that might be seriously considered for concentrate disposal in the future.

Physical Oceanographic Measures

With the above conceptual study zones and data gathering approach, a total of at least five (5) ADCP units would be deployed (three at one location representing a transect offshore, and one each at two additional sites). These data logging instruments would be bottom-mounted, and programmed to record current speed and direction no less than hourly; final programming of data logging will be determined during study plan finalization. AOML has recommended that these instruments have a vertical resolution range in the water column of between one-half and one meter. Instrumentation should be equivalent to ADCP units available from RDI (www.rdinstruments.com).

ADCP units can be deployed for extended periods with a fairly high level of confidence due to improved battery life and reliability. Data downloading can be accomplished throughperiodic unit retrieval and servicing. Alternatively, technologies are now available that allow use of acoustical modems for data acquisition without physical retrieval of the bottom-deployed units. For the initial year of study, it is recommended that monthly site visits occur for downloading and instrumentation status checks. As outlined below, during this initial year of study, other data gathering activities are also proposed that will need to occur on a fairly frequent basis. If the studies continue on for multiple years, a reduced frequency of instrumentation status checks and data downloads may be elected if no other field investigations require these monthly field activities.

Water Quality Measures

At all of the ADCP deployment sites, it is recommended that an additional bottom-mounted recording instrument be co-located for continuous logging of prioritized water quality parameters. As a minimum, AOML recommends that these sensor packages include conductivity and temperature in order to provide a detailed time series record of near-bottom density data. Additional parameters of potential interest for instrumented data logging include dissolved oxygen, turbidity, and possibly nutrients. Instrumentation should be equivalent to Hydrolab meters (www.hydrolab.com). These bottom-mounted instruments will provide continuous records of bottom conditions near where outfall diffusers might be located. Units could be programmed to measure these key parameters at half-hour or hourly intervals, or at alternative frequencies that may be determined during detailed study plan development. These data would provide critical information regarding receiving water variability in density, which could support outfall diffuser design efforts in the future. Data logging instrumentation could also provide useful background records for turbidity and other key water quality parameters.

Data downloads and meter calibrations for the referenced water quality measuring instrumentation should be conducted on a routine basis (e.g, monthly). At the time of each data download visit, field personnel should collect field meter-based conductivity temperature density (CTD) profiles of the water column. Example instrumentation that would be suitable should be similar in function to that available from Seabird (www.seabird.com). These types of instruments, when lowered through the water column, provide a continuous data log of these water quality metrics as a function of depth. These profiles will provide the key density measures needed to understand water column stratification, and will be appropriate for supporting future modeling analyses.

At the time of the monthly site visits to the data gathering stations, field personnel would conduct water column water quality sampling using Niskin bottles or comparable remote-triggered sampling bottles. Discrete grab samples of water retrieved from near-bottom, mid-depth, and near-surface should be chemically analyzed for parameters including chlorophyll a, and some or all of the following parameters identified in the draft modifications to Chapter 62-620, F.A.C.:

> *"Dissolved Oxygen; pH; hydrogen sulfide; Specific Conductance; Total Dissolved Solids; Color, Aluminum (marine waters only), Bromide, Calcium; Chloride; Copper, Fluoride; Iron, Magnesium, Potassium, Sodium, Radioactive Substances (combined Radium 226 and 228) and Gross Alpha Particle Activity (including Radium 226, but excluding radon and uranium); Nitrate, as nitrogen; Nitrite as Nitrogen, un-ionized ammonia, as nitrogen; ammonia-ammonium, as nitrogen; Total Nitrogen; Total Organic Nitrogen; Total Phosphorus; Ortho-Phosphate".*

Sampling and analysis of some of the above parameters might be conducted at a lower frequency, depending on the future recommendations from the interagency working group participating in this feasibility study. Field instrument measures of temperature, salinity, pH, and dissolved oxygen should be taken for each surface, mid-depth, and bottom water sample at the time of sample collection to support subsequent calculation of unionized ammonia concentrations.

Marine Biological Study Elements

If marine biological elements are included in the Phase 2 field investigations, they should primarily focus on the benthic invertebrate and demersal (bottom-associated) fish communities in the vicinity of the data gathering locations. It is recommended that during the course of Phase 2 field study plan refinement, a thorough review be performed of the available benthic records in AOML's database, or in other available databases, to determine the relative suitability of those records for supporting definition of background Shannon-Weaver Diversity values for benthic invertebrate communities. If these records are found to be adequate for this purpose, no Phase 2 field investigations for marine biological metrics would be pursued further.

The option to include benthic surveys at the data gathering locations remains under consideration. If such studies are performed, the study plan elements should be refined with FDEP input regarding appropriate field standard operating procedures (SOPs) for sample collection, processing, taxonomic workup, and data analysis. On the basis of the provisions of Chapter 62-302, *F.A.C.*, no less than triplicate full-size Ponar grab samples would need to be collected and analyzed at each data gathering station. These benthic surveys should be performed no less than quarterly for the duration of the benthic studies.

If fish community characterization is included in the Phase 2 field study plan, population census approaches could take a number of forms. In light of the proposed monthly visits for the first year of study to service the deployed instrumentation, it may be appropriate to consider fish traps or merely hook and line survey methods. Alternatively, depending on the depths and visibility conditions in the study zones, diver-operated video surveys might be an option. All of these approaches have been applied successfully over the past 7 years in demonstrating the maintenance of balanced indigenous populations of fish and invertebrates, and compliance with federal water quality standards, despite long-term ocean outfall operations in Puerto Rico (CH2M HILL 1998).

Conceptual Study Duration

AOML proposes a multi-year study plan, with the study elements generally outlined as summarized in Table 2. As indicated, adaptive management should be applied, with periodic data reviews and field study refinement scheduled at appropriate junctures in time.

Table 2. Conceptual Phase 2 Field Investigation Study Elements and Duration Proposed by AOML

Study Period	Field Study Element	Activity Description
Year 1	Interagency Consultations to Discuss Study Zones and Data Gathering Locations Review Existing ADCP Data (Current Speed and Direction) for Melbourne Beach and Cape Canaveral (Cocoa Beach) Sites Review Existing Benthic Invertebrate and Fisheries Data, and Ancillary Water Quality Records	Conduct as soon as possible. Conduct as soon as possible. Conduct as soon as possible.
	Current Speed and Direction (Two ADCP Deployments at Melbourne Beach)	Deploy. Service Monthly.
	Bottom-Mounted Water Quality Data Logging Instruments Co-located with ADCP Units (Three Units Deployed at Melbourne Beach)	Deploy. Service Monthly.
	Water Column Profiles (Field Measurements)	Conduct Monthly
	Surface, Mid-Depth, and Bottom Water Sampling for Chemical Analysis of Prioritized Parameters; Corresponding Field Measures	Conduct Monthly
Year 2	Continue the Year 1 study elements and sampling frequencies for the first half of Year 2. During this period, analyze the Year 1 data and generate a technical report on Year 1 study results, with recommendations for program refinements. Implement changes mid-year, as applicable. Deploy up to three additional ADCP and Water Quality Data Logging Instruments at each of the other two study zones to provide concurrent time series data at all three study zones for at least part of Year 2.	Revise Field Activities, as appropriate.
Year 3	Continue Year 2 study elements and sampling frequencies for the first half of Year 3. During this period, analyze the Year 1 and 2 data and generate a technical report on the cumulative study results, with recommendations for program study element and monitoring frequency refinements. Implement changes mid-year, as applicable.	Revise Field Activities, as appropriate.
Year 4	Continue Year 3 study elements and sampling frequencies for the first half of Year 4. During this period, analyze the Year 1, 2, and 3 data and generate a technical report on the cumulative study results, with recommendations for program study element and monitoring frequency refinements. Implement changes mid-year, as applicable.	Revise Field Activities, as appropriate.

Table 2—*Continued*

Study Period	Field Study Element	Activity Description
Year 5 and Beyond	Continue Year 4 study elements and sampling frequencies for the first half of Year 4. During this period, analyze the multi-year data sets and generate a technical report on the cumulative study results, with recommendations for program study element and monitoring frequency refinements. Implement changes mid-year, as applicable.	Revise Field Activities, as appropriate.

MODELING OPTIONS AND OTHER ACTIVITIES

In addition to the suggested Phase 2 field investigations, there are a series of other activities that warrant SJRWMD consideration for inclusion in Phase 2. Modeling could provide some useful information helpful to utilities during their planning efforts, and some other analyses might also be of value as the field investigation study plan is developed, and necessary interagency agreements are crafted and executed. These modeling and other activities are outlined in this section of the TM.

There are two basic modeling approaches that may be required for analysis of concentrate discharge in coastal ocean waters adjacent to SJRWMD. A principal difference in the two modeling approaches is the different spatial scale. The first modeling approach is focused on the near-field scale that typically deals with initial dilution in the water column very close to the discharge site, e.g., near the outfall diffuser. Near-field modeling addresses physical mixing in areas within the immediate vicinity of the point of discharge. In contrast, the far-field scale of modeling addresses plume dispersion and can potentially cover areas extending from one to tens of kilometers from the source under evaluation (AOML 2005c). Other forms of far-field models also often address fate and transport of constituents beyond the zone of initial dilution, and can address both physical processes as well as biochemical transformations.

During the course of the interagency working meeting in Tallahassee on July 19, 2005, and through follow up telephone contacts, it appears clear that there is a high probability of needing to conduct near-field mixing zone modeling. With concentrate generated from treatment of inland waters (fresh surface water, estuarine water, or brackish groundwater), FDEP representatives noted that elevated nitrogen levels in concentrate have been documented by monitoring records for some WTPs. For plants relying on brackish groundwater as source waters, FDEP indicated that there is a higher probability of needing to conduct far-field water quality modeling of the ocean receiving waters to quantify the probability of coastal phytoplankton community response to nutrient content of concentrates.

MIXING ZONE MODELING

Concentrate plume dilution modeling using one of the standard FDEP-supported hydrodynamic models should be anticipated for any and all prospective concentrate ocean outfall evaluations. Several models may be applicable for evaluation of mixing zones, including UDKHDEN, UM3 (Visual Plumes), and the various forms of CORMIX. All are suitable for analysis of positively buoyant plumes, with UM3 and CORMIX having also been applied to plumes denser than the receiving water in question. On the basis of comments made by FDEP representatives at this working meeting, it would seem that one option would be to defer exercise of these models to demonstrate concentrate ocean outfall technical feasibility until a specific utility proposal for an outfall is made.

Alternatively, Phase 2 activities could be designed to include planning-level application of the appropriate mixing zone models to clearly demonstrate technical feasibility of achieving compliance with the applicable surface water standards with the proper combination of outfall diffuser design coupled with a range of discharge variables, including concentrate discharge rate, water column depth at the outfall diffuser ports, water column density conditions, and ambient current speed and velocity conditions.

Concentrate water quality characteristics applied for these modeling demonstrations bracketing the range of the above discharge variables could similarly be varied based on existing data regarding concentrate characteristics associated with the different source water types. Through appropriate combinations of the above variables, a set of modeling scenarios could be defined and run to predict the level of compliance achievable under worst-case discharge and receiving water conditions.

Some form of planning-level modeling would be very instructive for utility representatives interested in understanding the factors impacting conclusions regarding technical feasibility of gaining authorization under either the existing or proposed mixing zone rules. With strategic selection of modeling scenarios, guidance might be generated regarding how deep the outfalls would need to be to achieve dilution needed for a variety of concentrate characteristics. This would translate to relative distance offshore and therefore to relative cost of outfall implementation.

Similarly, modeling of outfall scenarios either distant from or near to inlets could provide planning-level demonstrations of the cost implications of needing to extend outfalls several miles offshore as opposed to locating diffusers in nearshore areas more affected by tidal energy and diurnal water exchange. Particularly if seawater demineralization is elected as a preferred approach, concentrate discharge to inlet sites might be an engineering option having favorable cost ramifications that should be clearly demonstrated during this feasibility study. It is acknowledged that discharge of concentrate derived from demineralization of inland waters to inlets may not be advisable because of water quality-related ecological concerns. These types of modeling demonstrations are highly recommended for inclusion in Phase 2 of this feasibility study.

Two approaches to the timing of this proposed modeling demonstration of technical feasibility could be applied. Under Alternative 1, the modeling of a range of discharge scenarios could be conducted early during the Phase 2 activities. The best available field records for key parameters (e.g., ADCP-generated current speed and direction records) would be applied, supported by reasonable assumptions regarding those for which no study area-specific data have been found.

Following this approach, the modeling results could be presented to utilities potentially interested in concentrate outfalls within the near future. These results may be helpful with respect to improving utilities' understanding of the ramifications of the FDEP's currently proposed mixing zone rule modifications which are currently scheduled for ERC review and approval as early as the fall of 2005.

Under Alternative 2, these mixing zone modeling demonstrations could be deferred until some field-gathered data are generated by the proposed Phase 2 collection of representative current speed and direction, and water column density profile data. While this approach has the allure of being supported by data generated under this program, the major disadvantage is that the modeling would probably need to be deferred for a currently undefinable period of time during which instrumentation would be acquired, installed, and serviced long enough to generate the interim data sets to be used in the modeling of scenarios. In truth, both approaches have merit, and it may be worthwhile to proceed with Alternative 1 but also conduct Alternative 2 – perhaps as an element of the report on the Year 1 study results mid-way through Year 2.

