Facilitating Public Access to Government Environmental Monitoring Data

The Living Everglades Web Site

EMPACT

Environmental Monitoring for Public Access & Community Tracking

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Disclaimer

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Resources

A number of resources were used to develop this handbook that readers might find useful when seeking more information. These resources cover many aspects of the Everglades restoration effort and provide access to web-based databases containing environmental monitoring and restoration information. See the following web sites:

Everglades Restoration

www.sfwmd.gov
The South Florida Water Management District's web site provides information on the district's mission and projects, as well as recent news and publications.

www.evergladesplan.org
This site provides information on efforts underway to restore the Everglades under the Comprehensive Everglades Restoration Plan (CERP). It also includes background information on related issues, including the science of the Everglades and why restoration is important.

www.nps.gov/ever/home.htm
This National Park Service web site provides a wealth of information on the Everglades, its habitats, flora and fauna, geology, and history. It explains the stresses on the ecosystem and the preservation efforts under way.

http://sofia.usgs.gov
South Florida Information Access (SOFIA) provides information in support of research, decision-making, and resource management for the South Florida ecosystem restoration effort. The web site is sponsored by the U.S. Geological Survey's Place-Based Science Program.

Web-Based Databases Containing Environmental Monitoring and Restoration Information

www.epa.gov/empact
The web site for U.S. Environmental Protection Agency's (EPA's) Environmental Monitoring for Public Access and Community Tracking Program (EMPACT) provides information about the program and its projects.

www.epa.gov/neengprg/
The goal of EPA's National Environmental Information Exchange Network Grant Program is to advance the National Environmental Information Exchange Network by encouraging state and other partners' data integration efforts. Funding will be provided through grants for capacity-building capabilities for network participation.

www.epa.gov/oei/analysis.htm
This site provides links to many web-based databases created by EPA's Office of Environmental Information.

www.epa.gov/ipbpages/
Provided every 4 months, the *Information Products Bulletin* announces to the public the availability of significant information products involving environmental monitoring and restoration. The bulletin is a joint effort between EPA and the Environmental Council of States.

www.sso.org/ecos/eie/index.html
The Environmental Information Exchange web site from the Environmental Council of the States provides links to many useful resources for states interested in improving the collection, management, and exchange of environmental information.

Contents

Chapter 1—Introduction

More than a century ago, the Florida Everglades covered more than 4 million acres of land, extending from Central Florida to the southernmost tip of the state and the Florida Keys. An abundance of wading and migratory birds populated the region. Many other plant and animal species also made their home in the Everglades—some of which were found nowhere else in the world. These species had adapted to and flourished in the seasonal wet/dry cycles that characterized the region.

Photo courtesy of SFWMD

As early as the 1800s, settlers tried to drain portions of the region—some of which remained under water a good part of the year—to help them develop and farm the land. But it wasn't until the 20th century that a massive government effort was initiated to drain thousands of areas of swamp land and divert water from the Everglades with the help of canals and levees. These efforts were successful in that they made a large portion of the state habitable and farmable, helped to control flooding, and brought fresh water to South Florida for municipal use and irrigation. These efforts also altered the natural flow of the Everglades, however, and sent valuable fresh water out to sea.

Photo courtesy of SFWMD

As a result, the area encompassing the Everglades was reduced by more than 50 percent of its original size. Altered water patterns and habitat losses had significant effects on biodiversity in the region. Additional stresses on the ecosystem include increased fires, degraded water quality, and invasions of exotic species.

Today, a vast effort to restore the Florida Everglades is underway, involving federal, state, tribal, and local agencies; universities; research and scientific centers; and citizens' groups. Hundreds of engineers, ecologists, hydrologists, and other professionals are working together to implement a planned restoration effort, led by the U.S. Army Corps of Engineers and the South Florida Water Management District (SFWMD).

This project—the largest wetlands restoration project of its kind ever undertaken—is a decades-long, $8 billion endeavor, funded in part by the taxpayers of South Florida. It is therefore imperative that the residents of South Florida have direct access to the latest environmental information collected regarding the changing health of the Everglades ecosystem and the progress of the restoration effort.

Photo courtesy of SFWMD

1.1 Making Environmental Information Accessible to the South Florida Public

Under the Everglades Forever Act, the state of Florida has mandated the SFWMD to restore the health of the Everglades. Central to this effort is the collection and analysis of current and historical data on environmental

Photo courtesy of SFWMD

health indicators in the region. The SFWMD collects meteorological, hydrological, water quality, and flora/fauna species distribution data on the Everglades and maintains archival information as well. This information is currently stored in a database that has not been easily accessible to the public.

In 1999, the U.S. Environmental Protection Agency (EPA) awarded the SFWMD an Environmental Monitoring for Public Access and Community Tracking (EMPACT) Metro Grant of nearly $500,000 for a pilot project, known as *Public Reporting and Dynamic Access: Changing Regional Environmental Health of South Florida's Everglades Ecosystem*. The purpose of this project is to make information on the health of the Everglades more accessible and understandable to the residents, scientists, teachers, and government agencies of South Florida (see text box on page 3 for more details on the project).

This goal is being accomplished through the dissemination of public information materials and the establishment of an Internet site called *The Living Everglades*. Together, these tools serve as a public information and communication network to report the latest environmental information regarding the changing state of health of the Everglades ecosystem.

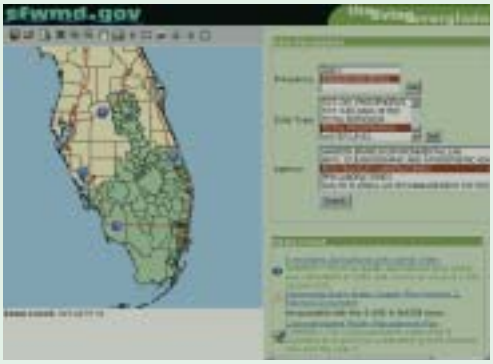
1.2 The Purpose and Organization of This Handbook

This handbook was developed to document *The Living Everglades* web site development process and to share information with other communities looking to establish a similar information network on ecological restoration efforts. The manual explains, in a step-by-step process, how the SFWMD created its web site, including choosing particular data features, developing the architecture to support the site (with a focus on providing map-based access to time-series data and documents), and soliciting input from stakeholders to create a user-friendly web site. With this information, we hope that communities can take aspects of the project and customize it to meet their own local needs.

The handbook is designed primarily for agencies that already collect environmental data and want to make these data more accessible to other users, such as researchers or the community at large. These agencies will find all chapters of the handbook relevant, but should be aware that Chapters 4 and 5 (and some of the appendices), which delve into the web site development process, might be most

The Five Key Objectives of the Project

To make environmental information about the Everglades accessible to its intended users, the SFWMD established the following five objectives for the web site project:



1. Establish an easy-to-use "data mart" with essential elements derived from the SFWMD's existing database. The data mart will be designed in a format that integrates the spatial and temporal aspects of the data. The SFWMD will use emerging technology that is compatible with the agency's database to implement a web-enabled data mart. The SFWMD's geographic information system (GIS) will be a component of the data mart. The combination of GIS and environmental data will provide the basis for a graphical user interface that captures user input necessary to build a data mart query through spatial visualization (maps), time-window selection, and data specifics.
2. Use the new combined database/web technology to communicate hydrologic and water quality data through an external web site and web-based Java™ application, which is fully supported by the database technology. Include cooperating stakeholders in the design and implementation of the interface, providing for optimal public interaction with the web page at all educational and interest levels. Use the stakeholders' vision to develop a dynamic web site with future expansion possibilities. Combine spatial and temporal aspects of the data to build an interface that can query the data over space and time.
3. Establish an environmental reference source on the web page that details the SFWMD's environmental goals, rationale for action taken, projects in progress, future projects under consideration, and environmental guidelines based on the most current science. Provide a database of SFWMD documents of current and planned projects and water supply plans that can be searched by keywords or phrases.
4. Provide customized mapping, time-series graphics, audio material, and word or phrase search of SFWMD documents in the data mart distributed through the web site to educate and inform the users in English and Spanish.
5. Provide coordinated outreach and training programs on the contents of the data mart, its web-based interface, and educational opportunities for teachers, media professionals, scientists, and the public through the efforts of cooperating stakeholders and the SFWMD.

suited to computer programmers, software consultants, and other Information Technology (IT) specialists.

The handbook is organized as follows:

- **Chapter 2, The Everglades Restoration Effort,** provides background on the stresses on the Florida Everglades, the role of the SFWMD in preserving and restoring the ecosystem,

the environmental data the agency collects and monitors, and the database used to store these data.

- **Chapter 3, Overview of *The Living Everglades* Web Site,** explains the organization, contents, and uses of *The Living Everglades* web site.
- **Chapter 4, Creating a Similar Web Site,** discusses the basic steps in setting up a similar web site, including establishing the key audiences and purpose, conducting a data inventory, choosing a data access/delivery system, ensuring ease of use and management, and determining resource requirements.
- **Chapter 5, Behind the Web Site: The Software Application Design,** provides a behind-the-scenes look into the architecture and programming of the three-tiered web site.
- **Chapter 6, Working With Stakeholders and Partners,** discusses how the SFWMD effectively worked with partners and stakeholders to develop a user-friendly web site, train users, and promote the site.

1.3 The Role of EMPACT

EPA created EMPACT <www.epa.gov/empact> in 1997 to take advantage of new technologies that make providing environmental information to the public in near real-time possible. EMPACT projects aim to help communities collect, manage, and distribute time-relevant environmental information, as well as provide residents with easy-to-understand, practical information they can use to make informed, day-to-day decisions.

EPA partnered with the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS) to help achieve nationwide consistency in measuring environmental data, managing the information, and delivering it to the public. The EMPACT program ended in 2001, having achieved its goal of helping communities gain access to current and accurate environmental information in their jurisdictions.

EMPACT projects were initiated in more than 160 metropolitan areas in 39 states. These projects covered a wide range of environmental issues, such as groundwater contamination, ocean pollution, smog, ultraviolet radiation protection, and overall ecosystem quality. Some of these projects were initiated directly by EPA, while others were launched by communities with the help of EPA-funded Metro Grants. EMPACT projects have helped local governments build monitoring infrastructures and disseminate environmental information to millions of people.

Chapter 2—The Everglades Restoration Effort

The Everglades is a unique ecological system, found nowhere else in the world. It is one of our nation's greatest ecological treasures and contributes to Florida's water supply, economy, and recreation. The region also serves as the habitat for thousands of diverse species of wildlife and plant life, some of which are found only in the Everglades. Many different kinds of habitats are found in the Everglades, including marine and estuarine environments, mangroves, sawgrass prairies, cypress swamps, and pinelands.

The Everglades watershed begins in Central Florida's Kissimmee River basin and extends to the Florida Bay. It is part of a larger system of creeks, streams, rivers, and lakes called the Kissimmee-Okeechobee-Everglades System.

2.1 What Are the Primary Stresses on the Everglades Ecosystem?

In 1948, the Central and Southern Florida (C&SF) Project was authorized to provide flood control, water control, water supply, and other services to the portions of Florida stretching from Orlando to Florida Bay. The U.S. Army Corps of Engineers and the SFWMD thereby constructed an elaborate and effective water management system, which diverted billions of gallons of water from the region. The system accomplished its goals but also had significant ecological impacts on the region such as the reduction of wildlife habitat and the disruption of hydrological cycles.

Photo courtesy of SFWMD

As a result, water management is the critical issue for the Everglades today. The biodiversity in the region requires clean water in correct quantities to survive. In the past, flooding from summer storms in the Kissimmee River basin created an extremely wide, but shallow, river that slowly flowed to the Gulf of Mexico. The summer rains would then give way to a 6-month dry season. The Everglades' plants and animals are adapted to this seasonal wet/dry cycle.

Today, however, water system controls disrupt this natural flow. Now, too much water is often withheld from the Everglades during the wet season, and too much water is diverted into it during the winter drought. Water storage is also affected.

These changes in water flows have reduced available habitat and food supplies for many wildlife species in the Everglades. They also have disrupted feeding and nesting cycles, leading to declines in certain species.

In addition to water management problems, the region's water quality itself has been degraded over time. Salinity changes, excess nutrients, and pollution all play a part in reducing the water quality in the Everglades ecosystem:

- The diversion of freshwater from the region can cause salt water to penetrate aquifers, affecting water supplies and the ability of soils to support plants.
- Excess nutrients (eutrophication), such as phosphorus and nitrates from agricultural runoff, affect the region in a number of critical ways. Eutrophication robs water bodies of needed oxygen and damages existing biological communities; for example, it can lead to invasions of cattails, which outcompete and take over areas of native plant populations such as sawgrass.

- Pollutants, such as pesticides, fungicides, and herbicides, also are a growing problem in the Everglades. High levels of mercury, a toxic metal, have been found in a variety of wildlife, including fish, raccoons, alligators, and Florida panthers.

Another stress on the ecosystem is the existence of non-native plants and animals (also known as exotic species), which have been introduced to the Everglades over the years as pets, ornamentals, food sources, or biological controls. Some new species have not posed threats to the natural balance of the ecosystem. Others, however, do not have natural predators in the area and, as a result, have overpopulated and become unmanageable. Introduced species also pose threats to native species through predation and competition for food and habitat.

The growing human population in the Everglades watershed—nearly 900 new residents move into Florida every day—increases the demand for natural resources, including water. More development also means more buildings and paving, which can reduce the ability of rainwater to penetrate into aquifers. With less freshwater available, Florida residents might need to increasingly resort to drinking desalinated water. Suburban sprawl, caused by the growing population, also threatens to engulf the Everglades, resulting in critical habitat loss for the flora and fauna of the region.

Indicators of Ecological Problems in the Everglades

- 90 to 95 percent reduction in wading bird populations.
- 68 threatened or endangered plant and animal species.
- 1.7 billion gallons of water per day on average lost through discharge to the ocean.
- 1 million acres of the ecosystem under health advisories for mercury contamination.
- Over 1.5 million acres infested with invasive, exotic plants.
- Declining population levels of commercially and recreationally important fish species in the St. Lucie and Caloosahatchee estuaries and Biscayne and Florida Bays.
- Defoliation of seagrasses, fish kills, and deformed fish within the St. Lucie estuary.
- Continued reduction in number of birds initiating breeding in South Florida.
- Repetitive water shortages and salt water intrusion.

Source: www.evergladesplan.org

2.2 What Is Being Done to Protect the Everglades?

In 1947, Marjory Stoneman Douglas, a South Florida resident, published what

became a best-selling book, *The Everglades: River of Grass*. The book awakened people to both the natural beauty and importance of the Everglades, as well as civilization's alarming impacts on this ecosystem.

Photo courtesy of Wellesley College Archives

Marjory Stoneman Douglas

Later that year, Congress established Everglades National Park in the southern section of the Everglades to preserve and protect the area. But the founding of the park did not stop the ecosystem's decline. Wading bird populations have declined dramatically since the 1930s, and a number of plant and animal species are now endangered, including the Florida panther, West Indian manatee, American crocodile, wood stork, and green turtle. Water quality has continued to decline, and exotic species flourish in certain areas.

In 1992, the U.S. Army Corps of Engineers was authorized to develop a comprehensive plan to restore and preserve South Florida's natural ecosystem, while enhancing water supply and maintaining flood protection. The resulting Central and South Florida Project Comprehensive Review Study—commonly called the Restudy—led by the Corps and the SFWMD, culminated in the development of a Comprehensive Everglades Restoration Plan (CERP). The CERP was submitted to Congress in April 1999 and approved in December 2000.

The CERP is the "road map," or framework, to restore, protect, and preserve the water and biological resources of Central and South Florida. It includes more than 60 major components designed to reverse the course of declining ecosystem health. According to the USGS, the current CERP represents the single greatest—and likely the last—opportunity to dramatically improve the ecological health of the greater Everglades in South Florida.

The interagency, interdisciplinary process to develop the CERP was a partnership that involved participants from diverse backgrounds, interests, and agency missions. The flexibility and openness of this process is ongoing during implementation, to allow for continual dialogue and improvements to the plan.

The CERP is part of a larger effort to restore the Everglades ecosystem and provide for a sustainable South Florida. This larger effort is being developed under the direction of the South Florida Ecosystem Task Force by federal, state, local, and tribal leaders. The Task Force is focusing on bringing together more than 200 restoration projects under one framework.

> *"The Everglades ecosystem must be restored both in terms of water quality and water quantity and must be preserved and protected in a manner that is long term and comprehensive."*
>
> – The Everglades Forever Act (Florida Statute No. 373.4922)

2.3 What Is the Role of the SFWMD?

In 1949, the Florida Legislature created the Central and Southern Florida Flood Control District, the predecessor to the SFWMD. In 1972, under the Florida Water Resources Act, the state created five water management districts, with expanded responsibilities for regional water resource management and environmental protection. The districts' boundaries are determined by watersheds and other natural, hydrologic, and geographic features. In 1976,

the legislature approved a constitutional amendment giving each district the authority to levy property taxes.

The SFWMD's main responsibility is operating and maintaining the C&SF Project, which consists of 1,800 miles of canals and levees, 200 water control structures, and 16 major pump stations. The district spans 16 counties in Florida, with a total population of about 6 million residents—accounting for more than one-third of the state's residents. This geographic region covers nearly 18,000 square miles and includes areas of agricultural lands and water conservation areas, along with urban areas undergoing growth and development.