FAR-FIELD WATER QUALITY MODELING

Water quality modeling of the coastal environment of the Atlantic Ocean has not been conducted routinely in Florida. There are relatively few dischargers that might ever need to demonstrate their impacts, or lack thereof, on the ocean. Conducting such modeling evaluations because of the prospective nitrogen concentrations present in some forms of concentrate may be a precedent-setting regulatory requirement.

On the basis of the brief discussions on this topic during the July 19, 2005, interagency working meeting, it was agreed that if this evaluation were to be required, some form of coastal water quality model would need to be created, calibrated, and validated. These types of models are relatively complex in that they must first accurately predict the 3-dimensional hydrodynamic conditions in the water column throughout the study area, and then must link this analytical capacity with the physical, chemical, and biological processes occurring in the water column that cause water quality changes over time.

An Environmental Fluid Dynamics Code (EFDC)-based model was suggested as possibly the most appropriate for simulating coastal hydrodynamic conditions, and linkage of this physical model with the Water Quality Analysis Simulation Program (WASP6) provides an analytical package capable of addressing both the physical and chemical aspects of ocean outfall effects. Useful information regarding these types of modeling approaches may be retrieved from www.epa.gov/athens/wwqtsc/html/efdc.html.

In light of the historical reliance on brackish groundwater as a raw water supply, and FDEP's concerns regarding assessing the potential for nutrient levels in concentrate causing or contributing to coastal water body eutrophication, risk of receiving water response to concentrate in the form of phytoplankton stimulation will need to be addressed in the future. At this point in the feasibility study, however, it seems premature to invest much energy into development and calibration of a regional water quality model applicable to the SJRWMD coastal waters.

As an alternative approach, it is recommended that a more thorough evaluation of nitrogen levels in demineralization concentrate be conducted during the Phase 2 activities to better quantify the incidence and magnitude of such elevated levels. If these Phase 2 investigations confirm that nitrogen concerns could be major impediments to gaining regulatory approval, this could drive utilities to either be more proactive at evaluating source water alternatives, or could merely catalyze a more rapid development of reliance on seawater as the preferred source water. Presumably, use of seawater as the raw water source for demineralization plants would eliminate FDEP's concerns regarding nutrient levels in concentrate discharges to the ocean.

Some utilities are currently designing or operating demineralization WTPs using brackish groundwater, estuarine water, or even fresh surface water as their source water. Where nitrogen levels in that source water are demonstrated to be high enough to represent a confirmable risk in terms of concentrate discharges causing or contributing to coastal system eutrophication, concentrate treatment to reduce the nitrogen concentrations to acceptable levels would be an option. FDEP representatives indicated that the nitrogen is present as ammonia, and therefore is reasonably easy to reduce through standard water treatment approaches. This intermediate step may well prove to be the recommended approach should utilities ultimately choose to continue to rely on inland water sources but pursue an ocean outfall disposal approach to concentrate management in the future.

OTHER POTENTIAL PHASE 2 ACTIVITIES

Various topics of discussion were raised during the July 19, 2005, interagency working meeting that may warrant follow up activities during Phase 2. These include the following:

In-Depth Review of Ancillary Field Records from Historical Studies

The AOML information inventory and literature review identified the GIS coverage detailing substrate composition and characteristics (see Figure 4). One concept raised was that investigators that conducted those field investigations of bottom substrate types may have collected ancillary biological or water quality records at the time of sediment sampling. It seems appropriate to conduct a review of the database to determine if any records of temperature, salinity, dissolved oxygen, or other relevant parameters are retrievable, and specifically if such information exists for different depths within the water column. Biological records should be reviewed to see if the available data provide usable information for calculation of baseline Shannon Weaver Diversity values. If sufficient historical records can be retrieved and compiled, this supplemental data set could have value for improving our understanding of the temporal and spatial variability in the physical, biological, and water quality conditions of this overall study area.

Development of Conceptual Engineering Projects for the Field Study Zones

The preliminary investigations performed to date have been focused on the ocean environment as the potential constraint on implementing ocean outfalls for concentrate disposal. An alternative view may warrant consideration during Phase 2. During prior studies in support of DWSP development, SJRWMD has conducted work that includes preliminary siting of conceptual demineralization facilities to help meet future water supply demands. Siting criteria used in those prior studies did not prioritize ocean outfall feasibility, focusing instead on potential co-location with power generating plants. A logical element of the Phase 2 ocean outfall feasibility study might include developing engineering project elements for conveyance of concentrate from prospective existing or proposed demineralization facilities to the coast for subsequent conveyance offshore to the conceptual ocean outfall(s).

Preparing conceptual designs of these engineering elements would create the basis for planning-level cost estimation for design, permitting, and construction of such facilities for representative scenarios and geographies within SJRWMD. Engineering concept scenarios for the land-based elements of expanded use of demineralization must be integrally linked with the sea-based elements of ocean outfalls in order to ultimately address economic feasibility issues. These have not yet been addressed, but should certainly come into play during Phase 2.

Once these conceptual engineering designs are available, they also will help crystallize evaluation of potential environmental fatal flaws. Conveyance of concentrate to the coast will in many parts of SJRWMD require pipeline crossings of water bodies like the Indian River Lagoon, Mosquito Lagoon, the Banana River, the Halifax River, or other forms of the Intracoastal Waterway. A rational, cost-effective, and permittable means of accomplishing conveyance must exist for the pursuit of ocean outfalls for concentrate disposal to make good planning sense. For this reason, it is recommended that Phase 2 include this planning-level activity.

PROPOSED PHASE 2 STUDY IMPLEMENTATION

The preceding sections of this Technical Memorandum present a series of candidate elements for potential inclusion in the Phase 2 feasibility study. Synthesis of suggestions from AOML, CH2M HILL, FDEP, and SJRWMD representatives has led to the following proposed set of implementation steps. Some of these are necessarily sequential in nature while others may occur concurrently. For this reason, the proposed study elements have been segregated into Phase 2a and Phase 2b groups, with tasks numbered under each group. As for much of this deliverable, the following proposed Phase 2 study implementation approach is intended to promote future interagency discussions and scope refinement.

PHASE 2A STUDY ELEMENTS

The proposed Phase 2a study elements consist of the preparatory tasks leading up to implementation of the field studies described under Phase 2b. Specific proposed tasks include the following.

- Task 2a.1 – Prepare Draft and Final Field Study Plan
- Task 2a.2 – Review Ancillary Water Quality and Benthic Community Data in Coastal Databases
- Task 2a.3 – Review Existing and Prospective Groundwater, Surface Water, and Ocean Water Quality With Respect to Potential Concentrate Parameters of Concern
- Task 2a.4 – Compare Cape Canaveral/Cocoa Beach and Melbourne Beach ADCP Records
- Task 2a.5 – Prepare Conceptual Engineering Designs for Representative Outfall Scenarios
- Task 2a.6 – Conduct Planning-Level Mixing Zone Modeling of Representative Outfall Scenarios

These are generally described below.

Task 2a.1 – Prepare Draft and Final Field Study Plan

The investigations conducted to date have indicated the need for supplemental field data gathering to support further ocean outfall evaluations. Under Task 2a.1, a detailed field study plan will be prepared detailing specific stations to be occupied and parameters to be measured. Instrumentation to be deployed or used in field measurements will be specified, and specifications for the method of data retrieval from deployed instruments will be defined. The study plan will detail planned programming of instruments to specify the frequency of data logging of the targeted parameters, and will provide justification for the proposed methodologies and programming.

The field study plan will specify proposed water quality measures, stations, and sampling frequencies, and will specify sample collection standard operating procedures (SOPs). SOPs will include field and analytical quality control measures to be applied to meter-based measurements as well as analytical sample collection and transport.

No biological sampling or ship-based survey methods using advanced acoustic or optical sensors are proposed for inclusion in this study plan. However, the draft study plan will be submitted to an interagency review panel that includes senior representatives of NMFS, USFWS, FWCC, and FDEP as a means of gaining input from these key resource management agencies regarding the relative need for such field investigations during Phase 2 of this feasibility study. Following issuance of a preliminary draft field study plan, an interagency working group workshop to discuss the proposed field study plan elements and methods would be facilitated to promote effective cross-agency discussions within a short period of time.

A key element of this field study plan will be a detailed cost estimate, and an implementation matrix defining the anticipated costs of each study element, and the responsible agency identified as willing and able to fund the associated activities. SJRWMD will lead interagency discussions regarding co-funding or contributions of in-kind services, and will use those discussions to help guide final implementation strategy selection.

Task 2a.2 – Review Ancillary Water Quality and Benthic Community Data in Coastal Databases

The National Ocean Service of NOAA has extensive information regarding benthic sediment composition within the study area. Under Task 2a.2, a subset of the stations located within 3 nautical miles from the Atlantic shoreline along SJRWMD will be identified using the agency's GIS system, and all associated information regarding the field studies conducted at those stations will be compiled into a subset of the database.

The database will be reviewed to confirm whether there are any ancillary records of water temperature, salinity, or other water quality characteristics as a function of depth within the water column. Any such records will be sorted by month of the year, and summarized to assemble seasonally-composited indications of water column water quality/density conditions. If sufficient data are found during this initial data screening effort, the analysis will proceed to determine if there are recognizable temporal or spatial patterns in the data. If sufficient data are not found, this task will be terminated.

During the course of this data subset review, the benthic records will be reviewed to determine the availability of benthic invertebrate community evaluations that are sufficiently robust to support calculation of Shannon Weaver Diversity values. If sufficient data are found, these analyses will be conducted to provide an overview of baseline diversity values in relation to the different study area geographies. If sufficient data are not found, this task will be terminated.

The results of both of the above database reviews will be summarized in an interim deliverable consisting of a brief technical memorandum.

Task 2a.3 – Review Existing and Prospective Groundwater, Surface Water, and Ocean Water Quality With Respect to Potential Concentrate Parameters of Concern

Concerns have been raised regarding use of ocean outfalls for disposal of concentrate that may, because of the characteristics of the source waters, bear nutrient levels that are higher than those present in the ocean. To better understand how prevalent this issue is, a review will be conducted of existing and prospective groundwater, surface water, and ocean water quality nutrients. This review will provide utilities a better perspective regarding the likely need to treat the concentrate prior to ocean disposal, and/or may influence source water selection decisions as demineralization technologies are considered in the future.

This review will be conducted using groundwater and surface water quality data readily available through SJRWMD's existing monitoring records from its own studies, or through investigations by constituent utilities. No new sampling of surface water or groundwater is proposed. Seawater water quality will be characterized using literature values if relevant data are not available through SJRWMD or other federal, state, or local agencies.

The results of this review will be summarized in a concise technical memorandum. Relevant data summaries may be appended as further documentation of the key points highlighted in the memorandum.

Task 2a.4 – Compare Cape Canaveral/Cocoa Beach and Melbourne Beach ADCP Records

The AOML information inventory and literature review documented the availability of current speed and direction data gathered through ADCP deployments by EPA off of Cape Canaveral/Cocoa Beach, and by FDEP off of Melbourne Beach. These monitoring sites are located approximately 30 km apart and at different depths and different distances from shore. Under Task 2a.4, the time series data will be analyzed statistically to determine if their use to characterize current speed and direction for the entire SJRWMD study area south of Cape Canaveral is defensible. Particular focus will be placed on analysis of overlapping time series of data.

The results of this review will be summarized in a concise technical memorandum. Relevant data summaries may be appended as further documentation of the key points highlighted in the memorandum. Graphical data comparisons in formats similar to the current speed and direction summaries presented in this TM will be used to depict data set similarities or differences, as applicable.

Task 2a.5 – Prepare Conceptual Engineering Designs for Representative Outfall Scenarios

Prior SJRWMD studies focused on demineralization feasibility identified a set of candidate locations for future facilities. Additionally, it is known that demineralization facilities currently exist where an ocean outfall option might represent an improvement over the status quo concentrate management approach. Up to three study locations will be selected and used as the origination points for concentrate generation. Under Task 2a.5, conceptual engineering designs for these three conceptual systems will be prepared to address engineering and environmental issues associated with pipeline routing to the coast, and subsequent outfall pipe extension offshore to alternative depths at which high rate diffuser installation would occur.

The planning level conceptual designs would produce drawings needed to depict corridors and routes. These deliverables would help identify ways to avoid potential environmental fatal flaws that could be encountered. Additionally, the conceptual designs will provide engineering data needed for planning-level costing of outfall concept implementation. Unless otherwise directed by SJRWMD, it may be assumed that one engineering concept will be prepared for each of the currently proposed study zones along the coast.

The products of Task 2a.5 will primarily consist of plan-view conceptual design drawings depicting possible corridors and linear routes for the shore-based and sea-based outfall systems. Representative cross sections and profiles may also be generated along with limited text descriptions to clarify the planning-level nature of these project visualizations.

Task 2a.6 – Conduct Planning-Level Mixing Zone Modeling of Representative Outfall Scenarios

Ultimately, to demonstrate concentrate ocean outfall feasibility, some form of mixing zone demonstration will be required. Planning-level modeling of a variety of discharge scenarios selected to bracket the possible combinations of key modeling variables is proposed under Task 2a.6. Key parameters that would need to be considered in developing the matrix of modeling scenarios include the following:

- Concentrate discharge rates
- Concentrate water quality/density
- Depth of water
- Receiving water quality/density
- Receiving water current speed and direction
- Diffuser design (number of ports, port angles, etc.)

Under this task, a range of values for these parameters acceptable to FDEP will be defined through interagency communications, including one meeting in Tallahassee, and documented in a brief technical memorandum. Following interagency agreement on the modeling assumptions to be applied, the model(s) to be used, and the range of parameter combinations to be analyzed, a series of modeling runs will be conducted. Modeling results will be synthesized into a series of summary graphs or tables, and attached to a brief technical memorandum specifically addressing discharge scenarios and regulatory permitability.

PHASE 2B STUDY ELEMENTS

The Phase 2b study elements consist of the field study implementation tasks, routine monitoring and data management, results documentation, and interagency coordination and communications. Specific tasks proposed include the following.

- Task 2b.1 – Execute Interagency Memorandum of Understanding and Cooperative Funding Agreements
- Task 2b.2 – Prepare Quality Assurance Project Plan
- Task 2b.3 – Purchase/Lease Equipment
- Task 2b.4 – Deploy ADCP and Water Quality Data Logging Units (Melbourne Beach Stations 0.5, 1.5, and 2.75)
- Task 2b.5 – Monthly Servicing of Deployed Instrumentation and Data Management (18 months)
- Task 2b.6 – Monthly Water Quality Surveys, Laboratory Liaison, and Data Management (18 months)
- Task 2b.7 – Quarterly Status Reports/Interagency Meetings
- Task 2b.8 – Year 1 Annual Summary Report

These are generally described below.

Task 2b.1 – Execute Interagency Memorandum of Understanding and Cooperative Funding Agreements

Once a final field study plan is generated as described under Task 2a.1, SJRWMD and the other agencies participating in this feasibility study will have a clear definition of what is to be done, when, and by whom. An interagency memorandum of understanding (MOU) and/or cooperative funding agreements (CFAs) will need to be drafted, reviewed, and approved by all parties prior to execution.

Task 2b.1 is identified as a needed step in the process leading to implementation of the Phase 2 field studies. SJRWMD will have the lead role in preparing and executing these administrative vehicles to its satisfaction prior to moving forward with any form of field study implementation.

Task 2b.2 – Prepare Quality Assurance Project Plan

The field study plan generated under Task 2a.1 will contain the bulk of the information needed to assemble the more detailed quality assurance project plan (QAPP) that will guide actual field activities. The QAPP can include the site safety plan as well as define in detail the specific field and sample management protocols to be applied by all team participants in order to ensure the highest quality data integrity.

Under Task 2b.2, the QAPP focused on the study elements incorporated into the finalized field study plan will be prepared and submitted for interagency working group review and approval. It is proposed that a formal agency signature page be used to document interagency agreement and commitment to work collaboratively on these studies through completion. The QAPP should include a summary of interagency commitments of funding and/or in-kind services.

Task 2b.3 – Purchase/Lease/Testing of Equipment

Once all necessary MOUs or CFAs are in place, and all administrative approvals are received, purchase and lease agreements for equipment acquisition and maintenance can be implemented. Essentially, under Task 2b.3, mobilization of long-lead time items will be conducted to prepare to launch the field studies. This task will include equipment acquisition, testing, and preparation for field deployments.

Task 2b.4 – Deploy ADCP and Water Quality Data Logging Units

As currently proposed, the initial field study would cover approximately 18 months, and will include ADCP deployment at Melbourne Beach at two distances from shore (roughly 1.5 and 2.75 miles offshore) to complement the existing ADCP deployed and maintained on behalf of the FDEP (approximately 0.5 mile offshore). It has been assumed that three bottom-mounted water quality data loggers will also be deployed at these three monitoring stations. Under Task 2b.4, the SJRWMD team will prepare for and execute the initial deployment of these instruments and will remain on-site long enough to confirm all systems are functioning.

It should be acknowledged that under the scenario where source waters are found to be free from constituents of potential concern, outfalls located nearer to shore or perhaps even near coastal inlets where tidal influence may promote concentrate dilution remain alternatives that utilities may opt to pursue in order to help minimize outfall related implementation and operational costs. In the SJRWMD investigation of five potential seawater demineralization project sites, one of the concentrate management strategies proposed was an outfall within the Ponce Inlet at depths of approximately 30 feet. At this depth and in this zone of tidal flushing, it was anticipated that adequate dilution could be achieved to meet all water quality standards (R.W. Beck 2004). Inclusion of near shore or inlet-related study areas into Phase 2b may occur if sufficient interest develops during execution of Task 2a.1.

Task 2b.5 – Routine Servicing of Deployed Instrumentation and Data Management (18 months)

On a routine basis, the three monitoring stations will be visited to download data and/or confirm all systems are functioning. Unless otherwise determined during the field study plan development efforts, it is assumed routine servicing will be conducted monthly for this initial period of field study. The data files downloaded will be compiled in an environmental database, and the data analyzed statistically to provide descriptive statistics and/or summary graphics depicting the monitoring results for that month.

Under Task 2b.5, these iterative operations will be conducted for a total of 18 months. The initial 12 months of data will be used to support the annual report described below. The subsequent 6 months of monitoring will be conducted without any monitoring program changes unless it becomes evident during the quarterly reviews described below that an earlier program refinement is warranted. Program refinement will be made only with interagency workgroup concurrence.

Task 2b.6 – Monthly Water Quality Surveys, Laboratory Liaison, and Data Management (18 months)

At the time of each monthly visit to the three monitoring stations at Melbourne Beach, field instruments calibrated in accordance with the manufacturer's guidelines will be used to document water column profiles of temperature and salinity. Additionally, water grab samples will be collected from near surface, mid depth, and near bottom for subsequent chemical analysis for the water quality parameters identified in the finalized field study plan and QAPP documents.

Water quality samples will be submitted to SJRWMD's designated analytical laboratory. Results obtained back from the laboratory will be compiled in an environmental database consistent with the records generated under Task 2b.5. Monthly data summaries will be tabulated to facilitate routine data screening for quality, and relevance to the demineralization ocean outfall feasibility study.

Under Task 2b.6, these iterative operations will be conducted for a total of 18 months. The initial 12 months of data will be used to support the annual report described below. The subsequent 6 months of monitoring will be conducted without any monitoring program changes unless it becomes evident during the quarterly reviews described below that an earlier program refinement is warranted. Program refinement will be made only with interagency workgroup concurrence.

Task 2b.7 – Quarterly Status Reports/Interagency Meetings

Interagency working group collaboration on field study plan development, and QAPP review and approval, will be important milestones. Once the field program implementation begins under Phase 2b, periodic data summarization and status reporting will be needed to maintain interagency working group involvement at key junctures in time.

It is proposed that quarterly status reports in the form of brief memoranda be implemented beginning roughly 3 months following the deployment of the ADCP units and start up of the water column sampling activities. These may be supplemented by interagency meetings at least biannually, if necessary to ensure all working group members are adequately briefed on interim findings, and possible needs for mid-course revisions to the program.

Task 2b.8 – Year 1 Annual Summary Report

Once the first 12-month period of data collection has been completed, a Year 1 Annual Summary Report will be prepared summarizing the data generated to date. Tabular and graphical summaries of the key parameters measured will be used to highlight the key points of note supported by the field program. Conclusions and recommendations supported by the field records will be presented, with particular focus on the need to revise the field program.

It has been assumed that the draft and final report will be finalized within the first half of Year 2, and that any program modifications will be implemented no later than the end of the 18 month initial study period. Interagency agreements for program refinement will need to be completed within this same time period to avoid any interruption in field data time series assuming the program proceeds beyond the initial 18-month period.

CONCLUSIONS AND RECOMMENDATIONS

The information summarized in this technical memorandum represents the synthesis of input from AOML's information inventory and literature review, and the interagency discussions to date regarding the concept of demineralization concentrate ocean outfalls offshore of SJRWMD. Many of the ideas presented have evolved from initial suggestions from individuals that have since merged and melded with other concepts from other sources. Thus, it should be acknowledged that the number of contributors to this document is quite large, and the product represents a multi-agency effort.

Phase 1 of this feasibility study was to accomplish an information inventory and literature review regarding oceanographic concerns that might impact the viability of the proposed concentrate ocean outfalls. This objective was accomplished. The AOML investigation confirmed that while some relevant data exist for the study area, the information available is considered sparse at best, and AOML's conclusion is that additional field studies are needed to truly position SJRWMD for assisting utilities in evaluating whether demineralization technologies should be integral elements of their long-term water supply plans.

A range of optional field study and related Phase 2 activities has been identified in this Technical Memorandum for SJRWMD's review and consideration. Some of these are viewed as worthy of prioritization (e.g., field studies to characterize temporal and spatial variability in nearshore water column density profiles) while others are good candidates for deferral until project-specific proposals emerge over time (e.g., detailed benthic invertebrate community assessments in the vicinity of prospective outfall locations). Other prospective Phase 2 elements may well have scientific or regulatory value, but could also have to be deferred if funding or other resource constraints exist that preclude full implementation of all possible recommended actions. These are conditions that all of the interagency team members fully understand; it will be up to SJRWMD's management team to sift through all of the possible Phase 2 elements and determine which are viewed as prioritized, affordable, and justifiable.

We recommend the following actions:

1. SJRWMD should proceed with having detailed scopes of work prepared for proposed Phases 2a and 2b as separate planning documents. The scopes of work should be designed to produce a field study sampling plan as well as task definition for the other proposed Phase 2 study elements.

2. The Phase 2b sampling plan should be designed with input from FDEP and other agency participants. It should contain detailed text and tabular summaries providing clear definition of, as a minimum, the following:

- Study zones and stations within each zone, where applicable
- Targeted data to be generated and rationale for each set of parameters (e.g., physical, chemical, and biological oceanographic information)
- Instrumentation to be used and associated programming (if applicable)
- Standard operating procedures for all field activities
- Field and analytical quality control measures
- Frequency of sampling/field surveys
- Data management plans
- Data interpretation and documentation schedules, including plans for adaptively managing field study scope elements and schedule

The sampling plan should include, as appendices, candidate vendor information and detailed cost estimates for each field study element. Costing information corresponding to the conceptual study elements will be needed for SJRWMD to determine what elements are to be incorporated into Phase 2b.

3. The scopes of work for the other Phase 2 activities outlined in this TM should be prepared to the level of detail needed for SJRWMD management review and determination regarding which of these activities can be included under Phase 2a.

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APPENDIX A – AOML PRELIMINARY DRAFT TECHNICAL MEMORANDUM 3, EVALUATION OF ADDITIONAL INFORMATION NEEDS, AUGUST 22, 2005

Task 3

Technical Memorandum 3

Evaluation of

Additional Information Needs

August 22, 2005

Preliminary Draft

John R. Proni

NOTE: This document is written in satisfaction of the requirements contained in Phase I, Task 3 of the work statement of the St. Johns River Water Management District (SJRWMD) and the Atlantic Oceanographic and Meteorological Laboratory (AOML) agreement. In discussions held with the SJRWMD project manager it was decided to include the contents of this memorandum as an appendix to a report to be prepared by a District contractor. What follows is the AOML contribution to the contractor's report.

CONTENTS

I. INTRODUCTION

This Technical Memorandum (TM) is focused upon environmental data and information needed to satisfy regulatory requirements for potential desalination concentrate discharge into coastal ocean waters adjacent to the St. Johns River Water Management District (SJRWMD). Although the Florida Department of Environmental Protection (FDEP) is the principal regulatory agency concerned with concentrate discharge in coastal ocean waters extending to three miles from shore, other agencies also have an interest. Other federal agencies include the National Marine Fisheries Service (NMFS), the US Environmental Protection Agency (EPA), the Department of the Interior (DOI) and the US Army Corps of Engineers (USACE). Other state agencies that are significant stakeholders include the Florida Fish and Wildlife Conservation Commission and SJRWMD itself, and there are a host of county and municipal level entities with interest in this potential element of water supply management in the future. A discussion of the key State of Florida permit considerations is given in the main body of this memorandum.