The mission of the SFWMD is to manage and protect water resources of the region by balancing and improving water quality, flood control, natural systems, and water supply. The agency is working to restore and manage ecosystems, protect water quality, and improve and plan for long-term water supply and flood control needs. The district's budget is funded by a combination of property taxes and other non-property sources, such as federal and state revenues and grants.

To implement the CERP, the SFWMD is collaborating with the U.S. Army Corps of Engineers and the Florida Department of Environmental Protection to provide the right amount of water and the right flow conditions to the Everglades while providing water for urban and agricultural needs for a 50-year population projection. To complete this task, the SFWMD and its partners are developing new management tools, conducting scientific and economic studies, carrying out public outreach activities, and implementing engineering projects.

2.4 What Information Does the SFWMD Collect on the Everglades?

The SFWMD collects and stores a variety of data addressing the health of the Everglades ecosystem. The kinds of data collected and monitored include:

- Water quality data, including information on salinity levels, phosphorus and other nutrients, mercury, and pesticides and other toxic substances.
- Hydrological and meteorological data such as rainfall quantity, seepage, flow volumes, flooding events, dry conditions, and water levels.
- Biological data, including fish, amphibian, reptile, wading bird, mammal, and invertebrate populations; nesting information; and plant spatial data.

Photo courtesy of SFWMD

Much of the data are stored in DBHYDRO, a quality-assured archival database, with supplemental monitoring data in other SFWMD databases. The databases are a result of cooperative programs with agencies such as USGS, the Everglades National Park, the U.S. Army Corps of Engineers, National Oceanic and Atmospheric Administration (NOAA), and local government agencies. Currently, DBHYDRO maintains water quality, hydrological, and meteorological information on more than 30,000 station-years of data collected at more than 6,000 stations within the district.

While DBHYDRO has become an important reference for hydrologic and water quality investigations in South Florida, the information in the database has not been available directly to the public. Instead, interested parties may submit questions through the DBHYDRO web site, and the answers are provided via e-mail by district researchers. (See <http://glades.sfwmd.gov/pls/DBHYDRO_pro_plsql/data_request_pkg.main_page>.) The SFWMD also makes an external copy of the database once a month. This access is facilitated by the DBHYDRO Browser web page at <www.sfwmd.gov/org/ema/dbhydro/>.

A primary focus of the SFWMD EMPACT Everglades project—*The Living Everglades* web site—is to improve public access of DBHYDRO monitoring data. The web site enables users to access near real-time data by using maps and easy-to-perform, targeted search queries. Query results then can be viewed in chart form (see Chapter 3, "Overview of *The Living Everglades* Web Site"). The purpose of *The Living Everglades* web site is not to replace DBHYDRO, but rather to take much of the information stored in the database and make it easier for users to access.

Not all of the data stored on DBHYDRO and other district databases are currently made available through *The Living Everglades* web site; however, the SFWMD plans to expand the web site's data content in the future through its Enterprise Data Management Program. For example, the web site's water quality data currently focuses on nitrogen and phosphorous, but does not yet provide access to SFWMD's data on mercury, pesticides, and other toxic substances. Also, the web site does not yet provide access to SFWMD's biological data.

Chapter 3—Overview of *The Living Everglades* Web Site

This chapter summarizes the major categories of information that are included on *The Living Everglades* web site. Users can access information on hundreds of ecological parameters through the site data queries, described later in this chapter. The web site also provides users with a better understanding of the SFWMD's projects and programs.

The web site is attractive, engaging, and streamlined for easy navigation and contains an array of colorful photo images and dynamic graphics. Every page and section also includes a primary contact person, who can be reached directly through e-mail links. The SFWMD set up these direct contacts so that users' requests, questions, and comments can be quickly forwarded to a person who is familiar with the project or program described.

The Living Everglades web site can be accessed online at <http://glades.sfwmd.gov>.

3.1 What Types of Information Are Available on the Web Site?

The home page of *The Living Everglades* web site houses an overview of the historical and geological characteristics of the Everglades, as well as a list of the ecological parameters about which the database provides information. The web site home page is organized into eight main subheadings:

- **About This Site**, which includes background information on the web site project and EPA's EMPACT program. The page also describes the web site development team and the stakeholders and partners supporting the project.
- **Everglades Information**, which includes information on history, geology, habitats, wildlife, water resources, and weather in the Everglades; a topographical map of the region; links to other web sites; and a list of frequently asked questions.
- **Virtual Tour**, which provides a map of the South Florida watershed region.
- **Obtaining Data**, which serves the main focus of the web site—links to map-based and pre-defined data queries where users can access SFWMD's data on numerous ecological parameters throughout the region.
- **Tutorial**, which instructs users on querying the site and finding information.
- **Education**, which includes various curricula, lesson plans, and links to sources of additional information for teachers and students.

- **Glossary**, which defines relevant terms in nontechnical language.
- **Fun**, which includes games, coloring books, postcards, and web links for schoolchildren.

3.1a History of Everglades

To give users a solid overview of the Everglades, *The Living Everglades* web site provides links to 11 other web sites (including those sponsored by the National Park Service, the National Wildlife Federation, and the Historical Museum of Southern Florida), which describe the state of the Everglades from the mid-1800s to the present day, the impacts humans have had on water quantity and quality, and the overall environmental health of the region.

These web sites educate users by providing information on the history of the Everglades from various perspectives. The National Park Service, for example, tells "The Everglades Water Story," which illustrates the size and habitat of the Everglades before the area was inhabited by humans, along with the impacts that reservoirs, farming, and industrial development have had in reducing the diversity and number of wildlife populations in the area. The Florida Everglades site prepared by the Chamber of Commerce includes a first-person historical account of the changes in the Everglades told by a lifetime resident of the region.

3.1b Geology

The landscapes in the Everglades today are a direct result of geologic events in the past. *The Living Everglades* web site therefore includes links to seven web sites that review the geological influences on the Everglades area, beginning with the impacts from climate change and rising sea levels that occurred as glaciers receded.

This portion of the site also includes a series of downloadable maps from the Florida Geologic Survey. Understanding the geology of the Everglades gives users an appreciation of how this fragile ecosystem and its various habitats developed over the course of time and a perspective on the dramatic effects of natural and human activities on the region in just two centuries.

3.1c Habitats

Though the Everglades is often characterized as a swamp or marsh, several very distinct habitats exist within its boundaries. Slight changes in elevation, water salinity, and soil can create entirely different landscapes, each with its own community of plants and animals. The "Habitats" section of the web site includes a "virtual tour" of the Florida Everglades developed by the USGS Center for Coastal Geology. This section contains information on general characteristics of the Everglades ecosystem and specific descriptions of the animal and plant life residing in the region.

Natural areas are important for their recreational value, historic importance, native wildlife, and scientific research. Many natural areas also benefit people indirectly, even those that are seldom visited. Salt marshes, mangrove swamps, and coastal lagoons are necessary habitats

for almost all species of marine fish and shellfish. Scrub areas allow rainfall to soak underground, recharging water reservoirs that contain drinking water. Swamps and other wetlands control floods, purify water, and produce freshwater fish. An understanding of the different habitats within the Everglades gives users a greater appreciation of the ecosystem and its ecological, economic, and social value.

3.1d Water Resources

Water Quality Parameters

The "Water Resources–Water Quality Parameters" section of the web site includes information on dissolved oxygen, pH, nitrogen, phosphorus, alkalinity, salinity, and fecal coliform bacteria. These are some of the many parameters that are measured and graphed in the "Map-Based Data Queries" section, located under "Obtaining Data" on the navigation bar on the home page. Understanding these terms can help users find information when conducting a map-based data query.

Physical Parameters

This section of the site includes information on rainfall water levels, water flow, turbidity, electrical conductivity, water temperature, air temperature, and soils. The descriptions for each parameter described in this section can help users understand the data they view when conducting map-based data queries on the site.

3.1e Weather

This section of the web site reviews the weather conditions in the Everglades region, including temperature and rainfall. The ability to monitor weather trends is a helpful tool for scientists interested in maintaining the environmental qualities of the region. By monitoring water and weather conditions, and by using canals and levees as necessary to send water out to sea or to storage areas before, during, and after storms, the impact and duration of flooding in the area can be controlled.

Photo courtesy of SFWMD

The climate in the Everglades is primarily humid subtropical, with two seasons: the 5-month rainy season, from June through October, when 70 percent of the year's rain falls and most hurricanes occur; and the 7-month dry season, from November through May.

In South and Central Florida, average yearly rainfall is about 53 inches, though actual rainfall varies widely from year to year and from location to location. For example, historical annual rainfall for the city of Miami ranges from a high of 89 inches to a low of 34 inches.

Due to this wide range, one part of the region might be flooded at the same time another area is in the midst of a drought.

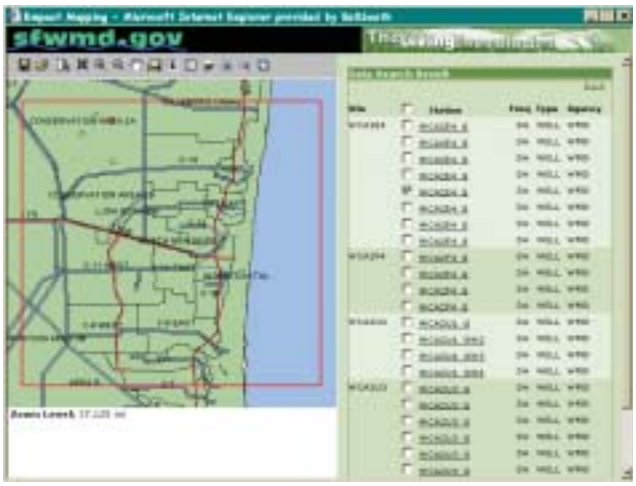
3.2 What Are the Main Interactive Features of the Web Site?

The Living Everglades web site features several interactive sections where the user can plot graphs and charts for the specific parameters described previously. The web site also includes educational tools and features for elementary to college-level students and teachers. Details on these features of the web site are highlighted in the following sections.

3.2a Data Queries

The heart of *The Living Everglades* web site includes the two main methods for obtaining environmental data about the Everglades ecosystem: (1) the map-based data queries, and (2) the pre-defined data queries. These data queries make it easy for users to obtain up-to-date, long-range, and historical data on a variety of topic areas.

Map-Based Data Queries



The "Map-Based Data Queries" section of the web site guides users through a variety of environmental management data for most of Central and South Florida. Before launching into the map-based data query, users can click "Tutorial" on the navigation bar on the home page for an animated, self-guided tour on how to use this section.

The "Map-Based Data Query" link takes users to a map divided into separate watershed regions. From here, users can select the "Region Search" tool to get information on a specific watershed: "Media Found" and "Data Parameters."

The "Media Found" section includes documents on the SFWMD restoration projects related to the watershed area selected as well as descriptive audio and video files (users need RealPlayer™ <www.real.com> to view audio and video files).

The "Data Parameters" section offers various selection criteria for users, including data frequency and type. Users can select daily or random interval frequency levels; they also can select data based on both levels of frequency. The data type options vary by the region and frequency of the parameters selected, but they can include water level, water flow, phosphorus, rainfall, and more. After selecting for data frequency and type, users are shown a list of agencies that supply these data.

Once users select the agencies whose data they would like to review, small icons pop up on the map, indicating the monitoring stations where these data are collected. Up to five data collection sites can be selected at one time.

Sample Data Search

Conducting a data search on *The Living Everglades* web site using a map-based query is a simple process. Consider the following example.

For the watershed region located in East Collier County, users can select:

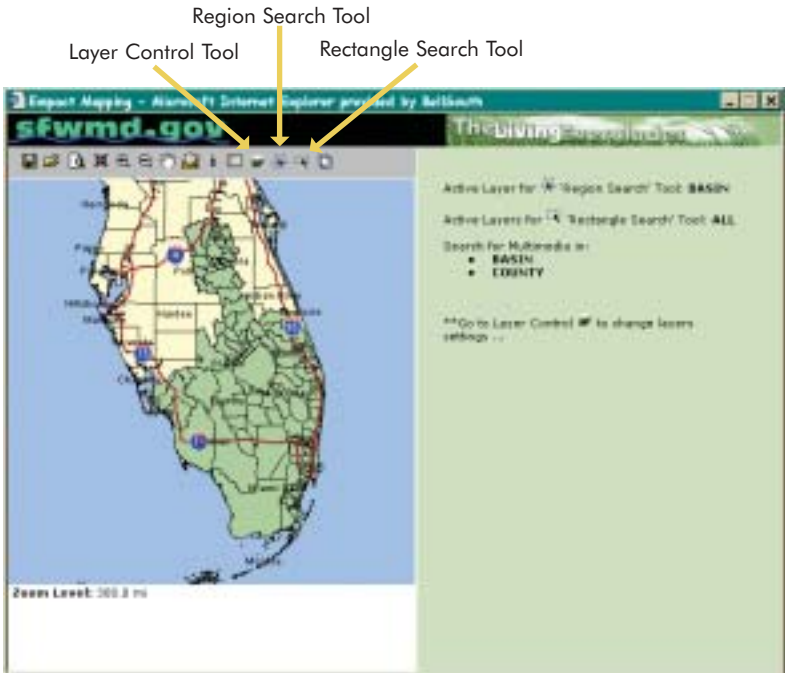
Level of frequency: "Daily" and "At Random."

Data Type: "Water level."

Agency: "Everglades National Park," "South Florida Water Management District," and "U.S. Geological Survey."

When users hit the "Search" button, the map indicates the monitoring stations where these data are collected. Users can select one station by clicking on the icon indicating the section on the map. For example, they might select the "Airplane" site. After hitting the "Plot Selection" button, users can access all of the data collected at that monitoring station for the selected data type. The data can be displayed as a line chart, a bar graph, a data table, or a combination of the three. Users can then choose the time period for which they would like to chart data. Users also can copy and paste the data tables into a spreadsheet program to conduct a statistical analysis of the data.

Users can search the site by large regions that encompass many watershed areas or by smaller regions that focus on a portion of one watershed, using the "Rectangle Search" tool. The "Layer Control" option changes layers settings; by stripping away layers, a variety of features can be viewed. For example, users can take away the watershed layer to view the map by county instead. Highways and canals also can be added or stripped away, so users can have a more specific view of the area being searched. The "Region Search" tool and the "Rectangle Search" tool can still be used to hone in on the specific data for a watershed or county.



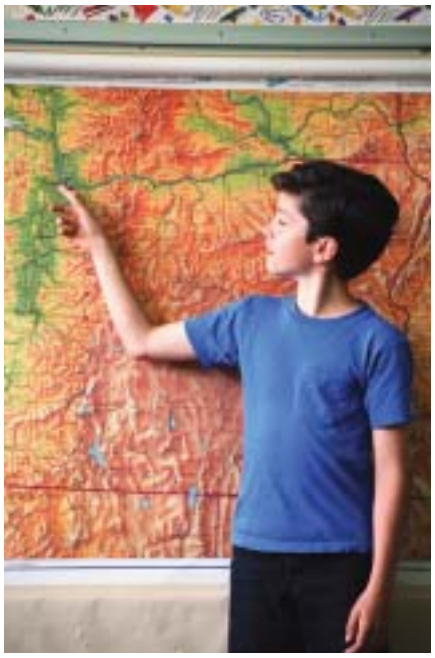
Pre-Defined Data Queries

Pre-defined data queries are intended to provide up-to-date answers on frequently asked questions without requiring users to use the map interface. As of summer 2002, the web site included three pre-defined data queries:

- Average water level per month in 2000 for Lake Kissimmee.

- Monthly rainfall in 2000 for Lee County.
- Top 10 rainy days in 1999 for Lake Okeechobee.

The SFWMD will add more pre-defined data queries to the site in the future.



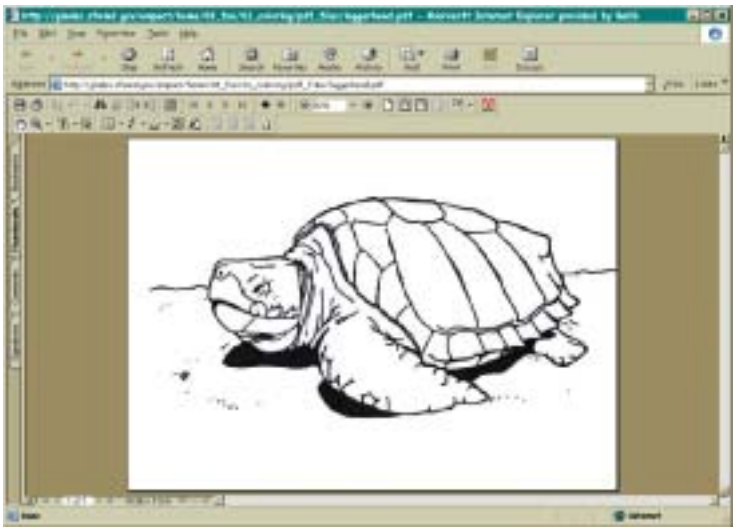
3.2b Education, Curricula, and Other Resources

The role of teachers and educators in Everglades restoration is vital, for the students of today might very well be the engineers and ecologists who design and implement Everglades restoration activities tomorrow. The "Education" section of the site includes a host of web pages compiled to help teachers gather educational resources centered on the Greater Everglades ecosystem. The site highlights a myriad of web links, including teachers' workshops that focus on the Everglades and water quality in South Florida. Resources for teachers include a list of books, guides, and curricula developed by scientists and educators, as well as classroom sessions whereby teachers can take a 3-hour trip on the Kissimmee River, where they will be introduced to field methods in water quality monitoring, aquatic plant and invertebrate sampling, and identification techniques.