In this AOML TM, the following is presented:

A. An assessment of the adequacy of existing information on the ocean environment adjacent to SJRWMD, with respect to current regulatory requirements for disposal of demineralization concentrate in coastal ocean waters. This assessment includes the following:

i. An evaluation of existing data

ii. Needs for additional data and analysis

iii. Modeling needs

B. Recommendations for the following:

i. Additional data collection

ii. Additional analysis modeling

iii. Initial ocean data monitoring

iv. Modeling approaches

II. METHODOLOGY/PROCESS OVERVIEW

In order to carry out an evaluation of the status of the adequacy of existing environmental data to address regulatory requirements for concentrate discharge, both the relevant regulatory requirements and appropriate environmental data must be identified. While significant regulatory information regarding concentrate discharges is available in the Florida Administrative Code (FAC), language in the Code relevant to discharge of desalination concentrate in the coastal ocean continues to evolve. The continuing evolution of the language has necessitated close cooperation with FDEP personnel regarding the discharge of desalination con-centrate. In the present context the words "regulatory requirements" include not only those requirements contained in the extant FAC, but also requirements in evolution, gleaned through conversations with regulatory agency personnel. Other evolving factors also play a significant role in the determination of identification of key environmental data. These factors include source water characteristics and potential discharge site environmental characteristics. Neither of these two factors are fully determined at the present time, so in the evaluation of relevant extant environmental data, and in anticipation of additional data requirements, latitude will be required.

In due course it is anticipated that cooperating water utilities will come forward to participate in the evolution of the desalination project. Those utilities will join in the prospective concentrate discharge site identification. Broadly speaking, needed environmental data can be grouped into those data needed for feasibility or planning purposes and those data relevant to specific prospective discharge sites.

While there are many factors entering into the concentrate discharge site selection process, one of the most important of those factors will be the environmental data obtained in the feasibility or planning process. The present study effort contributes to the exciting prospect of achieving enhanced environmental protection through a site selection process incorporating long-term biological, chemical and physical oceanographic data while at the same time carrying out a vitally needed public water supply project.

A basic assumption is that concentrate discharge into the coastal ocean will be accomplished using an ocean outfall possibly with a diffuser. It is also assumed that a mixing zone may be required so that the environmental data attendant to the granting of a mixing zone will be required. It is also assumed that the outfall/diffuser will be located within three miles from shore (this assumption is largely based on economic considerations). Since source water specification is not finalized, a range of source water types and desalination plant processing efficiencies must be allowed; this in turn requires consideration of both negatively and positively buoyant concentrate discharges. Some environmental parameters are such that they are more spatially similar than others, while some environmental parameters may vary significantly over relatively smaller spatial scales. For example, biological parameters may be expected, generally, to be more site-specific than large-scale oceanic currents. However each circumstance must be evaluated separately. For example, relatively small spatial scale differences both in physical oceanographic parameters and biological parameters may be expected in the vicinity of inlets.

The methodology employed herein was to (a) review the Florida Administrative Code (FAC) for requirements relative to discharge of concentrates in surface waters in general and for Class III Marine waters in particular (b) to hold frequent conversations with FDEP staff regarding concentrate discharges (c) to review environmental parameters of key importance in present discharges of substance to the coastal ocean via diffusers, (d) to determine other agency interest in concentrate discharges to the coastal ocean and (e) to hold conversations with environmental professionals in universities, private corporations and environmentally concerned citizens regarding discharges in the coastal ocean.

Having identified the key environmental parameters likely to play a role in concentrate discharge, an in-depth review of existing data was conducted. The results of this review were presented in the (draft) technical memorandum entitled *"Literature and Data Review for Ambient Coastal Ocean Parameters for Potential Coastal Ocean Concentrate Discharges-Phase I Task 2"* (AOML, Jan. 6, 2005). A summary of this report is presented in the document entitled *"Summary of NOAA Oceanographic Information Inventory and Literature Review*

Supporting a Demineralization Concentrate Ocean Outfall Feasibility Study" (CH2MHILL, July, 2005). Based on this review an evaluation of existing data is now presented.

III. ASSESSMENT OF THE ADEQUACY OF EXISTING INFORMATION

This assessment is of the adequacy of ocean environmental data and information adjacent to SJRWMD with respect to current regulatory requirements for disposal of demineralization concentrate in coastal ocean waters.

This assessment evaluates the adequacy of existing environmental data and/or information from multiple perspectives, but all are linked to regulatory requirements or concerns. The first perspective is data needs for the planning or feasibility of concentrate discharge in the coastal ocean and the second perspective is for data needs for site-specific concentrate discharges. The question "What environmental data gathered, prior to specific concentrate discharge site selection, will be of greatest use in the site selection process?" is also contemplated in the present section (as well as in other following sections). Beyond the perspective of use in the site-selection process, long-term environmental data are needed for evaluation of those discharge parameters in the FAC which require comparison between background (receiving water) environmental parameter values and values of those parameters (receiving water) in the presence of the concentrate discharge. Yet another perspective is for use of long-term environmental data is in coastal ocean modeling.

Typically, there are two general scales of modeling of interest in the context of discharge via diffusers in the coastal ocean, the first is on spatial scales on the order of several times the depth of the diffuser to several kilometers and the second is on larger scales perhaps many tens of kilometers in extent. Uncertainties in source water characteristics and processing characteristics could conceivably introduce a requirement for larger scale modeling. Yet another perspective is for initial considerations in the design of concentrate discharge monitoring programs. Long-term environmental data can be used to establish the range of naturally occurring ambient (receiving water) coastal ocean parameters contemplated for measurement in monitoring program design. Finally, constancy of ocean water (characteristics) as a source for desalination is a synergistic measurement possibility that can be studied in the context of long-term environmental measurements

A. Evaluation of existing data

NOAA (National Oceanographic and Meteorological Administration)/AOML has conducted a literature and data review on the ocean environment adjacent to SJRWMD. This extensive literature and data review was carried out to determine those coastal ocean parameters relevant to the discharge of concentrate in the coastal ocean. The Literature and Data Review together with information gained in a meeting held in Tallahassee Florida on July 20, 2005 with FDEP personnel and multiple telephone conversations with FDEP personnel both prior to and after the above meeting date have provided significant knowledge for much of the present evaluation.

i. Physical Oceanographic Data

Examination of the literature and data review will reveal that extant data on the coastal ocean physical oceanographic parameters relevant to the performance of a prospective concentrate discharge is limited. To illustrate the limited nature of the extant physical oceanographic data, consider the evaluation of concentrate discharge dilution. Concentrate discharge dilution depends upon the following physical oceanographic parameters: water column ambient current profiles (current speed and direction as a function of depth), water column density profiles (salinity and temperature as a function of depth), and discharge depth (height of the water column above the discharge location). For relatively shallow discharge sites wave action is also a consideration.

Only three ambient current data sets were found of extended duration, adequate sampling frequency, in water of appropriate depths, and at reasonable prospective discharge locations. Two of these three data sets had data of one year in duration or greater. The third had data of only two months in duration. One of these two data sets was (and continues to be) obtained by the Bureau of Beaches and Coastal Systems of the FDEP. The data are being gathered at a site approximately one-half mile seaward of Melbourne Beach in water approximately 8 meters deep. The second data set of interest was gathered by the EPA at a site located approximately 2.5 miles seaward of Cocoa Beach in a water depth of approximately 15 meters. Data were gathered at this site for a period of one year. See Figure 1 for site locations. The distance of separation of these two sites is approximately 30 kilometers. The FDEP and EPA data were the only two data sets of sufficient duration, appropriate sampling frequencies and appropriate locations, i.e. within three miles from shore, found.

Time Series of water column density profiles, calculated from measured water column salinity and temperature profiles, are not available for any location in the study area. Not a single data set providing monthly water column density profiles for a year or more was identified in the coastal ocean area of interest.

Bottom depth information appears to be the most complete data set found relevant to dilution calculations. The National Ocean Service (NOS), a component of NOAA, maintains an extensive digital Geographic Information System (GIS) database on ocean bottom depth for much of the coastal area of interest. Examples of bottom data are presented in both the NOAA/AOML review and in the SJRWMD contractor summary memorandum. Tidal height predictions are also available from the NOS.

ii. Chemical Oceanographic/Water Quality Data

Examination of the Literature and Data Review will reveal that only sparse chemical oceanographic data are available in the broad coastal ocean area of interest. As with water column density profiles, monthly measurements of water column oxygen, PH, turbidity and chlorophyll a profiles are of general interest and could be useful in understanding longer term trends in the coastal ocean.

Coastal ocean nutrient data is also of value. The significance of nutrient data depends to a large extent upon the character of the source water(s) utilized. Generally, coastal ocean waters tend to be low in ammonia concentrations. This can be in significant contrast to lagoon water and groundwater. Lagoon water and/or groundwater water may have sufficient ammonia present that when used as source water in the demineralization process, sufficient concentration may occur so as to potentially raise toxicity issues. After removal of ammonia, certain nutrient issues may remain, which may entail longer-term, larger spatial scale transport and dilution considerations.

A review has recently been completed concerning nutrients in the near-shore coastal waters of Brevard County. This review/analysis is entitled *"Brevard County Near Shore Ocean Nutrification Analysis"* (NOAA/AOML July 18, 2005) and is available both on the Internet and from AOML. A review of the available nutrient data is presented therein.

iii. Biological Oceanographic Data

There is a moderate amount of extant biological oceanographic data. In the Literature and Data Review it was found that the NOS also has a digital (GIS) database for ocean bottom type (although the quality of each data entry was found to vary substantially). Substrate (bottom) type is an important ancillary piece of information relevant to prospective concentrate discharge since it is an important factor in the determination of both the type and diversity of benthic biota. A valuable exercise will be to examine this database more carefully to identify regions of interest for prospective discharge in which adequate substrate data is lacking.

There is little oceanic water column biological data. For example, water column profiles for plankton were not found for the prospective coastal ocean areas of interest for discharge.

There is some information on species that migrate through, or occupy, portions of the coastal ocean area of interest. Shrimp and turtles are examples of species that occasionally occupy areas of interest.

B. Needs for Additional Data and Analysis

i. Physical Oceanographic Data (Tier One)

Long-term, preferably multiple-year, data at coastal sites likely to have oceanographic characteristics typical of future cooperating-utility discharge sites are needed. The discharge sites probably will be located within three miles from shore, away from inlets, away from shellfish beds or other biological resources. The water utilities will have other criteria, e.g. population distribution and growth, to include in discharge site selection beyond environmental optimization.

In identifying the additional oceanographic data needed for feasibility or planning considerations, now and later, specific discharge site permitting advantages can be taken of what appears to be significant spatial homogeneity of key oceanographic parameters.

The coastal ocean lying within three miles of shore and adjacent to SJRWMD is less likely to be affected by perturbations from the Gulf Stream than coastal areas proximal to the Gulf Stream such as Southeast Florida. Thus, ambient currents are likely to be primarily tidal and wind driven currents. This suggests that a few ambient current profile-measuring devices could provide the basic information needed for preliminary modeling, evaluation of dilution, dispersion, and transport, for potential specific locations for concentrate dischargers. From this perspective any additional site-specific current measurements could serve to confirm the similarity of current behavior at the specific site with the broader region. Then, the long-term current characteristics measured in the feasibility or planning process could confidently be applied to specific sites of utility interest, thereby decreasing the financial burden for additional long-term current measurement on the cooperating utilities.

The work effort for ambient current understanding can begin with an analysis of the data gathered at the FDEP and EPA measurement sites discussed above. The measurement sites are within 30 kilometers of each other (see Figure 1) and data from the sites can be usefully analyzed and compared, particularly if there are time periods when data have been gathered concurrently at both sites. Both wave and temperature data may have been gathered at each of the sites. Wind data was gathered at the FDEP site.

Understanding available dilution as a function of distance from shore and depth is of importance to water utilities since a significant cost factor will be the length of piping lines from shore to the outfall/diffuser site. The determination of available dilution will be accomplished through the use of computer models using ambient current data as input. Analysis of current data from the FDEP and EPA sites will permit an initial comparison of current characteristics at a water depth of (approximately) 8 meters at a distance of 0.5 miles from shore with those at a water depth of (approximately) 15 meters at a distance of approximately 2.5 miles from shore.

Some spatial similarly may also be expected for water column salinity and temperature (and hence density) profiles. Long-term water column salinity and temperature profiles obtained at several fixed sites in the coastal ocean will enable planners to determine the degree to which the water column is well-mixed and whether there is any evidence of stratification present. These data will enable evaluation of the effects of water column density to influence distribution, concentrate plume discharge entrainment, and the super-position or build up to an equilibrium concentration under tidal action.

The need for information of the type described is clearly presented in the evolving requirements and regulation of the FDEP (Section III Workshop on Concentrate Discharge Draft December 2, 2004, FDEP).

ii. Chemical Oceanographic/Water Quality Data (Tier Two)

One potential scenario for desalination plants discharging concentrate into the coastal ocean adjacent to SJRWMD is that the source water for the desalination plants will be ocean water. Coastal ocean water would then serve two purposes, to be both the receiving water for the concentrate discharge, and the source from which the concentrate originates. Therefore, long-term coastal ocean chemical oceanographic and water quality measurements serve a dual purpose: to help characterize and determine the constancy of characteristics of the source water and also to help determine the range of variation of receiving water characteristics (and also the range of variation of concentrate characteristics). Parameters of particular note in the context of measurements serving multiple purposes are water column profile measurements for salinity and temperature. Salinity and temperature profiles are required to calculate water column density profiles (Tier one physical oceanographic measurements). Salinity and temperature profiles are also required for the calculation of water column chloride profiles (Tier two water quality measurements). Density profiles are needed as input to dilution models and chloride profiles measurements are needed for satisfaction of an FAC requirement (discussed following). At least seasonal measurements are required for both of the above uses.

Once again the hypothesis of fairly uniform or spatially homogenous ocean water column characteristics can be evolved (and also validated) for the general applicability of planning type measurement for site-specific type needs.

The need for salinity profile measurements has already been presented in section (A) preceding. However, long-term salinity (conductivity, chloride) profile measurements also have another purpose. Long-term (multiple year) data are required for use in determining compliance with the requirement for chlorides given in FAC 62-302.530 Class II: Marine parameter 18. The parameter requirement that chlorides not be increased 10% above normal background, requires the determination of “normal background” for salinity. Since there are normal daily and seasonal fluctuations, it is necessary to establish the values of such fluctuations. To establish those values, multiple-year data is required. If the measurements commence in the near future time, delays in data gathering can be reduced for future cooperating water utilities.

The potential circumstance just discussed is that both the source water and concentrate originate from ocean water, and the receiving waters are also ocean waters. Many other scenarios are possible. For example, source waters could be from groundwater or fresher surface waters, but the concentrate produced still discharged to the coastal ocean. Yet another scenario is that the concentrate would be blended with reclaimed water, or ground water, or surface water, or wastewater effluent, and then discharged to the coastal ocean.

In order to allow for some of these scenarios and also to get needed data in the coastal ocean adjacent to SJRWMD, some coastal ocean parameters that can profitably be measured include dissolved oxygen, pH, total dissolved solids, ammonia (and unionized ammonia), nitrate and ammonium .

iii. Biological Oceanographic Data (Tier Three)

In contrast to both physical and chemical oceanographic data, benthic biological data is generally more spatially variable and inhomogeneous. Shellfish beds, for example, may be spatially localized. For this reason, in contrast to ambient currents, which may be measured using instruments mounted at fixed sites, shipboard tows with advanced acoustic or optical sensors are required for rapid sea-bed classification.

Pelagic, or water column biological, data may be gathered using ship board operations as well, including towed instrumentation and profiling instrumentation. Water column biological data will be useful both for source water characterization and for receiving water characterization.

Cooperative efforts with the NMFS will be required to design study programs for any endangered species in areas of interests, essential fish habitat, migrating species, etc.

iv. Modeling

Little modeling effort has thus far been carried regarding desalination concentrate discharge into the coastal ocean adjacent to SJRWMD. A discussion of modeling approaches is presented in Section IVB following. Key modeling issues will include the effects of water column stratification (if present), discharge plume superposition (primarily in positively buoyant discharges) and ambient current distributions.

IV. RECOMMENDATIONS

A. Recommended Field Program Elements and Schedule

Year One-2006 (Recommendations for Year One are summarized in the Table on page 33.)

1. It is recommended that SJRWMD develop a detailed five year plan for additional analysis of extant coastal ocean data and for gathering of additional coastal ocean data, needed to support the advancement and development of desalination with concentrate discharge in the coastal ocean based upon the study plan presented in this technical memorandum. The first year of the study plan is summarized in Table 1. The development of this plan should be done in concert with the FDEP and NOAA. This activity should be carried out as soon as possible.

2. It is recommended that SJRWMD continue discussions with potential cooperating water utilities to discuss

desalination, generally, and considerations involved in source water selection and concentrate discharge site selection specifically.

3. It is recommended that analysis of the extant FDEP and EPA ambient current meter gathered at the locations indicated in Figure 1 be carried out. The ambient current meter data is required as input for FDEP and other concentrate discharge dilution models.

4. It is recommended that the extant NOAA bottom substrate data gathered at the locations shown in Figure 2 be analyzed. This analysis will be part of the initial examination of biological considerations in outfall siting.

5. It is recommended that SJRWMD install a minimum of two ambient current profiling systems at the locations seaward of Melbourne Beach shown in Figure 3. The purpose of gathering ambient current data at these two sites (together with continuing data from the FDEP site) is to enable SJRWMD to have the ambient current data needed as input to dilution models. The output from the models will enable a determination of dilution as a function of distance from shore, or with respect to water depth, whichever is most applicable. Dilution achievable will be a key consideration

in determining the length (and cost) of piping from shore to the concentrate discharge site.

6. It is recommended that SJRWMD install two appropriate sensor packages co-located with the ADCP sites shown in Figure 3. It is also recommended that in the event that the FDEP ADCP site does not have an appropriate sensor package, that SJRWMD install a (third) sensor package at the FDEP ADCP site. An appropriate sensor package will include, as a minimum, conductivity and temperature sensors. In discussions with FDEP it will be determined if other sensors are desired including oxygen, turbidity, Chlorophyll-a and others. An important quantity derivable from these conductivity and temperature measurements will be near bottom, eg one meter above bottom, water column density values as a time series with density values recorded every hour. The density data will be integrated with water column density profiles (see Recommendation No. 9 following) as input to dilution and transport models.

7. It is recommended that, based upon the results of a comparison analysis of the extant data from the FDEP ADCP and EPA ADCP, and from an analysis of the first few months of data from the three ADCP systems shown in Figure 3, it be determine if there are significant differences in ambient current values

as a function of distance from shore. Based (partially) upon this analysis, additional ADCP deployment sites north of Cape Canaveral will be selected.

8. It is recommended that the two ADCP sites located at approximately 1.0 nautical miles and 3.0 nautical miles from shore, shown in Figure 3, be equipped with acoustical modems for the transfer of data to a small boat. The modems enable the gathering of data from the ADCP (and other sensors) without the need for divers. The small boat cruises will be carried out monthly. If it were determined in later discussions that real-time data from either the ADCPs or other sensors is needed, buoys could be place at the ADCP sites for real time RF transmission of data. If surface signatures of the measurements sites is problematical, acoustical modems could be deployed for real time underwater sound data transmission.

9. It is recommended that water column CTD profiles be obtained during the monthly cruises to the ADCP sites. It is also recommended that water column samples be obtained during the monthly cruises. The specific quantities to be sampled will be determined in discussions with the FDEP.

10. It is recommended that SJRWMD discuss models to be used to calculate dilution with the FDEP at the same time the

discussions between FDEP and SJRWMD recommended in Recommendation No. 1 above are carried out. Extant models will require some modification and the approach to achieving these modifications determined. The FDEP has dilution and mixing models currently operational but may not have models allowing negatively buoyant plumes. Several potential contractors to SJRWMD should have the ability to modify extant models if needed.

11. It is recommended that as soon as appropriate models are available, that the ambient current and density data gathered at the three ADCP sites shown in Figure 3 be used to develop a time series of dilution values for each of the ADCP sites. Dilution as a function of distance from the discharge point is of substantial interest for mixing zone calculations.

12. Quarterly meetings or teleconferences with the FDEP are recommended during the first year of effort (beginning in the second quarter FY 2006) to review accomplishments to date, and to plan future efforts in the program.

13. It is recommended that throughout the course of the first year of effort, discussions be held with other interested agencies, eg, NMFS, US ACE, DOI, to determine their interests and whether other measurements, surveys, etc. may be needed.

14. It is anticipated that within six months of the initiation of the desalination effort, input from cooperating water and sewer utilities will begin to be received. This input should address potential concentrate disposal sites, source water possibilities and plant processing efficiencies.

YEAR TWO-2007:

Analysis of the first year of data from the ambient current profiling devices will enable a determination of any similarity of the ambient currents at the three sites initially selected, ie, the FDEP site and the two additional sites off Melbourne Beach. Similarity of current directions, mean speeds, speed distributions, and spatial coherence of any large-scale current features can be examined. Comparison with the EPA site ADCP data will yield information on the spatial homogeneity of current data.

Minimum/maximum current flows and seasonal behavior of currents can be analyzed to provide input for worst-case discharge analysis.

Ambient current data recording and sensor package measurements should continue throughout the second year of the measurement. The specific recording locations will remain the same and, if any sufficiently enthusiastic cooperating water utility suggests, currents at additional sited will be recorded. Ambient current measurements and sensor package measurements at sites north of Cape Canaveral will begin prospectively within a year with cooperating water utility interests.

Analysis of the salinity and temperature profiles from the data gathered in 2006 will indicate whether water column stratification occurs in coastal ocean areas of interest for concentrate discharge.

In 2007, additional input from cooperating utilities is anticipated. This input, together with that from FDEP, will likely suggest more specific data gathering needs in areas of concentrate discharge. Modeling efforts for dilution, mixing zones and transport will continue, and will incorporate new environmental data. Initial estimates of 'worst case' dilutions will be made

YEAR THREE-2008:

Analysis of the second year of data will be underway and will enable an analysis of two full years of ambient current data. First and second year seasonal data can be compared and significant differences analyzed.

Analysis of first and second year salinity and temperature profiles will enable further confidence in the occurrence or absence of water column stratification in prospective areas.

Ambient current data recording should continue for a third year (2008). The specific recording locations may remain the same or be modified depending upon data analysis results and cooperating utilities and FDEP input.

Prospective sources of water for desalination/de-mineralization should be more clearly defined by the third year of the effort. By more closely identifying prospective source waters, more refined near field and far field modeling efforts can be undertaken.

YEAR FOUR-2009

By the fourth year, it is anticipated that significant progress will have been made on determining specific locations for concentrate discharge as well as potential source water. Plans for actual field measurements for Year Five (2010) should be in the process of final development

YEAR FIVE-2010

By this year, final modeling and measurements should be completed. The data gathered in the preceding years will be used to design and support concentrate discharge monitoring plans which will be incorporated by water utilities into permit applications. Coordination with the FDEP is key to the success of future monitoring plans.

B. Potential Modeling Approaches

There appear to be two basic modeling approaches required for concentrate discharge in coastal ocean waters adjacent to SJRWMD. Both these approaches will utilize the additional data discussed in section IIIB(i) and IIIB(ii) preceding and in sections IVA preceding. The principal difference in the two modeling requirements is the different spatial scale. The first modeling scale is the near field scale that can extend up to a few kilometers from the concentrate discharge site, eg, the outfall diffuser site. The second scale is the far-field spatial scale that can extend from a few kilometers to tens of kilometers.

The near field modeling approach will use standard near field discharge models, modified to include negatively buoyant discharges, such as CORMIX, currently used by both the FDEP and EPA. The CORMIX model or any other acceptable model used will have to address negatively buoyant discharges in addition to the more widely encountered positively buoyant discharges.

This will be particularly true if the source water used in the desalination process is coastal ocean water.

The near field model will require the long-term time series of physical oceanographic parameters discussed in section IVA preceding. The near field models may be required to address water column stratification effects, particularly if the additional physical oceanographic data indicates the occurrence of stratification.

The near field model will likely also be required to estimate the ultimate concentration, or re-entrainment build-up, due to tidal reversals or superposition. The significance of build up effects will likely be somewhat different for positively buoyant discharge plumes and negatively buoyant plumes. Mention of these modeling capabilities is made in Section III.

The far field model, depending upon source water characteristics, may be needed for transport estimates of substances contained in the concentrate. There will likely be a significant difference in substances contained in the discharged concentrate depending upon whether ocean water alone is used as source water, or whether other waters, eg ground water, might be combined with ocean water as source water. Likewise, blending of other flows, eg reclaimed water, with ocean water sources could affect concentrate substances. Flushing residence time estimates could also be addressed.

V. SUMMARY AND CONCLUSIONS

A. Summary

This report is written in satisfaction of Task 3 Phase 1 of that agreement between SJRWMD and AOML. This section focuses on those environmental data needed to address regulatory requirements by the FDEP to discharge desalination/de-mineralization concentrate into coastal water adjacent to SJRWMD. This report discusses the adequacy of existing information on the ocean environment adjacent to SJRWMD, with respect to current and evolving regulatory requirements for the disposal of concentrate in coastal ocean waters.

This report discusses a multi-year plan for the acquisition of additional data. This plan incorporates concurrent modeling effort recommendations and also planning for eventual additional input by cooperating water utilities regarding prospective discharge site locations.