Photo courtesy of SFWMD

Additional resources for teachers and students include audio and video tapes on the Everglades, available from the Everglades National Park Bookstore and the SFWMD. Moreover, users can find books and other publications focusing on the Everglades through these and other sources noted on the web site.

Teachers who have developed a lesson plan using the web site materials are encouraged to post their plan to the web site. As the SFWMD receives lesson plans, they are posted on the page so other teachers can access them. Teachers who develop Florida Comprehensive Assessment Test or Sunshine State Standards correlations using the materials also will be able to post these to the web site. Educational resources can be forwarded to Loisa Kerwin, Director, Riverwoods Field Laboratory at <lkerwin@strato.net>.



3.2c Fun and Games

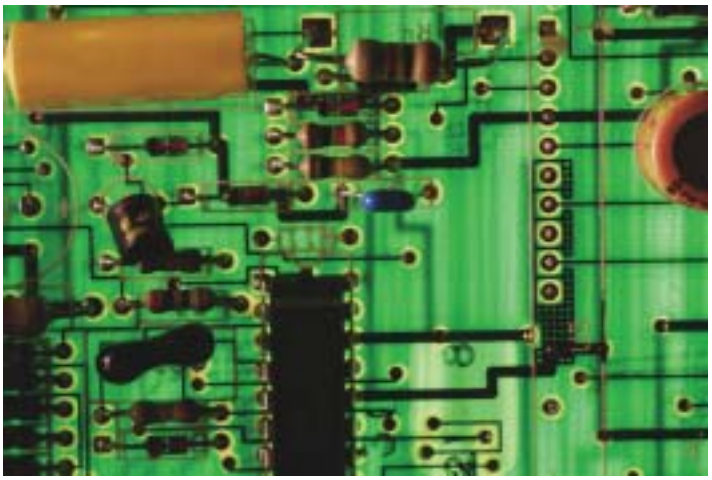
The "Fun" section of the web site is aimed at making learning about the Everglades, wildlife, and nature interesting to schoolchildren. This section of the site features:

- Printable coloring book pages depicting drawings of animals that live in the region, including the alligator, spoonbill, manatee, wood stork, and sea turtle.
- A "Concentration"-type game where players try to match up the year with the number of species counted in the Everglades at that time.
- E-postcards that children can send to friends and family, which feature a picture of a wood stork, manatee, or spoonbill—animals that make their home in the Everglades.
- Links to a variety of educational web sites, including an EPA Planet Protectors Club Online Coloring Book and other materials from EPA. The site also includes links to web pages created by the National Park Service highlighting classroom activities for children in kindergarten through 6th grade, resources for teachers, and links to <www.kidsplanet.org>, a web site developed by Defenders of Wildlife to teach schoolchildren about endangered species.

3.2e Virtual Tour

The Living Everglades web site will eventually include a "Tour Your Watershed" section, which will contain links to information on the Kissimmee River, Lake Okeechobee, the Everglades, and the Florida Bay.

Chapter 4—Creating a Similar Web Site



This chapter provides basic instructions to help other agencies and organizations plan for and create a web site similar to *The Living Everglades* web site. The chapter assumes that your organization is already collecting, storing, and managing environmental data in a database system that you would like to make publicly accessible through a web site.

The steps in the web site development process include the following:

- Determine the main functions for your web site
- Conduct a data inventory
- Choose a data access/delivery system
- Decide how to make your web site user-friendly
- Ensure ease of management and updates for your web site
- Determine costs, time required, difficulty level, and labor requirements
- Create your web site
- Involve stakeholders

Keep in mind that creating a web site does not mean that your organization needs to host the web site. There are many businesses called application service providers that can provide web hosting services for you.

4.1 Determine the Main Functions for Your Web Site

The first step in the web site development process is to determine your web site's main functions by considering its purpose and audience. For example, the SFWMD wanted *The Living Everglades* web site to provide useful, clear, and up-to-date information on the Everglades and the SFWMD's restoration projects to a wide breadth of Florida citizens, including teachers and students, the general public, and environmental scientists at universities and nonprofit organizations.

The SFWMD wanted the taxpayers of South Florida to understand the stresses on the Everglades ecosystem and the status of efforts to restore and preserve the region. In addition, by having teachers and students use *The Living Everglades* web site, the SFWMD hoped the next generation would gain an understanding of the value of ecosystems such as the Everglades and would learn how to use high-tech tools, such as web-accessible environmental databases, for gaining knowledge of the status of ecosystems. The web site also provides easy access to data in DBHYDRO and other SFWMD databases that could be helpful to environmental researchers and scientists. In addition to these primary audiences, the SFWMD recognized that the audience for the web site will likely include many other interested parties

in the United States and internationally, given the scope and historical importance of the Everglades restoration project.

Given the purpose and audiences for *The Living Everglades* web site, SFWMD decided the site should provide the following functions:

- **Background information.** Background information on the Everglades and the science of ecological monitoring and restoration can help users appreciate the importance of the Everglades system, learn what must be achieved to restore the Everglades, and understand the scope of the problems facing agencies involved in the restoration and preservation effort.
- **Map-based query feature.** Users can query the environmental database using maps that visualize results, facilitate ease of use, and help provide a relational context. Maps enable users to access data from a particular site in the Everglades by simply clicking on that area on an online map (they do not need to know the names or locations of the SFWMD's monitoring stations). The maps also show users where geographical elements are located in relation to each other. This facilitates an understanding of how ecological processes in one area, such as water flow in the Kissimmee River, can affect wildlife habitat in areas downstream from the river, such as in the Everglades.
- **Chart query results.** By presenting the results of queries in a time-series chart, which is a chart indicating the time or date for each data observation, users can better understand data trends and patterns.
- **Spatially relevant data.** "Spatially relevant" data all have geographical locations connected with them so users can gain an understanding of the environmental health of different areas and specific parts of the ecosystem.
- **Temporally relevant data.** By giving the public access to the most up-to-date, quality-assured data available from public agencies, SFWMD can ensure the data are "temporally relevant"; that is, data are available from recent enough observations to allow for analysis of the current ecological situation.

- **User-friendliness.** The SFWMD wanted to ensure that all Florida citizens—not just computer technicians—would be able to obtain useful information from the web site on the health of the Everglades and the district's restoration projects.

4.2 Conduct a Data Inventory

After deciding your site's functions, the next step is to conduct an inventory of your existing data. To create a web site similar to *The Living Everglades*, consider the types of environmental data already stored on your organization's database (e.g., water levels, pollution concentrations, wildlife population data), but also consider:

- Relevant GIS data.
- Environmental reference documents that describe your ecological restoration projects and goals.
- Audio and video files that relate to various regions in the ecosystem (e.g., pictures or vocalizations of native wildlife species, aerial views of particular landscapes).

- Other relevant public data in the area.

The inventory will help you identify what data you have, along with any data gaps. At this point, you might want to contact other environmental organizations and agencies to determine if they have any of the data you are seeking. For example, you will likely need to obtain GIS data from other agencies, such as USGS. Keep in mind that occasionally you might need clearance or permission to make data from other agencies and organizations publicly accessible.

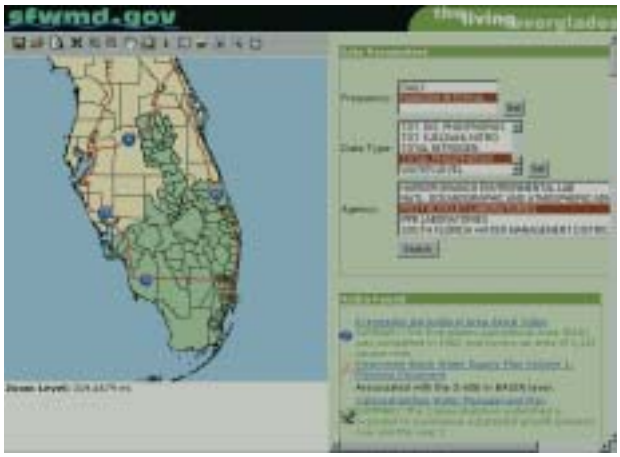
When you seek data from other agencies and organizations, you might want to consider forming partnerships with them. Through these partnerships, you might be able to share data more easily in the future, develop future projects jointly, and increase the publicity for your site (see Chapter 6, Working With Stakeholders and Partners).

4.3 Choose a Data Access/Delivery System

After deciding what data sources to make available through your web site, you will need to choose a method for accessing and conveying this information. This method will be your data access/delivery system. This system will need to be constructed using various software components (see Chapter 5 for information on the software design of *The Living Everglades* web site). As a general rule, the more sophisticated the system, the higher the cost. Two of the biggest issues you will need to address are user-friendliness and scalability.

4.3a User-Friendliness

The less sophisticated the intended user, the more simple and user-friendly your data query and results visualization should be. Keep in mind that more sophisticated users (e.g., scientists, researchers) also will demand a simple and user-friendly data query and results visualization and will avoid using a more difficult interface even if they are capable of using it. A more user-friendly site helps all users save time and avoid frustration.



Because the SFWMD wanted its site to be accessible to a wide variety of audiences, it chose to construct a very user-friendly and powerful data access/delivery system—the map-based query feature of *The Living Everglades* web site. This system is user-friendly because it allows users to access SFWMD environmental data via maps and conveys the results of user queries through charts. SFWMD's system displays maps at various scales (i.e., close-ups or showing the entire map), clearly shows the location of monitoring stations, and is interactive (i.e., it allows users to choose monitoring stations by clicking on the map itself).

When contemplating your own data access/delivery needs, think how user-friendly your site needs to be. Consider, for example, if users require time-series charts or if they can adequately view results in a simple data table or text file. Also, consider if you need a map-based query feature. Although maps make it easier for users to choose data from particular

locations, if your agency only has data from a few stations, you might simply list the locations and provide hotlinks to the data available for each station. Also, if you do want to provide a map but have only a few monitoring stations, you will probably not need to make the map interactive.

Finally, if you are interested in providing environmental reference documents and audio and video files through your site, you have the option to not make these accessible through a map-based query. You could still provide access to these files via hotlinks on a different HTML page. The SFWMD used innovative software that allowed it to make all of these files available through its map-based query feature.

4.3b Scalability

Scalability refers to the ability of software and hardware to adapt to increased demands, such as the number of simultaneous users and the amount of data uploaded or downloaded per day. Different data delivery/access systems vary in their scalability. If your data delivery/access system cannot handle user demands, the speed with which the web site processes users' data queries might decrease substantially. Worse, it might crash and require significant resources to repair. After anticipating the number of users using your site and the amount of data to be downloaded, contact software vendors (see Appendix G, Technical Contacts) to determine if they can meet your scalability needs.

If you do not anticipate any significant scalability issues, you might be able to save money on the software you need to create your data access/delivery system. You can use Microsoft® Access, for example, to serve as a data mart—the subset of your database that will be accessible through your web site—if you do not anticipate a large number of simultaneous users or data downloads. If you decide to use Microsoft® Access version 2002 for your data mart, your cost will be approximately $340. Your choice of software products should be made holistically, however, by considering how well software products purchased from different vendors will interact with each other.

Because the SFWMD anticipated that *The Living Everglades* site would be used by a large number of people and would involve downloading significant amounts of data, the district purchased software components that could handle high system demands (see Chapter 5 for more information). The SFWMD decided to use the Oracle® 8i database server for a number of reasons, including its ability to address the SFWMD's scalability concerns. Depending on the license purchased, this software can cost many thousands of dollars. In addition, IT staff for Oracle generally run at least twice as high as IT staff for Microsoft® Access.

After considering your data access/delivery system needs, you might determine that you would like to construct the same data access/delivery system used by the SFWMD for *The Living Everglades* web site. In this case, you can receive for free some of the custom-made software design components used by SFWMD to construct this system since these components were created using EMPACT funds. (Contact Brian Turcotte, 561 682-6579, or Marie Pietrucha, 561 682-6309, both of the SFWMD, for more information; also see the Appendices to this handbook for more details.)

Keep in mind that the SFWMD's data access/delivery system is not your only option. You can create a useful web site that includes at least some of the same features of the SFWMD's site by using different software and making different design choices.

4.4 Decide How To Make Your Web Site User-Friendly

To make your web site user-friendly, you will need to address the graphical user interface (GUI), develop a consistent look for your site, provide special features that make the site easy to use, and make sure the site functions properly and responds quickly to user requests.

4.4a The GUI

An important part of the data access/delivery system is the GUI. GUI is a term used to describe the HTML links, icons, buttons, checkboxes, and drop-down lists that allow the user to tell the web site to perform certain commands with a click or two of a mouse button. For example, when the user clicks on an HTML link, represented by underlined text, this tells the web site to open a window and access the new web site referred to by the underlined text.

In an example from the SFWMD site, when the user clicks on an icon of a polygon within the map-based query, this tells the web site that the user wants to choose data from a particular region from the map and allows the user to click on that region to start the data-gathering process. A good GUI can make a web site much more user-friendly, which will make it more enjoyable and easier for people to use the web site.

For the map-based query feature, the SFWMD made use of a number of icons, checkboxes, and drop-down lists to facilitate ease of use. For example, by providing an icon that a user could click on to choose to perform a regional search in the map-based query, the SFWMD avoids requiring the user to learn and enter programming language. In most cases, the software used by the web site designer to create the web site provides a variety of GUI options to the designer.

4.4b A Consistent Look

Developing a consistent look for your web site is important because it can make your web site more pleasing to the eye, more memorable, and less confusing to read and use. A consistent look requires "branding"—the consistent use of colors, fonts, images, and graphic elements; menus and navigation aides; and footer information.

4.4c Special Features

You might want to consider adding special features to your web site to help users learn how to navigate your site more quickly. These features include help functions, search functions, site

maps, and e-mail contacts to allow users to ask questions and provide feedback to you. Self-help features can reduce the amount of time your organization spends providing technical support to users. The SFWMD, for example, provides an online, self-guided tutorial through *The Living Everglades* web site that teaches users how to perform the map-based query.

4.4d Proper Function and Response

You must also ensure that your web site functions properly and responds quickly to user requests. To provide quick response times for users, the SFWMD designed *The Living Everglades* web site in such a way as to minimize the amount of data processing that needs to occur on the user's computer, which increases response times. The main disadvantage of this method is that it requires a high-performance central server, which can increase costs.

4.5 Ensure Ease of Management and Updates

Web site management and updates take considerable time and effort. Two main strategies can ensure the ease of management and updates of your web site. One is to use a software application design that makes it easy to modify or replace the software components that make your web site possible. The other is to make sure your web site can handle anticipated system loads and therefore avoid system crashes.

By designing your web site properly, you will be able to minimize the costs and other resources required to manage and update it. For example, the SFWMD's choice of software (the Oracel9iAS application server) and web design makes updates simpler; SFWMD does not have to change programming language within each of the web pages individually. Instead, it can change code used by all web pages within the application server itself. This method reduces the redundancy of programming code in the web site design (see Chapter 5 for more information on the SFWMD's software application design).

4.6 Determine Costs, Time Required, Difficulty Level, and Labor Requirements

The costs, time required, difficulty level, and labor requirements for developing your web site will depend on a number of factors, including the functions you choose for your web site, the types of data you choose to make accessible, the data access/delivery system itself, and your available funds. In addition, you will need to carry out a major effort in terms of extracting data from your archival database, cleaning up and transforming your data, and loading your data into the data mart. The extent and cost of the data extraction, transformation, and loading effort will depend on the state of your data (i.e., differing data formats and database structures). As you plan the development of your web site, you might want to use the table on page 23 to help you identify your costs.

To create *The Living Everglades* web site (including carrying out the stakeholder process and promoting the web site), the SFWMD received an EMPACT grant for $488,598. The SFWMD also provided a matching contribution as part of the grant agreement. As mentioned earlier, an organization looking to create a similar web site might be able to incur significantly fewer resources by utilizing the SFWMD's custom-made software products and programming language (contact Brian Turcotte, 561 682-6579, or Marie Pietrucha, 561 682-6309, at the SFWMD for more infor-

mation). These products include the web site design and data mart design. In addition, if you decide to streamline the functions for your web site or reduce the sophistication of your data access/delivery system, your costs will be less. On the other hand, reducing the cost of some of the essential components of your web site might be difficult (e.g., the cost of providing temporally relevant data).

The SFWMD estimates that creating a similar web site to *The Living Everglades* site would require three or four software developers working for about 6 months (moderate to heavy commitment of time). SFWMD rates the difficulty of this project anywhere from moderately complex to complex.