B. Conclusions

i. The present extant environmental data on the coastal ocean are not adequate to address the present and evolving regulatory requirements for the disposal of desalination/demineralization concentrate into the coastal ocean. However, extant FDEP and EPA ambient current data off Melbourne Beach and Cocoa Beach may be profitably analyzed.

ii. Despite the fact that specific potential concentrate discharge sites have not yet been selected, significant data needed to meet regulatory requirements can profitably be gathered by commencing long-term (multi year) coastal ocean environmental measurements now.

iii. As specific potential concentrate discharge sites are identified, through collaborative efforts between the SJRWMD, cooperating water utilities, and regulatory agencies, such as the FDEP, it is expected that additional site-specific measurements will be required (especially benthic measurements). The validity of the site-specific measurements will be greatly enhanced through comparison with, and incorporation into, long-term measurements already underway. They will serve as input data for modeling estimations of dilution, mixing zones, and transport.

iv. The long-term measurements discussed previously will serve several purposes. They will serve to assist in the satisfaction of FAC requirements that specify comparison of ambient values of environmental parameters, eg, salinity, with values resulting when concentrate is discharged. They will serve to determine whether ocean water column stratification occurs and will provide basic data needed for initial modeling efforts. They will serve to determine the characteristics and constancy of coastal ocean water as source water for desalination. They will serve to assist regulatory agencies in specifying monitoring requirements for concentrate discharges, and they will serve to assist in the potential site selection for concentrate discharges. They will serve as input data for model estimation of dilution, mixing zones, and transport.

v. Discussions with FDEP and discussions during the July 19, 2005, meeting suggest that preference for concentrate discharge sites located significant distances from inlets may be warranted. This preference helps lessen consideration of significant environmental change over small spatial scales. It appears (based on preliminary examination of extant ambient current data)that ambient currents in the coastal ocean adjacent to SJRWMD are largely driven by tides and winds (although Gulf Stream related current effects may be present). If so, current data may be expected to be similar over much of the coastal ocean including prospective discharge sites. Thus, the applicability of long-term current measurements for specific prospective concentrate discharge sites is reasonable.

vi. Water characteristics and desalination plant processing largely control concentrate characteristics, but source water also impacts characteristics. If there exists a wide range of characteristics, a broader range of parameters in modeling is required.

vii. Concentrate discharge models will be one of two types. The first is a local or near field model for calculation of concentrate plume behavior and characteristics in the vicinity of the discharge. The second is a larger scale fate and transport model. The source water will determine the need for larger scale modeling. The local or near field model must be a model (eg, CORMIX) acceptable to be used by the FDEP.

viii. Further analyses of the NOAA database should be carried out. This will help guide prospective discharge site selection and the need for additional data gathering.

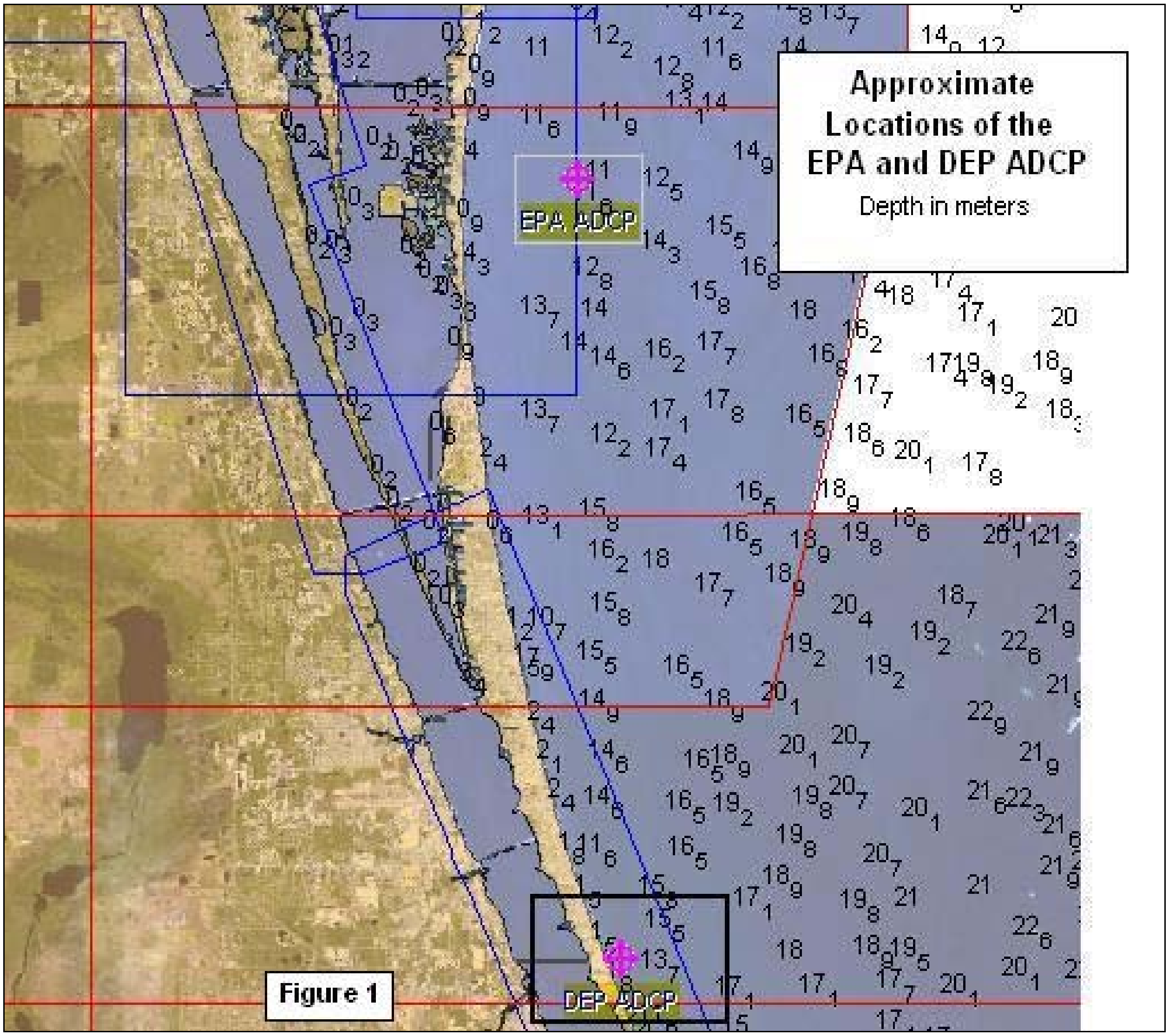
Table 1.

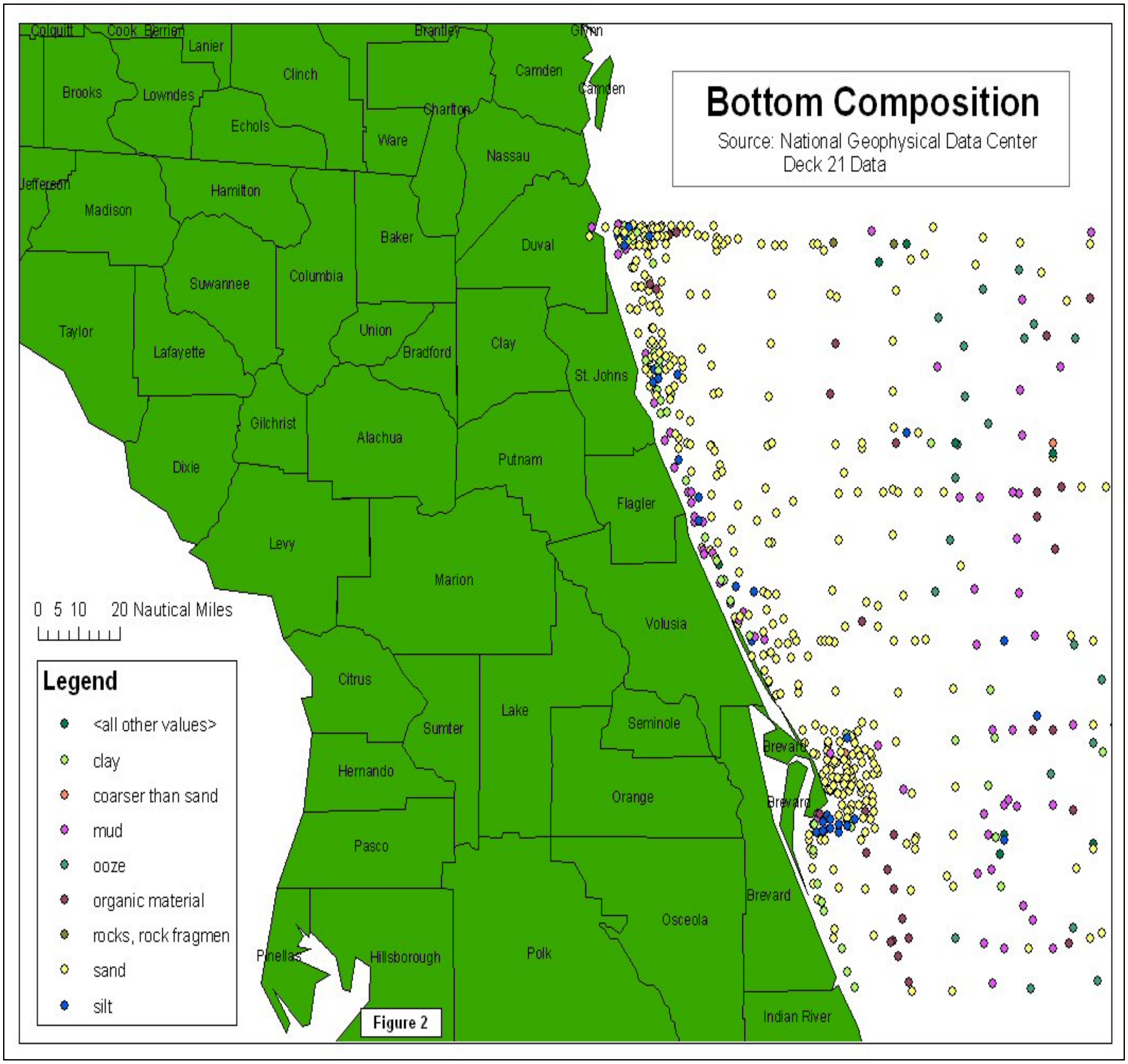
Proposed Phase 2 Field Studies to be Conducted in YEAR 2006 (YEAR ONE)

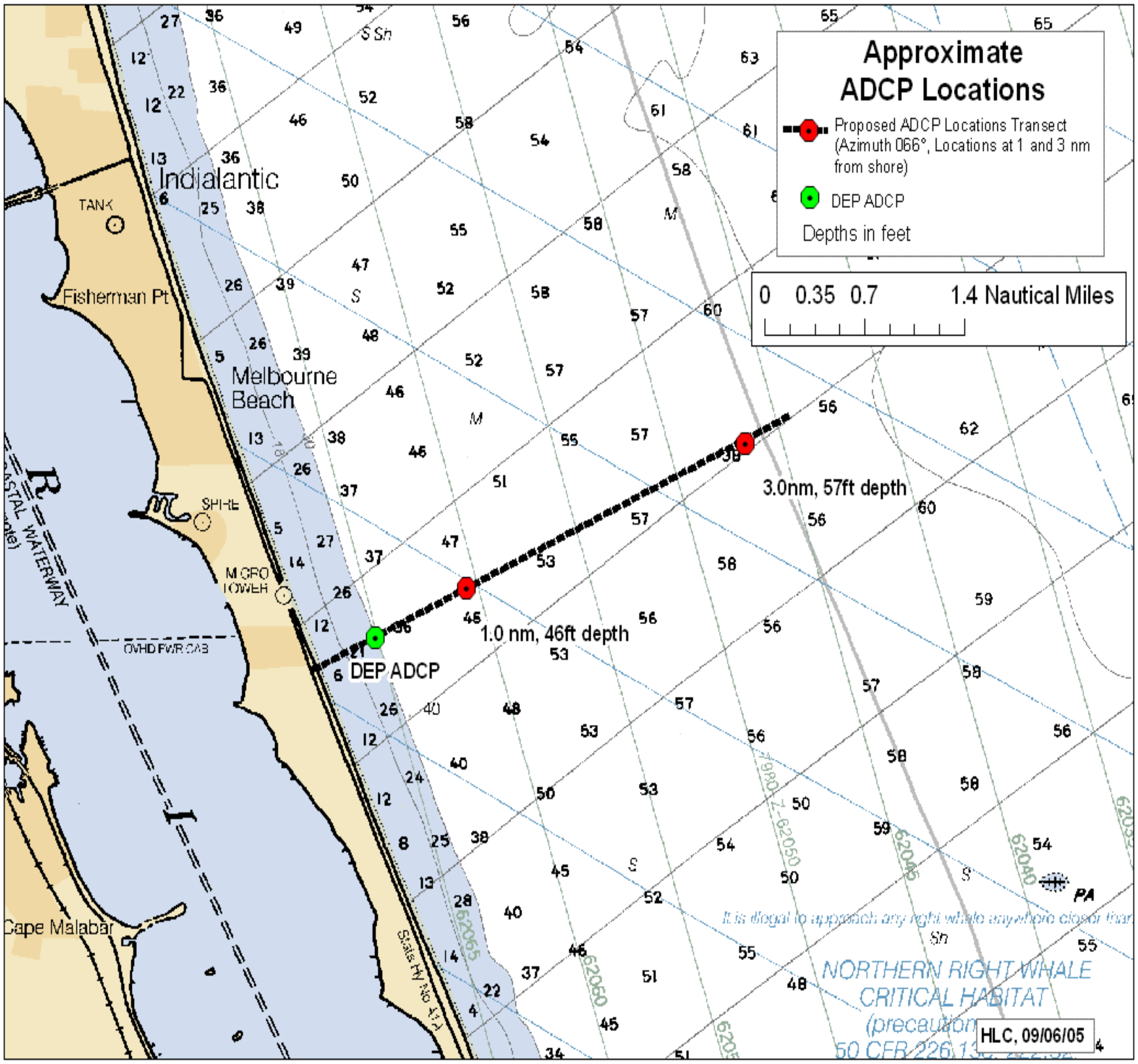
ACTIVITY	RELATION OF ACTIVITY TO EVALUATION	SUMMARY LOCATIONS	SAMPLING METHODS	SAMPLING FREQUENCY	DURATION	WORK DONE BY
Analyze extant FDEP & EPA ambient current data	Required input for dilution models	See Fig 1	Acoustic Doppler Profiler (ADCP)	Hourly current profile	2001-present (FDEP) 2003-2004 (EPA)	AOML
Analyze extant NOAA bottom substrate data	Initial biological information for outfall siting	See Fig 2	Various, including bottom grabs	Occasional	All known data	AOML
Deploy 2 ADCPs at 1.5 mi & 2.75 mi from shore of Melbourne Beach	Required to determine dilution as function of distance from shore	See Fig 3	ADCP	Hourly profile	First quarter of 2006-2008	AOML
Deploy 2 bottom-mounted CTD sensor packs co-located with ADCP sites	To provide continuous near bottom water density data for input to dilution models	See Fig 3	Conducti-vity, tempera-ture	Hourly	First quarter of 2006-2008	AOML/ local univer-sity
Monthly small boat ADCP visits	Obtain data, service equipment, obtain CTD water column profiles and water samples	Locations shown in Figure 3 & elsewhere	Boat-lowered CTD data at least every ½ meter depth increments	Monthly	First quarter of 2006-2008	AOML/ local univer-sity

YEAR 2006 (YEAR ONE)

ACTIVITY	RELATION OF ACTIVITY TO EVALUATION	LOCATION	SAMPLING	SAMPLING FREQUENCY	DURATION	WORK DONE BY
Months 1, 6, & 12 - Meet with FDEP	FDEP Guidance Needed	Tallahassee				FDEP, SJRWMD, NOAA
Month 3 - Initiate modeling activities of current & density data gathered	Needed for dilution, mixing zone calculation	Contractors' Facilities				SJRWMD contractors
Months 3, 6, & 12 – Review modeling results with FDEP	FDEP performance evalution of models used by SJRWMD	Tallahassee				SJRWMD, FDEP, NOAA, Contractors


Approximate
Locations of the
EPA and DEP ADCP
Depth in meters
EPA ADCP
DEP ADCP
Figure 1


Bottom Composition
Source: National Geophysical Data Center
Deck 21 Data
0 5 10 20 Nautical Miles
Legend
<all other values>
clay
coarser than sand
mud
ooze
organic material
rocks, rock fragmen
sand
silt
Colquitt
Cook
Berrien
Lanier
Brantley
Glynn
Camden
Brooks
Lowndes
Clinch
Charlton
Echols
Ware
Nassau
Jefferson
Madison
Hamilton
Baker
Duval
Suwannee
Columbia
Taylor
Lafayette
Union
Bradford
Clay
St. Johns
Gilchrist
Alachua
Putnam
Dixie
Flagler
Levy
Marion
Volusia
Citrus
Lake
Seminole
Sumter
Brevard
Hernando
Orange
Pasco
Osceola
Pinellas
Hillsborough
Polk
Indian River
Figure 2


Approximate ADCP Locations
Proposed ADCP Locations Transect (Azimuth 066°, Locations at 1 and 3 nm from shore)
DEP ADCP
Depths in feet
0 0.35 0.7 1.4 Nautical Miles
3.0nm, 57ft depth
1.0 nm, 46ft depth
DEP ADCP
Indialantic
Fisherman Pt
Melbourne Beach
Cape Malabar
TANK
SPIRE
MICRO TOWER
OVHD PWR CAB
NORTHERN RIGHT WHALE
CRITICAL HABITAT
HLC, 09/06/05

REFERENCES

1. "Literature and Data Review for Ambient Coastal Ocean Parameters for Potential Coastal Ocean Concentrate Discharges-Phase I Task 2" (AOML, Jan 6, 2005).

2. "Summary of NOAA Oceanographic Information Inventory and Literature Review Supporting a Demineralization Concentrate Ocean Outfall Feasibility Study" (CH2MHILL, July, 2005).

3. "Brevard County Near Shore Ocean Nutrification Analysis" (NOAA/AOML July 18, 2005).

4. Section III Workshop on Concentrate Discharge Draft December 2, 2004, FDEP.

APPENDIX B – 2002 MODIFICATIONS TO THE *FLORIDA STATUTES* REGARDING DEMINERALIZATION CONCENTRATE

THE 2002 FLORIDA STATUTES

Title XXIX PUBLIC HEALTH | Chapter 403 ENVIRONMENTAL CONTROL | View Entire Chapter

403.0882 Discharge of demineralization concentrate.--

(1) The Legislature finds and declares that it is in the public interest to conserve and protect water resources, provide adequate water supplies and provide for natural systems, and promote brackish water demineralization as an alternative to withdrawals of freshwater groundwater and surface water by removing institutional barriers to demineralization and, through research, including demonstration projects, to advance water and water byproduct treatment technology, sound waste byproduct disposal methods, and regional solutions to water resources issues. In order to promote the state objective of alternative water supply development, including the use of demineralization technologies, and to encourage the conservation and protection of the state's natural resources, the concentrate resulting from demineralization must be classified as potable water byproduct regardless of flow quantity and must be appropriately treated and discharged or reused.

(2) For the purposes of this section, the term:

(a) "Demineralization concentrate" means the concentrated byproduct water, brine, or reject water produced by ion exchange or membrane separation technologies such as reverse osmosis, membrane softening, ultrafiltration, membrane filtration, electrodialysis, and electrodialysis reversal used for desalination, softening, or reducing total dissolved solids during water treatment for public water supply purposes.

(b) "Small water utility business" means any facility that distributes potable water to two or more customers with a concentrate discharge of less than 50,000 gallons per day.

(3) The department shall initiate rulemaking no later than October 1, 2001, to address facilities that discharge demineralization concentrate. The department shall convene a

technical advisory committee to assist in the development of the rules, which committee shall include one representative each from the demineralization industry, local government, water and wastewater utilities, the engineering profession, business, and environmental organizations. The technical advisory committee shall also include one member representing the five water management districts and one representative from the Florida Marine Research Institute. In convening the technical advisory committee, consideration must be given to geographical balance. The rules must address, at a minimum:

(a) Permit application forms for concentrate disposal;

(b) Specific options and requirements for demineralization concentrate disposal, including a standardized list of effluent and monitoring parameters, which may be adjusted or expanded by the department as necessary to protect water quality;

(c) Specific requirements and accepted methods for evaluating mixing of effluent in receiving waters; and

(d) Specific toxicity provisions.

(4)(a) For facilities that discharge demineralization concentrate, the failure of whole effluent toxicity tests predominantly due to the presence of constituents naturally occurring in the source water, limited to calcium, potassium, sodium, magnesium, chloride, bromide, and other constituents designated by the department, may not be the basis for denial of a permit, denial of a permit renewal, revocation of a permit, or other enforcement action by the department as long as the volume of water necessary to achieve water quality standards is available within a distance not in excess of two times the natural water depth at the point of discharge under all flow conditions.

(b) If failure of whole effluent toxicity tests is due predominately to the presence of the naturally occurring constituents identified in paragraph (a), the department shall issue a permit for the demineralization concentrate discharge if:

1. The volume of water necessary to achieve water quality standards is available within a distance not in excess of two times the natural water depth at the point of discharge under all flow conditions; and

2. All other permitting requirements are met.

A variance for toxicity under the circumstance described in this paragraph is not required.

(c) Facilities that fail to meet the requirements of this subsection may be permitted in accordance with department rule, including all applicable moderating provisions such as variances, exemptions, and mixing zones.

(5) Blending of demineralization concentrate with reclaimed water shall be allowed in accordance with the department's reuse rules.

(6) This subsection applies only to small water utility businesses.

(a) The discharge of demineralization concentrate from small water utility businesses is presumed to be allowable and permittable in all waters in the state if:

1. The discharge meets the effluent limitations in s. 403.086(4), except that high level disinfection is not required unless the presence of fecal coliforms in the source water will result in the discharge not meeting applicable water quality standards;

2. The discharge of demineralization concentrate achieves a minimum of 4-to-1 dilution within a distance not in excess of two times the natural water depth at the point of discharge under all flow conditions; and

3. The point of discharge is located at a reasonably accessible point that minimizes water quality impacts to the greatest extent possible.

(b) The presumption in paragraph (a) may be overcome only by a demonstration that one or more of the following conditions is present:

1. The discharge will be made directly into an Outstanding Florida Water, except as provided in chapter 90-262, Laws of Florida;

2. The discharge will be made directly to Class I or Class II waters;

3. The discharge will be made to a water body having a total maximum daily load established by the department and the discharge will cause or contribute to a violation of the established load;

4. The discharge fails to meet the requirements of the antidegradation policy contained in the department rules;

5. The discharge will be made to a sole-source aquifer;

6. The discharge fails to meet applicable surface water and groundwater quality standards; or

7. The results of any toxicity test performed by the applicant under paragraph (d) or by the department indicate that the discharge does not meet toxicity requirements at the boundary of the mixing zone under subparagraph (a)2.

(c) If one or more of the conditions in paragraph (b) has been demonstrated, the department may:

1. Require more stringent effluent limitations;

2. Require relocation of the discharge point or a change in the method of discharge;

3. Limit the duration or volume of the discharge; or

4. Prohibit the discharge if there is no alternative that meets the conditions of subparagraphs 1.-3.

(d) For facilities owned by small water utility businesses, the department may not:

1. Require those businesses to perform toxicity testing at other than the time of permit application, permit renewal, or any requested permit modification, unless the initial toxicity test or any subsequent toxicity test performed by the department does not meet toxicity requirements.

2. Require those businesses to obtain a water-quality-based effluent limitation determination.

(7) The department may adopt additional rules for the regulation of demineralization and to administer this section and s. 403.061(11)(b).

APPENDIX C – DRAFT MODIFICATIONS TO SECTION 62-4.244(3), FAC, AND SECTION 62-620.625(6), FAC, REGARDING DEMINERALIZATION CONCENTRATE MIXING ZONE PROVISIONS (DECEMBER 2, 2004)

CHAPTER 62-4

PERMITS

62-4.244 Mixing Zones: Surface Waters.

(1) - (2) No change.

(3)(a) Waters within mixing zones shall not be degraded below the minimum standards prescribed for all waters at all times in Rule 62-302.500, F.A.C. In determining compliance with the provisions of subsection 62-302.500(1), F.A.C., the average concentration of wastes in the mixing zone shall be measured or computed using generally acceptable scientific techniques provided that, the maximum concentration of wastes in the mixing zone shall not exceed the amount lethal to 50% of the test organisms in 96 hours (96 hr. LC_{50}) for a species significant to the indigenous aquatic community, except as provided in paragraph (b), (c) or (d) below. The dissolved oxygen value within any mixing zone shall not be less than 1.5 milligrams per liter at any time or place, except for an open ocean discharge which must be above 1.5 milligrams per liter within 20 feet of the outfall structure.

(b) The maximum concentration of wastes in the mixing zone (except as described in (c) for open ocean discharges and as described in (d) for ionic imbalanced demineralization concentrate discharges) may exceed the 96 hr. LC_{50} only when all of the following conditions are satisfied.

(c) No change.

(d) Discharges of demineralization concentrate, as defined in Section 403.0882(2)(a), F.S., for which ionic imbalance is demonstrated, may exceed the 96 hr. LC_{50} in a mixing zone no greater than the area defined in Rules 62-4.244(3)(d)1.b., and 2.a., F.A.C. Ionic imbalance is defined as the failure of whole effluent toxicity tests caused predominantly by the presence of major ionic constituents naturally occurring in the source water (limited to calcium, potassium, sodium, magnesium, chloride, bromide, and other constituents designated by the Department). Demonstration of compliance is shown when:

1. For all demineralization concentrate discharges defined in Section 403.0882(2)(a), F.S., except for small water utility businesses defined in Section 403.0882(2)(b), F.S.:

a. The effluent, when diluted to 20% full strength with water having a salinity representative of the receiving water's salinity, shall not cause more than 50% mortality in 96 hours (96-hr LC_{50}) in a species significant to the indigenous aquatic community.

b. Under all ambient receiving water flow conditions, the effluent, mixed with receiving waters, must meet water quality standards within a distance not in excess of two times the water depth at the point of discharge. The water depth is defined as either the depth at Mean Tide Level in tidally affected waters or the depth at annual average low flow conditions for non-tidal rivers, streams, canals, or ship channels. In no case shall the depth be artificially changed from its existing depth for the purpose of extending the area for complying with water quality standards and the acute toxicity requirements of Rule 62-4.244(3)(d), F.A.C.

2. For small water utility businesses, as defined in Section 403.0882(2)(b), F.S.;

a. The discharge must achieve a minimum of 4-to-1 dilution within a distance not in excess of two times the water depth at the point of discharge under all ambient receiving water flow conditions, and;

b. The requirements in Rule 62-4.244(3)(d)1.a., F.A.C., must be met.

(4) – (7) No change.

SPECIFIC AUTHORITY: 403.051, 403.061, 403.062, 403.087, 403.0882, 403.804, 403.805, FS.