Identifying Costs

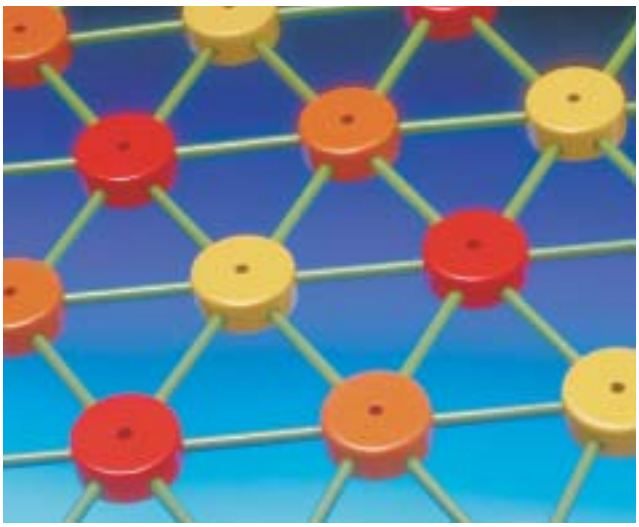
What Is Required?	Costs
Initial research Determining functions Data inventory Investigating software for data delivery/access system	
Software purchases Database server Application server Web server Mapping software Chart software Web design software	
Design and programming costs (usually requires hiring software consultants) Data mart design Data extraction/clean up/load (80% of effort in data marts) Creating a single working product from various software components Web site design	
Administrative costs Planning Training Direction and oversight Deliverable review Ongoing support and maintenance	
Stakeholder process Identifying stakeholders and partners Establishing partner agreements Carrying out stakeholder training sessions Promoting your web site	

4.7 Create the Web Site and Involve Stakeholders

After you have completed the preparatory work covered in this chapter, you will be able to proceed with the actual steps required to create your web site. Chapter 5 describes how the SFWMD created its site to achieve its goals, the general steps required to construct the web site, and the SFWMD's recommendations for other agencies interested in creating a similar site. Chapter 6 describes how to work with stakeholders to ensure your web site meets the needs of your intended audiences.

Chapter 5—Behind the Web Site: The Software Application Design

This chapter describes the overall structure of *The Living Everglades* web site, the functions of each software component included in the web site design, and general instructions for constructing the web site based on this design. If you are a project manager, note that this chapter and the appendices in this manual can be used by a software consultant or an in-house expert as a starting point for the creation of your web site. Please refer to the glossary (Appendix F) for definitions of computer terms used in this chapter.



The Living Everglades web site is a highly complex software application that required a significant amount of expertise and resources. If your agency does not have the same amount of in-house expertise as the SFWMD, you can still create a similar web site with enough financial resources, consulting expertise, and technical assistance from outside sources.

If you are interested in creating a similar web site for your own organization, consider which aspects of *The Living Everglades* web site are necessary to include. As discussed in Chapter 4, developing a useful web site that includes some of *The Living Everglades* features is possible without using all of the same software or techniques. Lastly, for useful tips when creating your web site, refer to SFWMD's lessons learned from developing *The Living Everglades* web site listed at the end of this chapter.

The SFWMD's Philosophy on the Software Design of *The Living Everglades* Web Site

The philosophy behind the software design for the web site was to provide a database-driven site that uses data structures and access methods specifically designed to handle time-series, spatial, and multimedia data. The SFWMD used the Java™ programming language in its design because it provides a direct and portable interface to the web site's data structures, which ensures flexibility and high performance. In addition, the SFWMD designed the site within a Model-View-Controller (MVC) framework, which separates three distinct forms of functionality within an application. In the case of The Living Everglades web site, the data mart is the Model, the user interface is the View, and the Java™ programming language, which "serves up" information from the data mart to the user, is the Controller. For more information on the MVC framework, see the Glossary (Appendix F).

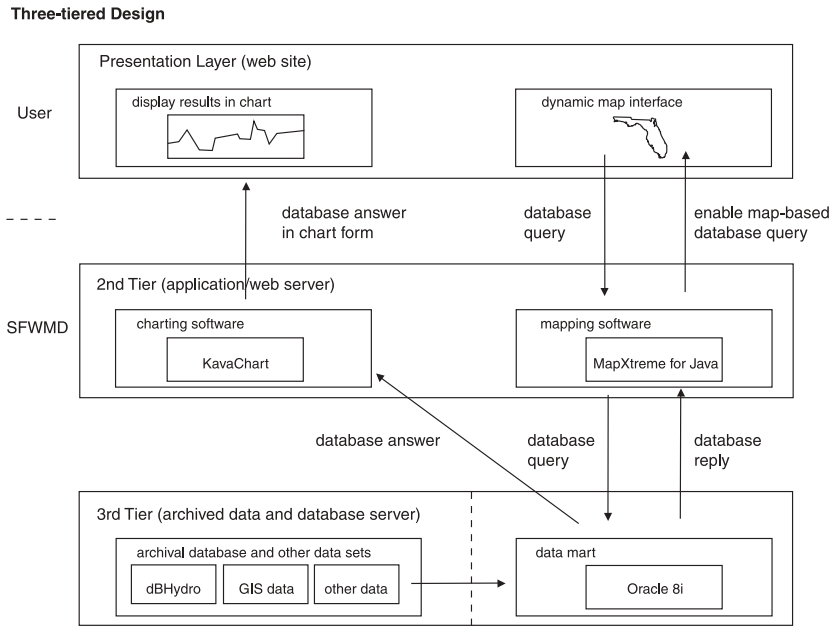
5.1 Overview of the Design

For the SFWMD to create the map-based query feature, provide quick response times for users, address scalability issues, and ensure ease of management and updates, it needed to purchase sophisticated software components and then program the components to coordinate with each other and handle the tasks required of them.

Some parts of *The Living Everglades* web site (not the map-based query feature) are constructed using a standard web architecture. When the user types in the URL for *The Living Everglades* home page, for example, the user's web browser accesses the web site information housed on a server located in the SFWMD's home office and displays it for the user on his or her computer. Whenever the user clicks on a hotlink within the web site, the server tells the web browser to open a window

and access web site information from the URL location referred to by that hotlink.

These simple functions require only two layers of software and hardware: (1) the web browser housed on the user's computer, and (2) the server software housed on the SFWMD's web server. This situation is described as a two-tiered client/server architecture, where "the client" is a term for the user's computer (including the interface or presentation layer), and the second tier is the web server.



To provide the map-based query feature and time-series charts through *The Living Everglades* web site, however, the SFWMD needed to expand the site's design by adding specialized software components to the second tier and a third tier containing a database server. This setup is described as a three-tiered client/server architecture. The third tier, which can be thought of as the bottom tier, is the location where a subset of the SFWMD's environmental data—the data that the SFWMD chooses to make available to the general public—are stored.

The subset of environmental data is called the data mart and is managed by the SFWMD through the Oracle® 8i database server software. The data mart is periodically updated with data from the district's archival database, called DBHYDRO (see Chapter 3 for more details on DBHYDRO). The updates flow through a data gateway. In addition to environmental measurement data, the data mart includes other applicable information as well, such as GIS data, environmental references and other documents, and audio and video files. The data updates are one of the most complex "back end" pieces that SFWMD uses.

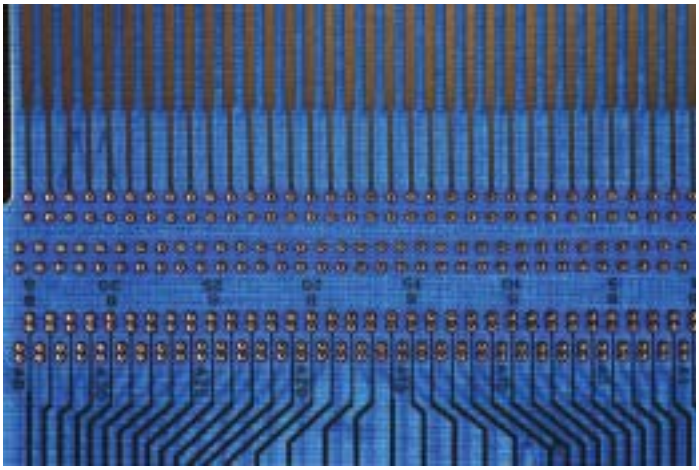
The specialized components that the SFWMD added to the second tier include mapping software, charting software (to chart time-series data), and a combination application/web server. The mapping software, called MapXtreme® for Java™, and charting software, called KavaChart, communicate with the data mart on the third tier and provide visuals of the results of database queries and other user commands. The application/web server, called Oracle® 9iAS, obtains information provided by MapXtreme and KavaChart and then provides these to the client (i.e., the user's computer via the web browser).

The SFWMD made sure that all of the components for its software application, both on the third tier and the middle tier, use the Java™ programming language when issuing new commands and when communicating with each other. According to the SFWMD, compared to other programming languages (e.g., ColdFusion, Active Server Pages, and PHP), Java™ provides maximum portability—it works in a wide variety of computer environments, in both the SFWMD's UNIX-based servers and its Windows-based servers—and provides performance enhancement by improving response times to user requests. (Note: the SFWMD does, however, use some of the above programming languages to create dynamic web pages for other purposes.)

The installation and integration of these software and hardware components is a very complex process. To succeed, the SFWMD made use of software development consultants rather than relying solely on in-house expertise.

5.2 A Closer Look at Each Tier

In this section, you will learn more details about each of the three tiers that make up the web site and general instructions for constructing each tier.



5.2a The Third Tier: The Data Mart

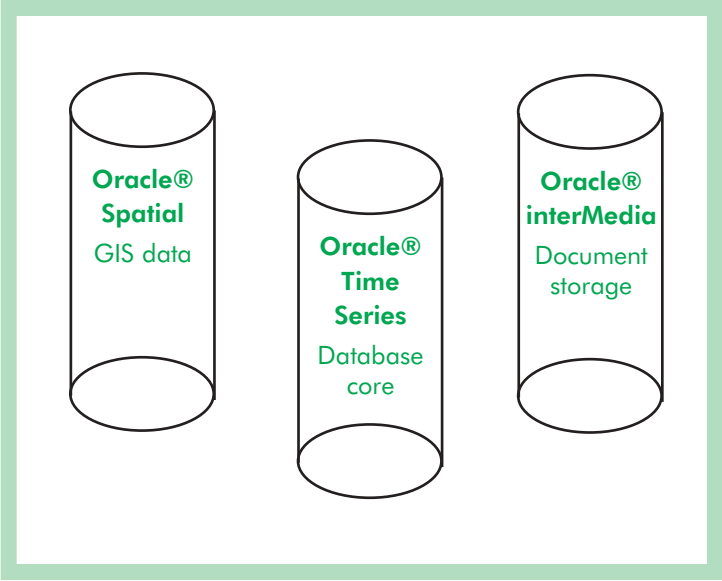
On the third tier, the SFWMD uses Oracle® 8i database server software. Oracle® 8i helped the SFWMD realize the potential for *The Living Everglades* project. SFWMD believed that an important benefit of using Oracle® 8i as a database server was that it can store and manage many types of information, including spatial data (such as maps and other GIS data); time-series data; and a variety of text and media files, such as documents, audio files, and video files.

Most other database servers can only manage one type of information—either spatial data, time-series data, or media files and documents. In addition, since Oracle® 8i is a relational database, SFWMD knew that the software was capable of referencing these various types of information to each other. For example, when a user chooses to access data from a particular geographical region, the database provides the user not only with the appropriate time-series data, but also all text and media files from that geographical region.

One of the reasons why Oracle® 8i can perform these functions is that it makes use of object-oriented programming and the object-relational model. In addition to the features noted above, object-oriented programming provides a number of other benefits including reduced development time, simplified system design, and greater system security. Finally, since this software makes use of the Java™ programming language, it can be used to create a web-accessible database. SFWMD noted that Oracle® 8i is set up to communicate with Java™-based software programs, such as MapXtreme® for Java™ and KavaChart (see Appendix G for technical contacts), which are deployed on the middle tier. It does not require any Java™ code sent between the two tiers to be recompiled or modified in any way.

The modules of Oracle® 8i that store and manage the different types of data are Oracle® Spatial, Oracle® Time Series, and Oracle® interMedia. On the SFWMD's data mart, Oracle® Spatial holds GIS data that the SFWMD obtained from USGS, EPA, and the district's own primary spatial data sets. The GIS data includes map coverages of water basins, counties, land use, canals, roads, lakes, and preserves. These data were loaded into Oracle® Spatial directly from Environmental Systems Research Institute (ESRI) coverage format using FME® Oracle Suite from Safe Software. On Oracle® interMedia, the SFWMD stores Microsoft® Word documents and Excel spreadsheets, PDF files, and video and audio files. The core of the database includes the subset of environmental measurement data from DBHYDRO and is stored on the Oracle® Time Series module.

The data mart is updated periodically with new, up-to-date data from DBHYDRO (and other applicable data sources). Specifically, the Oracle® Time Series module is updated every week, Oracle® Spatial every 6 months or as needed, and Oracle® interMedia as needed. The data mart is located on a Solaris 8 server, which provides a UNIX-based operating environment.



DBHYDRO (the archival database) is managed using the Oracle® 7.3.4 database server software and is located on an Open VMS server, separate from the data mart. All of the data in DBHYDRO have gone through a rigorous quality assurance/quality control (QA/QC) process. Because of the QA/QC process, the data available through *The Living Everglades* web site are not real-time data; however, the data are timely. (Note: The SFWMD uses telemetry to collect real-time data for its daily monitoring purposes.)

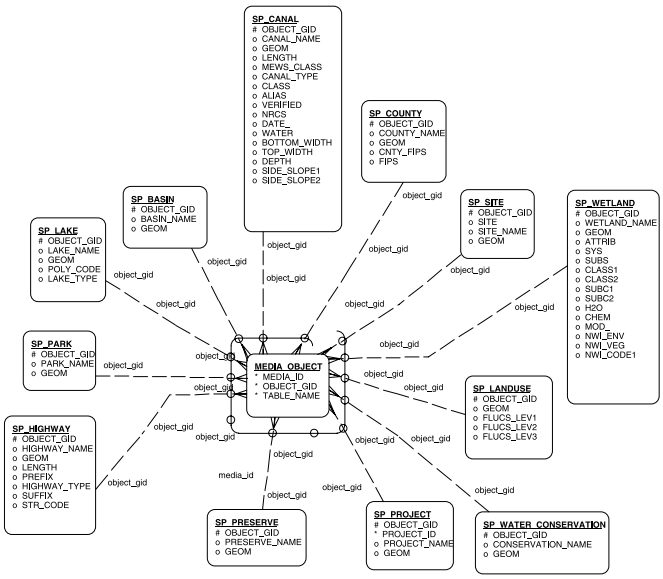
A firewall exists between the data mart and DBHYDRO because the SFWMD does not want the production version of DBHYDRO to be accessible to the general public, which ensures the data remain secure and unaltered. DBHYDRO, therefore, remains internal to the SFWMD. The firewall is a system designed to prevent unauthorized access to or from a private network.

5.2b Constructing the Third Tier

To set up a data mart on the third tier, you will need to complete three main steps:

- Purchase database server software.
- Create the data mart design.
- Create scripts or purchase specialized software (ETL tools) for data extraction, data cleanup, and loading into the data mart.

Your first step is to purchase database server software and have a server with enough power to store and run the software. The next step is to create a schema, or database structure, that defines what data will be in the database, how the data will relate to each other, and the attributes and methods associated with each data type (which need to be defined for software that makes use of object-oriented programming). (See Appendix A for the entity-relationship diagram that represents the data mart structure used for the third tier of *The Living Everglades* web site.)



The final step, which generally requires 80 percent of the resources necessary to implement a data

mart, is to extract, prepare, and load your archival data into the data mart, using your own custom-designed scripts or extraction, transformation, and loading (ETL) software tools. Scripts perform a number of functions, including helping to populate the data mart with updated information from your archival database (see Appendix C for more information on scripts used by the SFWMD). ETL tools are especially useful for implementing data marts when your archival databases are varied in structure and contain data in various formats.

You will usually need to hire a software consultant who specializes in creating and managing databases (especially object-relational databases) to set up a data mart, due to its complexity and technical requirements; however, you should be able to accomplish some initial steps with the help of the database software user's manual. One step that can save you time is to make use of the schema already created by the SFWMD. The schema, which can be thought of as a blank template, is generic enough that it can work for any organization's database regardless of the format. The SFWMD is offering the schema to other agencies and organizations for free. In addition to providing the schema to agencies, the SFWMD can provide the table list (see Appendix B for the schema's table list), which describes the purpose of each data table within the schema and a description of the data fields within each table.

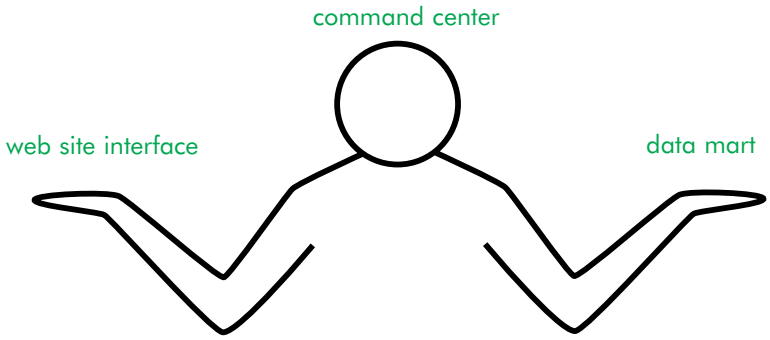
After creating the schema, you will need to load your collection points (environmental measurement data) into it, as well as any other files, such as environmental reference sources (documents), audio and video files (if desired), and site-specific GIS data. You can obtain GIS data from USGS and state agencies. Some GIS data are available on the Internet. You will not need to enter information manually into the data mart. Instead you can use ETL tools or scripts that can add the data automatically to the appropriate data mart tables.