LAW IMPLEMENTED: 403.021, 403.051, 403.061, 403.087, 403.088, 403.0882, 403.101, 403.121, 403.141, 403.161, 403.182, 403.201, 403.502, 403.702, 403.708, FS.

HISTORY – Formerly part of 17-3.05, Revised and Renumbered 3-1-79, Amended 10-2-80, 1-1-83, 2-1-83, 2-19-84, 4-26-87, 10-17-90, Formerly 17-4.244, Amended 3-26-00, - -05.

62-620.625 ADDITIONAL CONDITIONS APPLICABLE TO SPECIFIC CATEGORIES OF FACILITIES.

………

(6) Pursuant to Section 403.0882 F.S., the Florida Legislature has determined that it is in the public interest to promote alternative water supplies and brackish water demineralization as an alternative to withdrawals of groundwater and surface water. Within Rule 62-620.625(6), F.A.C., the terms "demineralization concentrate" and "concentrate" are used synonymously.

(a) The following provisions apply to all facilities that discharge demineralization concentrate, as defined in Rule 62-620.200(11), F.A.C. to waters:

1. During preliminary siting considerations, it is recommended that water supply utilities or entities which propose to operate demineralization facilities evaluate concentrate disposal options potentially available in the project area.

2. Discharge of demineralization concentrate to waters shall not commence until an individual wastewater treatment facility or activity permit or permit revision authorizing the discharge has been issued by the Department in accordance with the requirements of this Chapter.

3. Direct discharge to waters shall require an individual wastewater facility permit under this Chapter.

4. Blending of concentrate for purposes of treatment or disposal with wastewater from a Department permitted wastewater facility may require a separate permit unless the receiving wastewater facility permit is revised to incorporate all aspects of concentrate treatment or disposal in accordance with the requirements of Rule 62-620.200 (26) or (48), F.A.C., to provide reasonable assurance that the discharge will meet applicable water quality standards.

5. Demineralization concentrate and reclaimed water may be blended, provided that the requirements in Rule 62-610.865, F.A.C., Blending of Demineralization Concentrate with Reclaimed Water, are met. Requirements for permitting, monitoring, operation, and other activities associated with the concentrate, reclaimed water, and blending of demineralization concentrate with reclaimed water that impact water quality, shall be in accordance with Rule 62-610.865, F.A.C. If a single municipality or utility owns and operates both the water treatment facility which generates the concentrate and the domestic wastewater facility that produces the reclaimed water, a separate discharge permit is not required for the concentrate discharge facility in accordance with Rule 62-610.865(7)(b), F.A.C. In this case, however, the domestic wastewater permit must be revised to incorporate all aspects of

demineralization concentrate blending in accordance with the requirements of Rule 62-610.865, F.A.C.

6. A facility that discharges demineralization concentrate to groundwater using underground injection wells shall obtain an Underground Injection Control (UIC) permit including associated ground water monitoring in accordance with Chapter 62-528, F.A.C. and shall monitor demineralization concentrate effluent in accordance with Rule 62-620.625(6), F.A.C.

7. Demineralization concentrate effluent discharged to surface waters shall be monitored, at a minimum, for the following parameters, except that Small Water Utility Businesses shall be monitored in accordance with Rule 62-620.625(6)(b), F.A.C.: Flow, Dissolved Oxygen; pH; hydrogen sulfide; Specific Conductance; Total Dissolved Solids; Color, Aluminum (marine waters only), Bromide, Calcium; Chloride; Copper, Fluoride; Iron, Magnesium, Potassium, Sodium, Radioactive Substances (combined Radium 226 and 228) and Gross Alpha Particle Activity (including Radium 226, but excluding radon and uranium); Nitrate, as nitrogen; Nitrite as Nitrogen, un-ionized ammonia, as nitrogen; ammonia-ammonium, as nitrogen; Total Nitrogen; Total Organic Nitrogen; Total Phosphorus; Ortho-Phosphate. Requirements for toxicity monitoring shall be in accordance with Rule 62-620.625(6)(c), F.A.C.

8. Except as provided in Rule 62-620.625(6)(a)6., F.A.C., a facility that discharges demineralization concentrate to groundwater under a Department permit shall establish a groundwater monitoring plan in accordance with the requirements of Rule 62-522.600, F.A.C., The groundwater monitoring plan shall include an evaluation of background water quality in the receiving water. Dimensions for the zone of discharge for a discharge of demineralization concentrate to groundwater shall be in accordance with the requirements of Rule 62-522.410(2), F.A.C.

9. Demineralization concentrate effluent discharged to groundwater shall be monitored, at a minimum, for the following parameters, except that Small Water Utility Businesses shall be monitored in accordance with Rule 62-620.625(6)(b), F.A.C.: Flow, Total Dissolved Solids, Chloride, Fluoride, Sodium, Total Nitrate and Nitrite as Nitrogen, Radioactive Substances (combined Radium 226 and 228); Gross Alpha Particle Activity (including Radium 226, but excluding radon and uranium).

10. Demineralization concentrate facilities discharging to groundwater, other than UIC disposal, shall monitor, at a minimum, the following parameters at groundwater monitoring wells, except that Small Water Utility Businesses shall be monitored in accordance with Rule 62-620.625(6)(b), F.A.C.: Total Dissolved Solids, Chloride, Sodium, Total Nitrate and Nitrite as Nitrogen,

Radioactive Substances (combined Radium 226 and 228); Gross Alpha Particle Activity (including Radium 226, but excluding radon and uranium).

11. If the Gross Alpha Particle Activity detected in a sample of demineralization concentrate or in groundwater monitored in accordance with Rule 62-620.625(6)(a)7., 9. or 10., F.A.C., of this rule, is less than 5 Picocuries/liter, monitoring for Radium 226 and 228 shall not be required in that sample.

12. Demineralization concentrate facilities discharging to underground injection control wells shall monitor groundwater in accordance with the requirements of the facility UIC permit.

13. Demineralization concentrate discharges shall be monitored at the following frequencies, except that concentrate discharges from Small Water Utility Businesses shall be monitored in accordance with Rule 62-620.625(6)(b), F.A.C.:

Flow, pH, and dissolved oxygen	Daily
Radioactive substances	Quarterly
Other parameters	Monthly
Groundwater monitoring wells	Quarterly

14. The Department shall increase or decrease monitoring requirements, based on the initial characteristics of the source water and receiving water provided with the permit application, if necessary to protect receiving water quality.

15. The Department may authorize, through permit conditions or revisions, reductions in the constituents and/or frequency of demineralization concentrate discharge or groundwater monitoring, if permit monitoring data are consistently and significantly below the applicable water quality standards, pursuant to Chapters 62-302 and 62-520 F.A.C. For surface water discharge, reduction or elimination of constituents shall be in accordance with the anti-backsliding provisions Rule 62-620.620(3), F.A.C.

16. In accordance with Section 403.061(11)(b)4, F.S., mixing zones for chronic toxicity may be permitted in Outstanding Florida Waters for demineralization concentrate discharges permitted under this section provided that the failure of any whole effluent toxicity test on concentrate discharged by the facility meets the criteria of Section 403.0882(4)(a) and (b) F.S.

(b) The following provisions apply only to Small Water Utility Businesses:

1. Discharge of demineralization concentrate from Small Water Utility Businesses is presumed to be allowable and permittable in all waters, provided that the conditions of Section 403.0882(6)(a)1,2, and 3, F.S. are met.

2. Small Water Utility Businesses that discharge demineralization concentrate to ground water, and which meet the criteria referenced in Rule 62-620.625(6)(b)1., F.A.C., shall not be required to have more than: one upgradient, one downgradient intermediate, and one downgradient compliance monitoring well.

3. All Small Water Utility Businesses which meet the criteria in subparagraph (6)(b)1 of this rule, shall:

a. Meet the following effluent limitations on an annual average basis:

Carbonaceous Biochemical Oxygen Demand, Five Day ($CBOD_5$)	5 mg/l
Total Suspended Solids	5 mg/l
Total Nitrogen as N	3 mg/l
Total Phosphorus as P	1 mg/l

b. Monitor demineralization concentrate discharged to surface water, at a minimum, for the following parameters, except that toxicity testing shall be conducted in accordance with Rule 62-620.625(6)(c) and (d), F.A.C.: concentrate discharge flow, pH, Dissolved Oxygen, Total Suspended Solids, Total Nitrogen, Total Phosphorus, and Carbonaceous Biochemical Oxygen Demand.

c. Monitor demineralization concentrate discharged to groundwater, at a minimum, for the following parameters: concentrate discharge flow, Total Dissolved Solids, Sodium, Total Nitrogen, Nitrate as Nitrogen, Total Phosphorus, and Carbonaceous Biochemical Oxygen Demand. If Total Nitrogen is less than 3 mg/L, however, monitoring for Nitrate is not required.

d. Monitor, at a minimum, the following parameters at groundwater monitoring wells: Total Dissolved Solids, Sodium, Nitrate as Nitrogen.

4. Small Water Utility Businesses that discharge demineralization concentrate to waters, and which do not meet the presumption of permittability and allowability in Rule 62-620.625(6)(b)1., F.A.C., shall:

a. Monitor demineralization concentrate discharged to surface water, at a minimum, for the following parameters, except that toxicity testing shall be conducted in accordance with Rule 62-620.625 (6)(c), F.A.C: concentrate discharge flow, pH, Dissolved Oxygen, Radioactive Substances (combined

Radium 226 and 228); Gross Alpha Particle Activity (including Radium 226, but excluding radon and uranium), Total Nitrogen, Total Phosphorus, Carbonaceous Biochemical Oxygen Demand, Total Suspended Solids, and Fecal Coliforms, if fecal coliforms are present in the source water.

b. Monitor demineralization concentrate discharged to groundwater, at a minimum, for the following parameters: concentrate discharge flow, Total Dissolved Solids, Sodium, Chloride, Radioactive Substances (combined Radium 226 and 228); Gross Alpha Particle Activity (including Radium 226, but excluding radon and uranium), Total Nitrogen, Nitrate and Nitrite as Nitrogen, Total Phosphorus, and Carbonaceous Biochemical Oxygen Demand

c. Monitor, at a minimum, the following parameters at groundwater monitoring wells: Total Dissolved Solids, Chloride, Sodium, Total Nitrate and Nitrite as Nitrogen, Radioactive Substances (combined Radium 226 and 228); Gross Alpha Particle Activity (including Radium 226, but excluding radon and uranium

5. All Small Water Utility Businesses that discharge demineralization concentrate to waters shall be monitored at the following frequencies:

Flow, pH, and dissolved oxygen	Daily
Radioactive substances	Annually
Other parameters	Quarterly
Groundwater monitoring wells	Semi-annually

(c) The following provisions apply to toxicity testing at all facilities that discharge demineralization concentrate to surface waters, except as provided by Rule 62-620.625(6)(d), F.A.C.:

1. The provisions of Section 403.0882(4), F.S. and Rule 62-4.244(3)(d), F.A.C. apply to all facilities that discharge demineralization concentrate to surface waters, for which the failure of a whole effluent toxicity test is predominantly due to naturally occurring constituents in a source water, and for which ionic imbalance is demonstrated.

2. For the purpose of this rule, "naturally occurring" constituents in a source water are bromide, calcium, chloride, magnesium, potassium, sodium, and other constituents designated by the Department pursuant to Section 403.0882(4)(a), F.S. and in the MSIIT Protocol (Major Seawater Ion Imbalance Toxicity Protocol

3. Facilities that do not meet the toxicity requirements (failure of whole effluent toxicity testing due to ionic imbalance) of Section 403.0882(4)(a) and (b), F.S. and Rule 62-620.625(6)(c)1. and 2., F.A.C., may be permitted in

accordance with Department rules including all applicable moderating provisions, such as variances, exemptions, and mixing zones.

4. Toxicity testing to determine ionic imbalance by an Applicant or Permittee pursuant to Section 403.0882 shall be conducted in accordance with the MSIIT Protocol (Major Seawater Ion Imbalance Toxicity Protocol, DEP, 1995, updated 2004), which is adopted and incorporated by reference in Rule 62-620.100(3), F.A.C. Additionally an Applicant or Permittee may conduct toxicity testing using a Department approved alternate test procedure in accordance with Chapter 62-160, F.A.C. The approved alternate test procedure shall provide the ability to discriminate between toxicity resulting from an imbalance of naturally occurring constituents, as defined in Rule 62.620.625(6)(c)1. and 2., F.A.C., and any other toxic constituent.

5. Guidance for implementing the toxicity related provisions of Section 403.0882, F.S. and this section are provided in the "Guide To Permitting Wastewater Facilities Or Activities Under Chapter 62-620, F.A.C."

(d) The Department shall not require Small Water Utility Businesses discharging to surface waters to perform toxicity testing, except at the time of permit application, permit renewal, permit revision, or upon the failure of a toxicity test.

Specific Authority 403.061, 403.087, 403.088, 403.0882, 403.0885, 403.08851, 403.8055, FS.

Law Implemented 403.061, 403.087, 403.088, 403.0882, 403.0885, FS.

History -- New 11-29-94; Amended XX-XX-05.