The costs of creating the data mart depend largely on the consultant's fees, server software purchased, and the variety of data formats and data structures on your organization's archival databases. Keep in mind that costs will likely be lower if you choose to use the SFWMD's schema.

For more details on implementing a data mart, see Appendix C, which provides the development documentation for the data mart used for *The Living Everglades* web site. It is important to note that SFWMD had previously spent a lot of time developing and streamlining the archival database, DBHYDRO, which allowed for a relatively simple data extraction, transformation, and loading process.

Media_Type_Master	This table would hold the different types of media/document details, such as their extensions, type of document, and the software needed to access these media/documents.			
Table name	**Data Type**	**Size**	**Constraints**	**Comments**
media_type_id	NUMBER	10	Primary Key	Unique number given to the document type.
media_type	VARCHAR2	50	Not Null	Description of type e.g.Word, Excel, Adobe, ram etc.
media_extension	VARCHAR2	6	Not Null	e.g. .txt, .doc, .pdf, .jpg, .gif, .avi, .ram etc.
media_plugin_reader	VARCHAR2	200		MS-Word, Acrobat Reader, Real Player etc.
media_URL	VARCHAR2	256		Column would contain the URL suggesting where the Media Reader can be found for download.
media_mime_type	VARCHAR2	256		Mime Type for the particular file extension. Useful to identify the Plug-in Reader for that file.

5.2c The Middle Tier: The Command Center



The middle tier of *The Living Everglades* software application includes the Oracle® 9iAS (v.1.0.2.2) application/web server software, MapXtreme® for Java™, KavaChart, Java™ 2 Platform Enterprise Edition (J2EE), and frequently used bits of Java™-based code. The components on the middle tier are the "brains" of the software application—together, they receive and carry out the commands of the user. In addition, the middle tier components create all of the visualizations on the web site, including the maps, charts, GUI, text, and web site design. The middle tier components are all located on a server that has a Windows 2000 operating system. (Note: MapXtreme® for Java™ and KavaChart could be run on an independent platform instead of the same server as the other components.)

The Oracle® 9iAS application/web server software "serves up" the web pages and images to the client, receives commands and other input from the user, and exchanges information with the applications on the middle tier such as MapXtreme® for Java™ and KavaChart. The web server part of the Oracle® 9iAS includes the OC4J (Orion) servlet container for J2EE. All of the middle tier components are Java™-based. To interpret compiled Java™ code, Oracle® 9iAS makes use of the Java Virtual Machine.

In addition to exchanging information with Oracle® 9iAS, MapXtreme® for Java™ and KavaChart exchange information with the data mart located on the third tier. For example, by making use of the GIS data on Oracle® Spatial (on the third tier), MapXtreme® for Java™ provides the map interface for the user via the web browser (the top tier, see Section 5.2e). Similarly, KavaChart creates charts and tables using the time-series data on Oracle® Time Series (on the third tier). Just like the database server software, both MapXtreme® for Java™ and KavaChart make use of the object-relational model.

The map interface provided by MapXtreme® for Java™ works through a process called geocoding. This process assigns coordinate values (latitude and longitude) to the maps. When the user chooses a particular point on the map, MapXtreme® for Java™ determines the map coordinates referred to by the point, and then accesses the environmental information from the third tier's data mart that covers those coordinates (Oracle® interMedia on the third tier makes location queries possible by providing geometric locator services for the user).

By placing already compiled, frequently used bits of Java™ code on the middle tier that are accessed whenever needed, the SFWMD enables *The Living Everglades* web site to respond more quickly to user requests and makes the entire software application easier to manage and to further develop. Some of this code is organized and archived in libraries within the middle tier. This organization method is better than having too much Java™ code on the HTML pages themselves. The HTML for these web pages instead include a short Java™Script command that references the Java™ code in the middle tier libraries to perform a particular action. This approach allows for flexibility in the user's choice of web browser since processing is dependent on the application/web server instead of the user's particular choice of web browser. The Java™ code libraries provide many services, including customized user inter-

face presentation features, off-the-shelf server-side mapping application programming interfaces, database connectivity and query processing, server-side graphing, and HTTP response/request services.

J2EE is the coordinating center for the entire middle tier. The SFWMD used J2EE to establish the connections between Oracle® 9iAS, MapXtreme® for Java™, and KavaChart. J2EE makes the entire system work by allowing all of the different components to work together to produce a result that can be transmitted to the user's computer via the web browser.

5.2d Constructing the Middle Tier

The first step in creating the middle tier is to purchase the software components. The most expensive software component is MapXtreme® for Java™, which can cost between $10,000 and $30,000, depending on the server. KavaChart (including source code) costs about $1,000. You will at least need a trial development license from MapXtreme® for Java™ to get started. When you license MapXtreme® for Java™, you can have as many development licenses for it as you want as long as the licenses are not for production work. Oracle® 9iAS also has a cost, but you can save money by substituting freeware server software such as the Apache Tomcat servlet container (for more information, go to the Jakarta Project web site at <http://jakarta.apache.org/tomcat/>). Other middle tier components (such as frequently used bits of custom-developed Java™ code) are available for free from the SFWMD to interested government agencies.

After purchasing the software components, you will need the expertise of a software developer to piece together the various components and then make sure these components can receive commands from the client and obtain query results from the data mart. The software developer will use application program interfaces (APIs) within MapXtreme® for Java™ and KavaChart for program configuration and will then use J2EE to connect the various middle tier components into a single working unit.

To create the web pages, you can use web development software such as Macromedia® Dreamweaver®. The GUI for the web pages can be created using this web development software, and the GUI for the map-based query feature can be created using ready-made components within MapXtreme® for Java™. The web site design created by the SFWMD can be given to other government agencies for their use for free.

Keep in mind that there are pros and cons associated with using software such as MapXtreme® for Java™ or KavaChart since both require a large amount of custom coding. Although this type of software allows for full customization of your product to meet your needs, it can be expensive to maintain and document and requires more dependence on in-house staff knowledge. Another option is to create your web site using a simpler, ready-made web portal product. Web portals, which are web sites that provide a wide range of resources and services, can give users the ability to create their own sophisticated web sites using easy-to-use on-line tools.

To ensure the web pages are compliant with Section 508 of the amended Rehabilitation Act of 1998, you will need to ensure all graphic elements contain embedded "alt tags" for visually disabled users. These "alt tags" include descriptions of any pictures, charts, and maps that can be heard by visually disabled users when accessed using specialized software.

5.2e The Top Tier: The Presentation Layer

The presentation layer is the top tier. Through the user interface such as a web browser, the user can view and interact with the web pages "served" to the user's computer (i.e., the client) by the middle tier. The web pages are created with HTML code as well as Java™Script and Java™ Server Pages (JSP). The user accesses the map-based query feature through the presentation layer and is able to use the map query GUI to send commands to the SFWMD's data mart. The GUI captures user input necessary to build a data mart query through maps, time window selection, and data specifics. A firewall exists between the presentation layer and the middle tier for data security.

5.2f Constructing the Top Tier

The presentation layer is created by all of the workings of the middle tier software. The user will need to have a web browser (Internet Explorer or Netscape version 4.7 or better) and a computer with sufficient power to use the web site, especially the map-based query feature. *The Living Everglades* site is structured in such a way, however, as to minimize the user's hardware requirements while still providing excellent response time to user queries and commands.

5.3 Protecting the Software Application: Backups and Security Issues

You will probably want to back up your software application after you construct it. The SFWMD backs up *The Living Everglades* site with:

- Daily incremental backups
- Weekly full file system backups
- Weekly Oracle® exports to removable media

The SFWMD also has a disaster recovery plan as defined by its standard IT department practices. It can restore from backups, but does not have a "hot" site that it can "cut" to in case of hardware failure.

Security can be provided by constructing two firewalls: one between your archival database and the data mart, and another between the client and the middle tier. In addition to constructing fire walls, the SFWMD retained a sufficient amount of redundancy in the software application to address security issues. The SFWMD found that the main security concern it had was from Java™Script, which tends to "expose" pathways to the server. To address this concern, you can set up a development server inside the firewall to develop and test Java™Script applications that are inaccessible to users and then use a separate production server (also called a deployment server) to install Java™Script applications that are user-accessible.

5.4 Lessons Learned

The SFWMD learned a number of lessons when developing *The Living Everglades* web site. The SFWMD recommends the following when constructing your web site:

- **If possible, use only one IT company for both the data mart and the user interface.** The SFWMD hired one IT company to develop the data mart and a second IT company to create the web site interface. Using different IT companies for each of these tasks slowed down the development process. If two IT companies are necessary, be sure to facilitate the communication between all parties through explicit Statements of Work.

- **Set aside funds for teaching staff new technology.** The SFWMD did not realize that it was required by its change control procedures (i.e., procedures to protect the information security of in-house computer systems) to use in-house IT staff to implement the middle tier technology in SFWMD's production environment. The SFWMD did not initially budget for this and therefore needed to spend extra time teaching IT staff the new technology, performing coordination, and providing the desired oversight. The SFWMD found it challenging to develop mentoring methodologies for agency staff for this new technology.

- **Take steps to avoid IT bottlenecks.** The SFWMD encountered several IT bottlenecks because it had difficulty obtaining a timely commitment of hours from SFWMD database administrators and UNIX system administrators to perform certain necessary tasks. To avoid this problem, the SFWMD recommends ensuring IT management and rank-and-file employees commitment from the beginning, and not just the approval of executive management. The SFWMD spent a lot of time educating IT management (four training sessions in 2 years). Realize that your IT department will usually be very busy and understaffed and might experience staff turnover. Stakeholder interest (see Chapter 6) and feedback might refuel interest among upper management, who then can provide relief to overburdened IT staff.

- **Provide sufficient attention to web site content management to ensure resources are used effectively and without redundancy.** The SFWMD found that maintaining metadata for documents in the Oracle® interMedia portion of the data mart and linking these documents to spatial features was a part-time job on a continuing basis for a content manager. Web site content management is a new discipline and requires management attention to ensure resources are utilized effectively and without redundancy. The SFWMD sees the data mart as a content management system. It notes that its data mart is complementary to commercial content management systems because it extends functionality that is not part of any commercial package. On the other hand, the data mart does not replace commercial content management offerings because such offerings have robust workflow built into them to handle version control and approval.

- **Address data security.** The SFWMD data mart is created from documents and data stored in different places and is backed up incrementally on a daily basis with a full backup performed each week. If the database were lost or corrupted, it could be re-created. For additional security, the database tables are "owned" by a single Oracle schema for which password access is limited to a few key individuals. Also, all of the data tables have public synonyms and the pseudo-user "public" has "read access" to all tables.

- **Consider the pros and cons of using software consultants.** Software consultants can provide for faster development of sophisticated web sites and can bring new expertise in-

house; however, they are generally more expensive per hour than in-house staff, and finding consultants with an environmental background might be difficult. Although in-house staff are usually less expensive per hour than consultants, there is always the risk of "staff flight" after providing training on new technology. On the other hand, in-house staff might become more dedicated to the project because they have had the chance to develop the web site.

- **Budget extra time for deliverable review.**

Questions for IT Consultants

In the initial phases of searching for qualified consultants to construct a web site similar to The Living Everglades web site, the SFWMD recommends asking the following questions:

Oracle Database Administrator (for building the data mart):

- Are you an Oracle Certified Database Administrator?
- Do you have at least 4 years of professional experience? (practical experience is helpful)

Java™ Application Development (for writing the source code):

- Are you a J2EE Certified Programmer?
- Do you have at least 4 years of professional experience? (practical experience is helpful)
- What is your prior experience with Internet-based map servers such as MapXtreme® for Java™?

Database Programmer (for implementing the data mart):

- What is your prior experience with Oracle® Spatial?
- What is your prior experience with Oracle® TimeSeries?
- What is your prior experience with Oracle® interMedia?

Chapter 6—Working With Stakeholders and Partners

It is important not to create your web site in isolation—you will need the input of stakeholders and partners to ensure that your web site is both useful and user-friendly to all of them. This chapter explains how to work effectively with stakeholders and partners. You will learn why an implementing agency needs partners and stakeholders, how to identify and recruit partners and stakeholders, and how to conduct the stakeholder process. A case study is included at the end of the chapter showing how the SFWMD worked with one partner to improve the project web site, train specific audiences how to use it, and ultimately promote opportunities for the public to extract and view data.

6.1 What Are Stakeholders and Why Are They Important?

In general, stakeholders are people or organizations with a particular interest or investment in a project. They can include the intended audience and users of the project's products, as well as those individuals who are supporting a project (financially, technically, politically, or otherwise). By definition, stakeholders are affected by the performance or outcome of a project, and therefore, many are compelled to participate in the project's development.

Involving stakeholders in a project can help an agency receive valuable direction and feedback as a project progresses. This input creates a more useful and better targeted end product, plus it saves time and money down the road that might have to be spent to correct or revise the product. Stakeholder involvement also is critical for building consensus and support for the finished product.

The Living Everglades web site project involved three distinct groups of stakeholders:

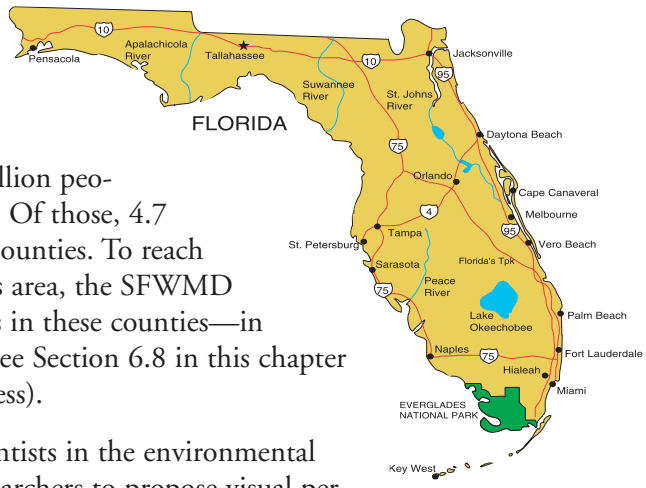
- **Intended users** of the web site, including educators, students, citizens, scientists, and environmental groups. Restoring the Everglades is an endeavor that directly impacts the citizens of South Florida, who are helping to subsidize the project through their tax dollars; it is therefore critical that these individuals' perspectives and needs for the web site are communicated and understood.
- **Partners**, or those intended users that are actively helping to make the project happen by providing resources, specialized skills, or in-kind donations. Partners in *The Living Everglades* web site included a variety of agencies and institutions, including colleges, local government offices, and businesses.
- **The media**, including television stations and broadcasters, radio managers and broadcasters, and newspaper publishers and reporters, who can help promote the finished product.

The SFWMD identified and recruited stakeholders and partners to participate in the design phase of the project, as well as to assist with outreach, training, and promotion.

6.2 How Do You Identify and Select Stakeholders and Partners?

When identifying stakeholders and potential partners, consider the audience and purpose of your project. Most likely, your audience and your stakeholders are the same people. For example, your audience may be defined by a geographic region, or by their profession or investment in the project. Think about who is going to use the finished product and who cares about the information it will communicate. These considerations will help you figure out who has a stake in the outcome of your project and how you might involve them.

Often, stakeholders are already organized in groups, such as government agencies, community action groups, and educators, each with their own communication network. They have regularly scheduled meetings or conference calls and use web sites, e-mail lists, and list servers to communicate with one another. Tapping into these networks can help you identify and reach more stakeholders. If your organization has a Public Information Department, be sure to partner with them early and often.



The SFWMD's targeted audience includes the nearly 6 million people who live in the 16-county region served by the district. Of those, 4.7 million live in Dade, Broward, Orange, and Palm Beach Counties. To reach out to the students, educators, and citizens who live in this area, the SFWMD coordinated with organizations that have existing networks in these counties—in particular, the Florida Center for Environmental Studies (see Section 6.8 in this chapter for more information on the stakeholder recruitment process).

The SFWMD maintains an ongoing partnership with scientists in the environmental community who work with the agency's engineers and researchers to propose visual performance measures for water quality and hydrologic data of the type that are housed in the web site's data mart. The SFWMD tapped into this existing network and utilized it to for review and comment in developing the web site's GUI.

6.3 How Do You Determine the Roles and Commitment of Stakeholders and Partners?

Once you have engaged a group of stakeholders and partners, they must understand their specific roles and commitment. Generally, a stakeholder's role is to represent the interests of its respective group. The stakeholder's commitment is to clearly communicate its group's perspectives and comments to project developers, who in turn make adjustments to meet the stakeholder's needs.

Partners are sometimes compensated for their efforts, or another arrangement is worked out (see box on page 36). Becoming a partner requires a different level of commitment that is worth documenting. A commitment letter or Memorandum of Understanding (MOU) are ways to ensure that everyone involved understands their roles and expectations. A commitment letter or MOU should spell out what each party will contribute to the project, outline

Partner Commitment

Partner commitment can take a variety of forms, including the following:

- **In-kind donations.** An "in-kind" donation is a noncash contribution of time, services, or goods by a donor to support a project. In-kind donations are valuable in building relationships and expanding your resource capability, since you can reserve your cash to pay for services that you haven't been able to get donated.
- **Cost-share.** Partners and the originating agency split the costs of a particular project, such as developing a curriculum.
- **Donations.** Partners provide monetary funds, which are typically used at your agency's discretion.
- **Compensated effort.** A partner agrees to perform a particular service or task and is compensated for its effort by a specified fee.

measurable goals, establish specific time frames, and delineate resource allocations or in-kind contributions.

Partners in the development of *The Living Everglades* web site played various roles, such as collecting needed evaluation data, assessing the user-friendliness and functionality of the site, and promoting the site through advertising assistance (see box on "Partner Roles" below).

In exchange for the services offered by partners, the SFWMD provided regular updates of the progress of its efforts and supplemental training to designated partner representatives. These representatives, in turn, provided training to other staff, students, or teachers who utilized the web site for research projects, teaching assignments, and other activities.

Partners and Their Roles

The SFWMD worked closely with one partner, the Florida Center for Environmental Studies (CES), located at Florida Atlantic University, to host workshops for potential web site users (stakeholders) and to coordinate outreach and training to universities, community colleges, and K-12 educators. CES also collected best practices from teachers and reached additional users through a list server for stakeholders and EMPACT advertisements on its web site (see Section 6.8 at the end of this chapter for more information on CES and its role in the project).

The SFWMD worked with a number of other partners to enhance and promote the web site, including the following:

- **Palm Beach Community College.** Palm Beach Community College provided regular communication and feedback on improving the ease of use and functionality of the site.
- **Palm Beach County of Environmental Resources Management (ERM).** ERM worked with the SFWMD's system designers to ensure the site's relevance and ease of use. The agency also provided advertising assistance, including providing a hotlink to The Living Everglades web site from ERM's homepage.
- **Palm Beach Soil and Water Conservation District.** This district provided feedback to the SFWMD on the ease of use of The Living Everglades web site and suggestions for improving its functionality for different stakeholder groups.
- **Scientific Environmental Applications, Inc.** This company assessed the web site for ease of accessibility and education soundness.

6.4 What Are the Benefits of Forming Partnerships?

Partnerships should be mutually beneficial for both the implementing agency and the partner. The implementing agency benefits by involving partners who can offer critical advice and feedback for enhancing the project and ensuring its goals are met. Involving partners in the development and testing phase can often save resources that would have to be expended later to "fix" a project. Partners also help spread the word about the project to potential users and can be instrumental in actively advertising and evaluating the project, thereby reaching greater numbers of the targeted audience.

Partners benefit by playing an active role in a project's development. They get a chance to offer their input and have their voices heard. They also gain valuable information and training to enhance their own programs and the opportunity to promote some of their work.

6.5 What Challenges to the Stakeholder Process Can You Anticipate and Address?

Remember that your project will not be the sole responsibility or "job" of any stakeholder or partner. Your organization, therefore, must make it easy for stakeholders and partners to fulfill their roles. Get feedback in an organized, convenient way, such as selecting the stakeholders' preferred means of communicating—whether by e-mail, phone calls, faxes, or face-to-face meetings. When meeting, choose meeting times and locations that are convenient to the stakeholders involved. The meeting facilitator also should be organized, efficient, and well-prepared.

Below are some general guidelines to consider when interacting with stakeholders:

- **Ask project developers to attend stakeholder meetings.** Communicating stakeholder comments to project developers can often be difficult, since they do not always "speak the same language." Face-to-face interaction allows stakeholders to express their comments and concerns without third-party translation. Project developers see first-hand how users interact with and respond to the project. By interacting directly with stakeholders, developers can resolve issues more easily.
- **Keep stakeholders informed.** Clarify expectations and commitments up front. Let them know you appreciate their time and effort by carefully listening to their feedback. Once they have offered input, communicate how you addressed their comments and keep them informed of the project's status.
- **Make it easy and enjoyable for them to participate.** The SFWMD chose central locations and served lunch to its workshop participants to help them fit the 3.5-hour workshop into the participants' day (see Section 6.8 in this chapter for more information on the workshops).

- **Be prepared.** If your project is "in the works," provide a product that is usable enough to solicit stakeholder feedback. For example, isolate one version of your web site that functions well enough to be tested.
- **Grant easy access.** If your web site or database is not publicly accessible through the Internet, you may have to assemble your stakeholders in one place to provide access to the product. Another option would be to password-protect a web site or establish a file transfer protocol and grant access to only stakeholders.

6.6 What Format Will Be Most Effective for Working With Stakeholders?

Once stakeholders have access to a working version of your project, you must decide how you will interact with them. Do you want to interact with them one at a time, or would it be more efficient to address groups at time? A number of formats are available, including individual phone calls, workshops, conference calls, video conferences, meetings, web sites, e-mail, and list server distributions. The most effective format depends on what resources you have available, the number of participants, and the level of interaction you expect.

The SFWMD and its partner CES integrated stakeholder feedback, user training, and outreach into a workshop format. The workshop format allowed the SFWMD to address an entire group of stakeholders at one time and grant direct access to the project. It also enabled stakeholders to interact directly with the project's developers (see Section 6.8 for more information). To reach more of the 16-county region, they recruited additional partners who could use their own facilities to host the workshops.

6.7 What Happens Beyond the Stakeholder Process?

When the stakeholder process is complete, you will have a usable project and a baseline of targeted users. How do you maintain the process and continue to promote your resource?

If your project involves a web site or database, it will be accessed by users who will likely continue to have questions and comments. One way to track and respond to these comments is to set up a section on the web site for submitting electronic questions. Users can post or e-mail questions that you or even other users can answer. Compile frequently asked questions and post them on the web site. This will save time and resources by not having to answer the same questions over and over again.

Many times, the targeted audience of your project has great ideas about how to use your resource, whether it's a database, web site, or other source of information. For example, the SFWMD and its partners collected best educational practices from teachers involved in the stakeholder process. These best practices include curricula, projects, and lessons that educators created while teaching their own students about the changing health of the Florida Everglades.

Stakeholders and partners also can help you to continue to promote your web site after its completion. By distributing information digests summarizing ecological analyses of data from *The Living Everglades* web site to stakeholders and partners in many locations, the SFWMD will effectively promote its web site to its audience.

The SFWMD has plans to contact the media to further promote and advertise *The Living Everglades* web site. It expects to take this step when the web site has been fully tested and is in working form. To reach an even greater number of stakeholders, the SFWMD will work with the media to identify other public channels such as TV, radio, and newspapers.

6.8 Case Study: Using Workshops To Reach Out to Potential Users

The SFWMD contracted with CES to host workshops for target audiences, including the general public, teachers, and environmental professionals and scientists. CES recruited workshop participants, prepared training materials, facilitated the workshops, and gathered stakeholders' comments.

Initially, CES facilitated and implemented three regional workshops for elementary, middle, and high school teachers and other educators. The purpose of the workshops was to introduce teachers to the web site, provide examples of how they can use it, explain origins of data and resources, and link data and resources with the CERP.

The SFWMD bundled together web site user training, stakeholder input, and outreach into a single workshop format, with three goals in mind:

- **Training.** Availability of the data to the cooperating stakeholders will enhance educational opportunities in the principles of environmental protection by augmenting existing educational programs throughout South Florida, such as the university system, the public and private school systems, and environmental organizations.
- **Outreach.** The stakeholders will promote the web site as material for classroom projects and discussions in which teachers and students learn about the Everglades ecosystem health indicators.
- **Stakeholder input.** Cooperating stakeholders play an active role in developing the design of the web interface. Stakeholders can:
  - Provide design review of the web interface.
  - Suggest the proper level of detail and user-friendliness.
  - Propose appropriate graphic formats to convey environmental information for public consumption.
  - Aid in document selection and organization.

The SFWMD partnered with CES because of its unique qualifications. As part of the Florida State University System (SUS), CES is sponsored by Florida Atlantic University, represents 11 universities, and acts as a facilitator and coordinator of research and training related to the environment—particularly those programs addressing water-dominated ecosystems. As a research and training facilitator and environmental education center, CES includes field studies for students and professional development opportunities for educators, as well as workshops, internships, and academic programs.

As a partner in developing *The Living Everglades* web site, CES agreed to fulfill the following tasks:

- Train educators how to utilize *The Living Everglades* web site as a teaching resource.
- Collect information on "best practices" from teachers.
- Survey users and evaluate the utility of the web site.

Identifying and Recruiting Stakeholders

To identify and recruit stakeholders, the SFWMD and CES advertised information about *The Living Everglades* project and outreach program on web sites and sent e-mail flyers and invitations to targeted audiences (see copies in Appendix D).

Promoting the Workshops

To promote the workshops, CES sent workshop promotional flyers and materials to science coordinators of middle and high school students. In addition, CES promoted the workshops electronically using the state's existing educational network and stakeholder networking. The educational network includes county school boards and professional organizations such as the Florida Association of Science Teachers and the League of Environmental Educators of Florida. For example, CES reached secondary school science teachers by working closely with county science coordinators and the Broward and Palm Beach County School boards. As part of the SUS, CES also worked with its existing network of faculty and contacts. CES contacted school boards and regional stakeholders network to promote the workshops and web site to teachers.

Choosing a Location for Workshops

To select locations for workshops that would reach the greatest number of people, CES sought population centers throughout the SFWMD's 16-county region. Within each strategic region (which, in this case, included Orlando, Miami, and Ft. Myers), CES identified organizations that had suitable facilities. To host a workshop, an organization had to have a computer training facility with an adequate number of computers with Internet connections. In many cases, CES worked with existing stakeholders to sponsor workshops or already had a strong working relationship with suitable organizations through previous successful projects.

Assembling Workshop Tools

Before actually facilitating the workshops, CES invested time and effort in assembling the tools it would need to effectively meet its outreach, training, and stakeholder goals. By investing this time and effort, CES optimized the time of attending stakeholders. (An agenda is available in Appendix D.) The tools used in the workshop included:

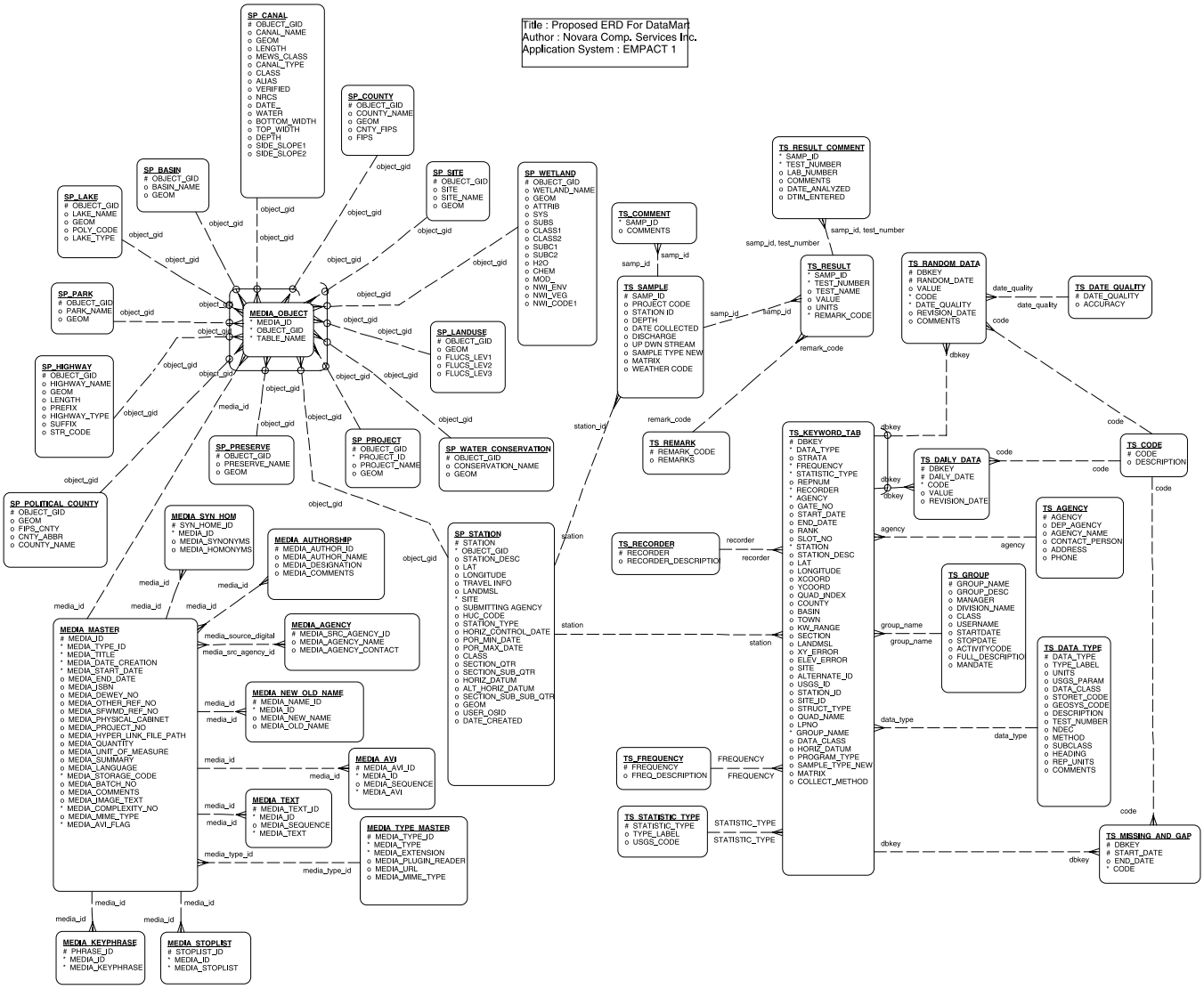
- **PowerPoint presentation.** To kick off the meeting, the SFWMD used a PowerPoint presentation to give an overview of the Everglades Restoration Project, the agency's role, and the status of *The Living Everglades* web site.
- **Draft web site.** To effectively host a training session, CES needed a product from which to work, which was a challenge since the web site was a work in progress. By working closely with the software developers, however, CES established a working draft web site and prepared it for stakeholder review by developing examples of queries and results on the web page, and a help system and tutorial to guide the user in navigating the web page. CES worked with developers to understand the current status of the draft web site. To provide better feedback to the SFWMD, CES invited the developers of the web site to the stakeholder meetings. This way, developers witnessed firsthand the interaction of users and the web site and could make the most appropriate changes.

- **Tutorial.** To help initiate users, CES developed a tutorial to illustrate how to navigate the site. The tutorial was made available on the draft web site. For the workshops, CES created the same tutorial in PowerPoint and walked users through their first data request. In addition, CES produced a comprehensive Users Guide that was used to help train users about the complexities of the site and was distributed to all workshop participants.
- **Development worksheet.** CES developed a web development worksheet as a tool for attendees to critique the web site, provide suggestions for improvement, and list additional resources they would like to see included. Stakeholders were asked to develop at least three questions for the "Frequently Asked Questions" section of the web site. This task helped the SFWMD and CES appreciate the web site from the users' perspective. The worksheet also asked participants to develop three predefined queries, one for each of the data parameters: water quality, hydrology, and weather.

Appendix A: Schema for Data Mart

The following schema, illustrated in this entity relationship diagram, shows the design and interrelationships for the data mart for *The Living Everglades* web site.

The SFWMD will make the data mart schema available at no cost to all interested agencies and organizations. Contact Brian Turcotte, 561 889-4794, or Marie Pietrucha, 561 682-6309, for more information.



Appendix B: Table List for Data Mart

The following table list for the data mart for *The Living Everglades* web site describes the characteristics and purpose of each data mart table and each field within each table.

The interrelationships of the tables is illustrated in the data mart entity relationship diagram (Appendix A).

Media_Type_Master	This table would hold the different types of media/document details, such as their extensions, type of document, and the software needed to access these media/documents.			
Table name	**Data Type**	**Size**	**Constraints**	**Comments**
media_type_id	NUMBER	10	Primary Key	Unique number given to the document type.
media_type	VARCHAR2	50	Not Null	Description of type e.g.Word, Excel, Adobe, ram etc.
media_extension	VARCHAR2	6	Not Null	e.g. .txt, .doc, .pdf, .jpg, .gif, .avi, .ram etc.
media_plugin_reader	VARCHAR2	200		MS-Word, Acrobat Reader, Real Player etc.
media_URL	VARCHAR2	256		Column would contain the URL suggesting where the Media Reader can be found for download.
media_mime_type	VARCHAR2	256		Mime Type for the particular file extension. Useful to identify the Plug-in Reader for that file.

Media_Agency	This maintains the Agency which digitized the Document. This is separate from TS_AGENCY which stores the agency data who have collected the data.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
media_src_agency_id	VARCHAR2	4	Primary Key	Unique number given to the agency which digitizes the media/document.
media_agency_name	VARCHAR2	50		Name of the Agency which digitized the document.
media_agency_contact	VARCHAR2	50		Name of the contact person.

Media_Master	This contains the general attributes of a document/media			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
media_id	NUMBER	10	Primary Key	Unique number given to the media/document.
media_type_id	NUMBER	10	Foreign Key	This is the Foreign Key refers to Media_Type_Master.
media_title	VARCHAR2	2000	Not Null	Title of the Document.
media_date_creation	DATE		Not Null	Data of Creation of the media/document.
media_start_date	DATE		Not Null	Start Data of Validity of the media/document.
media_end_date	DATE			End Date of Validity of the media/document.
media_ISBN	VARCHAR2	15		Reference Number.
media_DEWEY_NO	VARCHAR2	15		Reference Number.
media_Other_Ref_No	VARCHAR2	15		Reference Number.
media_SFWMD_ref_no	VARCHAR2	15		Reference Number.
media_physical_cabinet	VARCHAR2	2000		Location - where the physical media/document is located.
media_project_no	VARCHAR2	30		Project number for which the media/document is related. This refer to Project_Id in SP_Projects table.
media_hyper_link_File_path	VARCHAR2	256		Hyper link of the media/document, or Path of the file.
media_quantity	NUMBER	15		The Quantity Example. No. of Pages, No. of Floppy disks need to store the e-document, etc.
media_unit_of_measure	VARCHAR2	5		Ex. Pages, Mega Bytes, Slides etc.
media_summary	CLOB			The Executive Summary of the Document.
media_language	VARCHAR2	30		Language of the Document. Would be descriptive such as English, Spanish etc. (International).
media_storage_code	VARCHAR2	1	Not Null	Storage code referring .. If the media is stored in Oracle (O), or as a File (F) or is it a URL (U).
media_batch_no	VARCHAR2	30		Reference No. which indicates the batch of digitization given to the agency.
media_comments	VARCHAR2	4000		General Comments.
media_image_text	VARCHAR2	4000		Any text related to that is related to a specific Image, Audio or Video which is to be displayed as the sub-titles.
media_complexity_No	NUMBER	1	Not Null	0 thru 9 will decide the complexity number for the document. Default is 0. 0 is least complex.
Media_avi_flag	VARCHAR2	1	Not Null	T - for Text/Word/Excel/PDF documents, A for Audio file, V for Video/animation files and I for Image files.

Media_Text	This table would contain the Text documents.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
media_text_id	VARCHAR2	7	Primary Key	Unique number assigned to the Text Document.
media_id	NUMBER	10	Foreign Key	This is the Foreign key to Media master table.
media_sequence	NUMBER	3		This column would hold the sequence number for the media/document if that particular media/document is split and needed to be assembled during the display time.
media_text	CLOB		Not Null	The contents such as MS-Word, Text Files etc.

Media_AVI	This table would contain the Text, Audio, Video Image files.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
media_avi_id	VARCHAR2	7	Primary Key	Unique number assigned to the Text Document.
media_id	NUMBER	10	Foreign Key	This is the Foreign key to Media master table.
media_sequence	NUMBER	3		This column would hold the sequence number for the media if that particular media is split and needed to be assembled during the display time.
media_avi	BLOB		Not Null	All audio, video and image files, such as Bit Map Files, GIFs, JPGs, MP3s, AVIs etc.

Media_AuthorShip	Has the details of the author worked on the media/document.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
media_Author_id	VARCHAR2	10	Primary Key	Unique number given to Authorship for this media/document.
media_author_name	VARCHAR2	30		Name of the Author.
media_designation	VARCHAR2	30		Author's Designation.
media-Comments	VARCHAR2	256		Comments about the author.

Media_New_Old_Name	This holds the old and new names of the media or the document.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
media_name_id	VARCHAR2	10	Primary Key	Unique number for the name.
media_id	NUMBER	10	Foreign Key	This is the Foreign key to Media master table.
media_new_name	VARCHAR2	256		New Name of the Document.
media_old_name	VARCHAR2	256		Old Name of the Document.

Media_Keyphrase	This table would hold all the keywords that would be used to identify a particular document/media for display. Mostly used for Non-Text documents e.g. Audio, Video, etc.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Phrase_id	NUMBER	15	Primary Key	A Unique Key Assigned to the Key Phrase.
media_id	VARCHAR2	10	Foreign Key	This is the Foreign key to Media Master table.
media_keyphrase	VARCHAR2	128	Not Null	Phrase which would be useful for the search of a document or media.

Media_StopList	This table would hold all the keywords that would be used to identify the documents using which the document/media should not be displayed. Mostly used for Non-Text documents e.g. Audio, Video, etc.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
stoplist_id	NUMBER	15	Primary Key	Unique Key assigned to the Stoplist.
media_id	VARCHAR2	10	Foreign Key	This is the Foreign key to Media Master table.
media_Stoplist	VARCHAR2	128	Not Null	Phrase can be used to avoid the selection of the documents/media for display.

Media_Syn_Hom	This table holds the synonyms or the homonyms of the media/document.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Syn_hom_id	NUMBER	15	Primary Key	Unique Key assigned to the synonym/homonym.
media_id	NUMBER	10	Foreign Key	This is the Foreign key to Media master table.
media_Synonyms	VARCHAR2	128		Synonyms of media/document.
media_homonyms	VARCHAR2	128		Homonyms for the media/document.

Media_Object	This is used to relate spatial data with Inter-Media. Used for searching document based on spatial data.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
media_id	NUMBER	10	Foreign Key	This is the Foreign key to Media master table.
Object_GID	VARCHAR2	32	Foreign Key	Refers to Media_master, SP_County, SP_Sites, SP_Wetlands, SP_Landuse, SP_Projects, SP_Water_Conservation, SP_Station, SP_Preserves, SP_Political_County, SP_Highway, SP_Parks, SP_Lakes, SP_Basin, SP_Canals.
Table_name	VARCHAR2	30	Not Null	The table name whose primary key is referred in object_GID as foreign key. Should be validated from data dictionary.

SP_County	This table keeps track of the counties relevant to DBHYDRO.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Object_GID	VARCHAR2	32	Primary Key	The Unique identifier of County.
County_name	VARCHAR2	32		Full name of county.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the County.
County_fips	VARCHAR2	3		*FIPS code (001-135)
fips dropped.	VARCHAR2	6		*State FIPS code (12) This item could be

SP_Political_County	Stores the Political Boundaries of a County. Used for query, not for display.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Object_GID	VARCHAR2	32	Primary Key	The Unique identifier of Political County.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Political County.
Fips_County	VARCHAR2	3		*State FIPS code (3-digit: 001-135)
County_ Abbr	VARCHAR2	2		*2-digit County Abbreviation.
County_Name	VARCHAR2	32		*County Name.

SP_Basin	This table keeps a list of the hydrologic basins relevant to SFWMD. These basins should match those tracked in the District's geographic information system (GIS).			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Object_GID	VARCHAR2	32	Primary Key	The Unique identifier of Basin.
Basin_name	VARCHAR2	40		The full name of the hydrologic basin.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Basin.

SP_Lake	This table stores data about lakes of South Florida.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Object_GID	VARCHAR2	32	Primary Key	The Unique identifier of Lakes.
Lake_Name	VARCHAR2	50		Full Name of the Lake.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the lakes.
Poly_Code	VARCHAR2	2		*This item will not exist.
Lake_Type	VARCHAR2	6		*This item will not exist.

able Name	ype			
	ARCHAR2		rimary Key	
Canal_Name	VARCHAR2	50		Full Name of the Canal.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Canals.
Length	NUMBER	9		*Length of this REACH; Total canal length to be calculated by application.
Mews_Class	VARCHAR2	12		*Unnecessary.
Canal_Type	VARCHAR2	20		*Primary, Secondary, River, etc.
Class	VARCHAR2	6		*Major vs. Minor.
Alias	VARCHAR2	25		*Alias Name for canal.
Verified	VARCHAR2	3		*??
NRCS	VARCHAR2	10		*??
Date_	VARCHAR2	11		*??
Water	VARCHAR2	3		*??
Bottom_width	NUMBER	5,2		Bottom width of canal.
Top_width	NUMBER	5,2		Top width of canal.
Depth	NUMBER	5,2		Depth of canal.
side_slope1	NUMBER	3		One side of slope.
side_slope2	NUMBER	3		Other side of slope.

able Name	ype			
	ARCHAR2		rimary Key	.
Highway_Name	VARCHAR2	50		Full Name of the highway.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Highways.
Length	NUMBER	9		*Length of this road segment; Total length to be calculated by application.
Prefix	VARCHAR2	2		*NE, SW, etc.
Highway_Type	VARCHAR2	4		*ST, RD, AVE, etc.
Suffix	VARCHAR2	2		*W, N, SE, etc.
STR_Code	VARCHAR2	2		* Relative size of road (i.e., Interstate vs. boulevard)

able Name	ype			
	ARCHAR2		rimary Key	
Site	VARCHAR2	10		Abbreviation for the site.
Site_Name	VARCHAR2	60		Full Name of the Site.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Sites.

SP_Park	This table contains information about different parks of south Florida.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Object_GID	VARCHAR2	32	Primary Key	The Unique identifier of the Park.
Park_Name	VARCHAR2	50		Full Name of the Park.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Parks.

SP_Project	This table contains information about different projects of SFWMD e.g., Everglades Nutrient Removal Project.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Object_GID	VARCHAR2	32	Primary Key	The Unique identifier of Projects.
Project_id	VARCHAR2	8	Unique Key	Refers to column Group_Name in TS_Group table.
Project_Name	VARCHAR2	50		Full Name of the Project.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Projects.

SP_Preserve	This table contains information about different preserves for e.g. National Preserves.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Object_GID	VARCHAR2	32	Primary Key	The Unique identifier of Preserves.
Preserve_Name	VARCHAR2	50		Full Name of the Preserve.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Preserves.

SP_Water_Conservation	This Table contains information about water conservation areas.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Object_GID	VARCHAR2	32	Primary Key	The Unique identifier of Water Conservation.
Conservation_Name	VARCHAR2	50		Full Name of the Conservation.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Wet Conservation.

SP_Wetland	This table contains information about wetlands.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Object_GID	VARCHAR2	32	Primary Key	The Unique identifier of Wetlands.
Wetland_Name	VARCHAR2	50		Full Name of the Wetland.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Wetlands.
Attrib	VARCHAR2	20		*See NWI metadata
Sys	VARCHAR2	1		*See NWI metadata
Subs	VARCHAR2	1		*See NWI metadata
Class1	VARCHAR2	3		*See NWI metadata
Class2	VARCHAR2	2		*See NWI metadata
Subc1	VARCHAR2	1		*See NWI metadata
Subc2	VARCHAR2	1		*See NWI metadata
H2O	VARCHAR2	2		*See NWI metadata
Chem	VARCHAR2	1		*See NWI metadata
Mod_	VARCHAR2	10		*See NWI metadata
NWI_Env	VARCHAR2	1		*See NWI metadata
NWI_Veg	VARCHAR2	1		*See NWI metadata
NWI_Code1	VARCHAR2	2		*See NWI metadata

able Name	**ype**			
	ARCHAR2		rimary Key	anduse
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the land use.
Flucs_Lev1	VARCHAR2	3		*See LU95 metadata
Flucs_Lev2	VARCHAR2	3		*See LU95 metadata
Flucs_Lev3	VARCHAR2	4		*See LU95 metadata

SP_Station	Station attributes.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Station	VARCHAR2	10	Primary Key	A common pneumonic by which to refer to the location.
Site	VARCHAR2	10	Foreign Key	Name for general location of station (often used to simplify plotting). Refers to SP_Site.
Object_GID	VARCHAR2	32	Unique Key	The Unique identifier of station.
Station_desc	VARCHAR2	78		Description of the location.
Lat	NUMBER	9.3		Latitude.
Longitude	NUMBER	9.3		Longitude.
Travel_info	VARCHAR2	2000		Information on how to get to the station.
Landms1	NUMBER	7.2		Station elevation (ft msl).
Submitting_agency	VARCHAR2	8		Used to track the origin of the station record.
Huc_code	NUMBER	8		USGS Hydrologic Unit Code. HUCs are similar to basins.
Station_Type	VARCHAR2	13		Used to track the nature of the environment in which the station is located.
Horiz_control_date	DATE			The date the location was determined.
Por_min_date	DATE			Derived from the start date of all the time series at this station.
Por_max_date	DATE			Derived from the end date of all the time series at this station.
Class	VARCHAR2	7		Used to distinguish between water quality and hydrologic stations or both. Valid values are ALL, DTA, and WQ.
Section_qtr	VARCHAR2	2		A ½ mile by ½ mile "square" within a given section. These squares divide the section into quarters.
Section_sub_qtr	VARCHAR2	2		1¼ by ¼ mile "square" within a given quarter section.
Horiz_datum	VARCHAR2	12		Coordinate system for location information. Should be NAD83.
Alt_horiz_datum	VARCHAR2	12		Identification of alternate horizontal datum (coordinate system). For practical purposes this is NAD27 for all data. However, this design allows for it to be any coordinate system.
Section_sub_sub_qtr	VARCHAR2	2		1 1/8 by 1/8 mile "square" within a given sub quarter section.
Geom	SDO_GEOMETRY			Spatial Component. Used to store the geometry information for the Station.
User_osid	VARCHAR2	8		Used for auditing changes to this table.
Date_created	DATE			Used for auditing changes to this table.

able Name	ype			
	ARCHAR2		rimary Key	single character that is indicative of the quali-
Description	VARCHAR2	45		The translation of the code into meaningful language. For instance, a code of 'E' means the value was Estimated.

TS_Date_Quality	Indicates Accuracy Of Time Stamp.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Date_quality	VARCHAR2	1	Primary Key	A single character which is translated into some amount of time by the associated "accuracy" column.
Accuracy	VARCHAR2	10		The accuracy to which a given time stamp is known +/- the amount of time show.

TS_Frequency	This table contains a list of the frequencies at which various time series are summarized.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Frequency	VARCHAR2	2	Primary Key	Abbreviation of the frequency (i.e. DA is for Daily)
Freq_description	VARCHAR2	20		Spelled out description of the abbreviation.

TS_Missing_and_Gap	Time series details for missing and not available data.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Dbkey	VARCHAR2	5	Primary Key	This columns refers to ts_keyword_tab.
Start_date	DATE		Primary Key	Starting Date the data was found missing.
Code	VARCHAR2	1	Foreign Key	This column refers to TS_code. Contains values of M and N referring to Missing and Not Available data.
End_date	DATE			Ending Date the data was found missing.

TS_Daily_Data	Daily Values Data.			
Table Name	**Data Type**	**Size**	**Constraints**	**Comments**
Dbkey	VARCHAR2	5	Primary Key	This columns refers to ts_keyword_tab.
Daily_date	DATE		Primary Key	Time series data: Oracle date data type with hours and minutes portion equal to 0000.
Code	VARCHAR2	1	Foreign Key	A quality indicator that references the TS_code table.
Value	NUMBER	8.3		Time series data value.
Revision_date	DATE			Revision date for data. Code changed or value changed.

TS_Random_Data	Data Which Is Collected At Irregular Or Widely Spaced Intervals.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Dbkey	VARCHAR2	5	Primary Key	This columns refers to ts_keyword_tab.
Random_date	DATE		Primary Key	Date/time stamp for value.
Code	VARCHAR2	1	Foreign Key	Indicates quality or other attributes of value. Refers to TS_code table.
Date_quality	VARCHAR2	1	Foreign Key	Indicates date/time accuracy. Refers to TS_Date_Quality.
Value	NUMBER	8.3		
Revision_date	DATE			Code changed or value changed.
Comments Data.	VARCHAR2	50		General Comments about Random Sample

TS_Comment	This table stores comments for sample data stored in table “sample”.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Samp_id	VARCHAR2	13	Foreign Key	Identifies a discrete sample within a project. Usually sequential numbers 00001 - 99999. Refers to TS_Sample.
Comments	VARCHAR2	240		Comments for Sample Data.

TS_Recorder	Recording Device details.			
Table Name	**Data Type**	**Size**	**Constrains**	**Comments**
Recorder	VARCHAR2	4	Primary Key	Abbreviation of the recording device.
Recorder_description	VARCHAR2	70		Description of the abbreviation.

able Name	ype			
	ARCHAR2		rimary Key	
Type_label	VARCHAR2	25		The long name for the data type.
Units	VARCHAR2	30		Units of measurement of the specific data type. This attribute might more correctly be modeled at the result or data record level.
Usgs_param	NUMBER	5		The 5 digit code used by the USGS to indicate the type of measurement.
Data_class	VARCHAR2	7		This field has the value 'FLOW', 'STAGE', WEATHER', or 'WQ' and provides for the separation of datatypes into different disciplines.
Storet_code	NUMBER	5		The Environmental Protection Agency (EPA) database alias for this particular data type.
Geosys_code	VARCHAR2	2		Code used by Florida Bureau of Geology GEOSYS system.
Description	VARCHAR2	200		A description of the data type.
Test_number	NUMBER	3		Test number is a SFWMD assigned identifier used to supplement EPA STORET codes for water quality data. Sometimes the EPA may not have a STORET number for a given kind of measurement so the SFWMD assigns a test number in its place.
Ndec	NUMBER	2		The number of places to the right of the decimal point to which a given data type should be reported. This attribute would more correctly be modeled at the result or data record level. This information is used in conjunction with the number of significant figures in the result.
Method	VARCHAR2	10		The method by which a water quality sample was analyzed to obtain the given result.
Subclass	VARCHAR2	5		
Heading	VARCHAR2	8		The text to appear as a column heading in standard output reports.
Rep_units	VARCHAR2	8		Units in which the value for this data type are reported. The benefit of storing all data int he same units is that the data can be readily compared to one another without conversion.
Comments	LONG			Anything additional about this data type.

TS_Statistic_Type	Statistical method used to report data.			
Column Name	**Data Type**	**Size**	**Constraints**	**Comments**
Statistic_type	VARCHAR2	4	Primary Key	Code for Statistic type.
Type_label	VARCHAR2	30		Description of Statistic type.
USGS_Code	NUMBER	5		USGS Code for Statistic type.

TS_Keyword_Tab	Table maintained by triggers on underlying DBHYDRO tables. This table feeds the search engine for the database access program known as DBACCESS.			
Column Name	**Data Type**	**Size**	**Constraints**	**Comments**
Dbkey	VARCHAR2	5	Primary Key	The system assigned primary key for this table. Dbkey is the unique identifier for each time series (data set).
Data_type	VARCHAR2	5	Foreign Key	The short name for the data type. Refers to TS_Data_Type table.
Frequency	VARCHAR2	2	Foreign Key	Abbreviation of the frequency (i.e. DA is for Daily). Refers to TS_Frequency table.
Statistic_type	VARCHAR2	4	Foreign Key	Summary statistic (mean, min, max, etc.). Refers to TS_Statistic_Type table.
Recorder	VARCHAR2	4	Foreign Key	Abbreviation of the recording device. Refers to TS_Recorder table.
Agency	VARCHAR2	4	Foreign Key	The agency responsible for the quality control of the specific time series. This column references tx_agency.
Station	VARCHAR2	10	Foreign Key	A common pneumonic by which to refer to the location. Refers to SP_Station Table.
Group_name	VARCHAR2	8	Foreign Key	Group_name is used to refer to a group of related stations. Refers to TS_Group table.
Strata	NUMBER	7.3		Distance above local ground elevation (feet).
Repnum	NUMBER	2		Replication number: used to distinguish between like groups.
Gate_no	NUMBER	2		Gate number.
Start_date	DATE			Date at which data starts.
End_date	DATE			Date at which data ends.
Rank	NUMBER	1		Subjective ranking of time series reliability.
Slot_no	NUMBER	1		Slot number for slot gates.
Station_desc	VARCHAR2	78		Description of the location.
Lat	NUMBER	9.3		Latitude.
Longitude	NUMBER	9.3		Longitude.
Xcoord	NUMBER	10.3		Florida state plane x-coordinate NAD83.
Ycoord	NUMBER	10.3		Florida state plane y-coordinate NAD83.
Quad_index	NUMBER	8		A system-assigned key based on latitude and longitude.
County	VARCHAR2	3		Abbreviation for county.
Basin	VARCHAR2	8		The short name for the hydrologic basin.
Town	NUMBER	2		Township.
Kw_Range	NUMBER	2		Range.
Section	NUMBER	2		Section. There are typically 36 sections to a township-range intersection. Each section is typically 1 square mile.
LandMSL	NUMBER	7.2		Land surface elevation.
XY_error	NUMBER	8.4		Error in state plane coordinates (ft).

Elev_error	NUMBER	8.4	Error in elevation (ft).
Site	VARCHAR2	10	Name for general location of station (often used to simplify plotting).
Alternate_id	VARCHAR2	15	
Usgs_id	VARCHAR2	15	Identifier to the USGS database system.
Station_id	VARCHAR2	8	Identifies sampling station for water quality data points. Descriptions and geographical coordinates can be found in table SP_station.
Site_id	VARCHAR2	8	Unique Identifier assigned to the site.
Struct_type	VARCHAR2	4	The abbreviation for the structure type.
Quad_name	VARCHAR2	40	Quadrangle sheet name as given by the USGS.
Lpno	NUMBER	3	Land Planning Number. A SFWMD internal numbering scheme starting at 1.
Data_class	VARCHAR2	7	This field has the value 'FLOW', 'STAGE', 'WEATHER', or 'WQ' and provides for the separation of datatypes into different disciplines.
Horiz_datum	VARCHAR2	12	Coordinate system for location information. Should be NAD83.
Program_type	VARCHAR2	5	Separates normal monitoring activities from results that are deemed "experimental" in nature.
Sample_type_new	VARCHAR2	8	Keeps track of the kind of sample. This is especially useful for water quality data. This field is called sample type new because of an effort underway to make this attribute hold a single piece of information. Previous use of the sample type field allowed for several pieces of information to be stored in one column. As part of decomposing sample type, sample type new, matrix, and collect_method were created.
Matrix	VARCHAR2	5	The medium in which the water to be analyzed is resident.
Collect_method	VARCHAR2	5	The method by which the water quality sample was collected.

TS_Agency	This table contains information about cooperating agencies and organizations who contribute data to the database.			
Column Name	**Data Type**	**Size**	**Constraints**	**Comments**
Agency	VARCHAR2	4	Primary Key	The agency abbreviation used in the database.
DEP_Agency	NUMBER	3		Florida Dept. Of Environmental Regulation Agency Code.
Agency_Name	VARCHAR2	50		The full name of the cooperating agency or organization.
Contact_Person	VARCHAR2	30		Contact Person in the Agency.
Address	VARCHAR2	60		Address of the Agency.
Phone	NUMBER	10		Phone.

	ype			
	ARCHAR2		rimary Key	
Group_desc	VARCHAR2	70		Description of the Group.
Manager	VARCHAR2	30		Manager of the Group.
Division_name	VARCHAR2	30		Division Name.
Class	VARCHAR2	7		Allows for creation of views based on whether this field is 'ALL', 'DTA', or 'WQ'. The projects view excludes DTA groups.
Username	VARCHAR2	30		The network userid of the group manager. This is more appropriately implemented as a 1:M relationship and not a 1:1.
Startdate	DATE			The beginning date of the group or project.
Stopdate	DATE			The end date of the group or project.
Activitycode	VARCHAR2	20		The Financial System activity code for water quality projects.
Full_description	Long			A lengthy description for the group. For the major water quality projects this text comes from Richard Pfeuffer's technical publication.
Mandate	VARCHAR2	8		For water quality projects the mandate indicates whether the project is a Legislative Mandate, Governing Board mandate, or special project. Knowing the mandate allows for better prioritization of monitoring activities.

TS_Remark	Comprised of one or more data qualifiers as applied by the lab or project manager.			
Column Name	**Data Type**	**Size**	**Constraints**	**Comments**
Remark_code	VARCHAR2	3	Primary Key	Comprised of one or more data qualifiers as applied by the lab or project manager. These data qualifiers are approved by DEP.
Remarks	VARCHAR2	50		General Comments for Sample.

TS_Sample	This table contains test results for all samples which have been analyzed by the sfwmd lab and from contract labs			
Column Name	**Data Type**	**Size**	**Constraints**	**Comments**
Samp_id	VARCHAR2	13	Primary Key	Identifies a discrete sample within a project. Usually sequential numbers 00001-99999.
Project_code	VARCHAR2	8	Foreign Key	Identifies project specific sample. Derived from the project description. Eg. "Enrp" is the project code for samples collected in the "everglades nutrient removal project". Refers to SP-Projects.
Station_id	VARCHAR2	10	Foreign Key	Identifies sampling station for water quality data points. Descriptions and geographical coordinates can be found in table SP_Station.
Depth	NUMBER	7.2		Sample depth in meters. Surface samples have "zero" depth as do samples for which depth is unknown.
Date_collected	DATE			Date and time the sample was collected by the field person.
Discharge	NUMBER	2		A code indicating whether or not water was flowing at the time of the sampling event and in which direction it was flowing if it was flowing.
Up_dwn_stream	NUMBER	1		Indicates where a sample was collected with respect to a control structure. If downstream and flowing then higher turbidity may be expected. Code are 0=Undefined. 1=Upstream, 2=Downstream.
Sample_type_new	VARCHAR2	8		Keeps track of the kind of sample. This is especially useful for water quality data. This field is called sample type new because of an effort underway to make this attribute hold a single piece of information. Previous use of the sample type field allowed for several pieces of information to be stored in one column. As part of decomposing sample type, sample type new, matrix, and collect_method were created.
Matrix	VARCHAR2	5		The medium in which the water to be analyzed is resident.
Weather_code	NUMBER	2		Weather conditions when sample was taken g. 0=Undefined, 01=clear skies, 02=slight overcast, 03=medium overcast, 04=very overcast, 05=drizzles, 06=rain.

TS_Result	Contains the Test results of the Sample that was collected for given sample_id.			
Column Name	**Data Type**	**Size**	**Constraints**	**Comments**
Samp_id	VARCHAR2	13	Foreign Key	Identifies a discrete sample within a project. Usually sequential numbers 00001-99999. Refers to TS_Sample.
Remark_code	VARCHAR2	3	Foreign Key	Comprised of one or more data qualifiers as applied by the lab or project manager. These data qualifiers are approved by DEP. Refers to TS-Remark table.
Test_number	NUMBER	5	Unique	Numeric code used to identify individual tests within the laboratory. Description with test names and numbers can be found in table wqdora.tests_done. Eg. 25=TP04 "total phosphorus".
Test_Name	VARCHAR2	25		
Value	NUMBER	11.3		Numeric field which contains the result analyzed for a specific test. Descriptions with test names and numbers can be found in table wqdora.tests_done. Eg 25=TP04 "total phosphorus".
Units	VARCHAR2	8		Contains the units in which a test value is reported by the laboratory (SFWMD or contractor) eg. MICROG/L. Ideally, all units for a given test should be reported the same. When a lab gives us different units for a test it should trigger a review of the value so we make sure the data set is consistent with respect to units.

TS_Results_Comment	Contains comments for the test results and general comments for the Sample for given sample_id.			
Column Name	**Data Type**	**Size**	**Constraints**	**Comments**
Samp_id	VARCHAR2	13	Foreign Key	Identifies a discrete sample within a project. Usually sequential numbers 00001-99999. Refers to TS_Results.
Test_number	NUMBER	5	Foreign Key	Numeric code used to identify individual tests within the laboratory. Descriptions with test names and numbers can be found in table wqdora.tests_done. Eg. 25 = TP04 "total phosphorus". Refers to TS_Results.
Lab_number	VARCHAR2	10		LIMS number.
Comments	VARCHAR2	2000		Comments for Sample data.
Date_analyzed	DATE			Date and time the sample was analyzed by the field person.
Dtim_entered	DATE			Date and time the row was loaded into the sample table.

*Comments provided by Mr. Matthew Hinton

Appendix C: Additional Documentation for Data Mart

This appendix includes the instructions for creating the data mart for *The Living Everglades* web site; however, if you plan to deviate from this data mart structure, this appendix will not be enough by itself to allow you to create your data mart. In that case, your software consultants will need to gain an understanding of the overall architecture of the data mart, which is beyond the scope of this document.

Although these instructions are specific to the SFWMD's data mart, they contain information that might prove useful to the IT specialists you have on staff and/or any software consultants you hire to help you duplicate *The Living Everglades* web site.

The following are excerpts from "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

EMPACT Data Mart Goals

- Establish an easy-to-use data mart with essential elements derived from the existing DBHYDRO database in a format that will support a web-based data mining application that integrates the spatial and temporal aspects of the data.
- Use emerging database technology, compatible with the agency's relational database management system, to implement a web-enabled data mart. The district's GIS will be a component of the data mart.
- The combination of GIS and DBHYDRO will provide the basis for a graphical user interface (GUI) that captures user input necessary to build a data mart query through spatial visualization (maps), time window selection, and data specifics.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Functional Requirements

- Create the data mart
- Migrate the data from DBHYDRO to data mart
- Migrate the interMedia from various sources to data mart
- Real-time data transfer from DBHYDRO to data mart after migration
- Real-time intermedia data transfer from various sources to data mart after migration

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Computing Environment

- **Hardware.** Sun Microsystems Enterprise 220R server running Solaris 2.7 (2 UltraSparc-II 450MHz processors, 2Gb memory, 32x CD-ROM, 182Gb Sun StorEdge A5100 disk storage array)
- **Software.** Oracle® 8i Enterprise Edition, Oracle Jserver, Oracle Adv Security Option v8, Oracle Partitioning Option v8, Oracle® Spatial Cartridge, Oracle® Time Series Cartridge, Oracle® Intermedia, Oracle SQL*Plus 8.1.7. FME beta version Build 480.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

EMPACT Data Mart Implementation

Novara has designed the transformation engine to create and implement the data mart.

Transformation Engine

This transformation engine consists of various components, and this chapter describes all in detail. It contains configuration, creation, implementation, and migration scripts for spatial and time series, and the intermedia front-end tool. This is physically divided into a directory structure, which takes care of all the operations.

Directory Structure for Transformation Engine

The directory structure contains the Time Series, Spatial, and InterMedia directories. Each of the directories again contains the sub-directories for SQL files, LOG files, and for spatial, it also contains FME files.

For naming convention and for simplicity, the following variable is used and is defined:

EMPACT_HOME

For simplicity, we will mention $EMPACT_HOME for reference but it should be treated according to the operating system.

Under $EMPACT_HOME there are four sub-directories:

- Configuration
- Spatial
- TimeSeries
- InterMedia

Each sub-directory contains some files and directories, which are described in the following sections in detail.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Configuration

This section contains the information regarding the configuration of the data mart and describes the scripts used to create the data mart and its objects and for the manipulation of the objects. The scripts are located in the following directory:

$EMPACT_HOME/configuration

This directory contains two subdirectories:

- CREATE_SQL which contains the scripts to create various objects in Data Mart
- MAINTENANCE_SQL which contains the scripts to drop the index, table or to truncate the data from the objects.

Each file contains self-descriptive commands as well as comments and description to make it easy to understand. For any of these files, the following is the syntax to execute them.

$Oracle_HOME/bin/sqlplus (USER_SPECIFICATION) @file_name

USER_SPECIFICATION consists of the username/password@Oracle_service_name format.

Example:

sqlplus empact/password@emond @empact_table.sql

Here I have omitted $Oracle_HOME/bin as that is in my system PATH.

CREATE_SQL directory

This directory consists of the SQL scripts used to create the data mart. The following files are in this directory:

- **empact_ts_devl.sql**. This script contains the commands to create all of the tablespaces in the EMOND (i.e., the development instance of the EMPACT data mart). You should execute this script from SQL*Plus and not from Server Manager (svrmgrl) as it contains the PROMPT command. If you want to use it from server manager, comment out the PROMPT commands.
- **empact_ts_prod.sql**. This script is the same as the above script except, this is for the production instance (i.e., EMONP). All three instances contain the separate distribution of data files. For distribution, they have $ORAD1 and $ORAD2 variables declared. Please make sure that you have declared these parameters pointing to the proper file system before running the script.
- **empact_ts_trng.sql**. This script is the same as the above two scripts except it is for training and testing the data mart (i.e., EMONT). All other descriptions are the same as the other two scripts.
- **empact_user.sql**. This script contains the CREATE USER command for creation of the EMPACT user. It also contains the commands to grant the privileges to this user.
- **empact_resource.sql**. This script contains the command to assign the resources (i.e., quota on the tablespaces to the EMPACT user).
- **empact_table.sql**. This file contains the CREATE TABLE commands for all the tables of the data mart. All the tables have their own tablespace and storage clause. If any of them is partitioned, it has a partition clause or if IOT (Index Organized Table) then it has an IOT clause. Storage clause is estimated from the current size of database.
- **empact_index.sql**. This script contains the commands to create the indexes for all the tables defined above. Some special parameters and tablespace and storage clause consideration is also included.

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- **empact_constraint.sql**. This script contains the constraint clauses for all the tables of the data mart. This file contains constraints other than PRIMARY KEY and NOT NULL, which are already covered by the empact_table.sql script.
- **empact_view.sql**. This script contains the commands for creation of the data mart views.
- **empact_sequence.sql**. This script contains the commands to create the sequences used for the data mart.
- **empact_im_index.sql**. This script contains the "PREFERENCES" and index creation commands for InterMedia indices.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Step-By-Step Procedure To Create the Data Mart

For detailed description of each of these steps and scripts, refer to the configuration section where the scripts are defined and described.

1. Create the data mart by using db_? Scripts that are standard to the SFWMD. Make sure to check the log after creation. If the log is clean and there are no errors, then go to the next step.
2. Add user EMPACT with the privileges by executing the following script:
   sqlplus system/password @empact_user.sql
3. Create the tablespaces according to the instance you want to create. Choose the proper script for that instance. Make sure to check the log after creation. If the log is clean and there are no errors, then go to the next step.
4. Assign the quota on these tablespaces (unlimited) to the EMPACT user by executing the following script:
   sqlplus system/password @empact_resource.sql
5. Create the tables using the empact_table.sql script. Make sure to check the log after creation. If the log is clean and there are no errors, then go to the next step.
6. Create the sequences using empact_sequence.sql script. Make sure to check the log after creation. If the log is clean and there are no errors, then go to the next step.
7. At this stage, do not create the indices and also do not run the script for constraints. This can cause performance problems for the data transfer.
8. Run the scripts for Spatial. Go to the $EMPACT_HOME/spatial and run the script "trans_fme.bat". If there are problems running the full script, edit the script and place the rem before the wetland and landuse commands (starting with the "for" command). Run one by one the components by altering the rem against the "for" commands.

trans_fme.bat empact novara emond

Give the proper username, password and Oracle service name if it is changed. Make sure to check the log after creation. If the log is clean and there are no errors, then go to the next step.

9. Run the script for station and site by running "trans_sql.bat" from the same directory.

trans_sql.bat empact novara emond

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Give the proper username, password, and Oracle service name if it is changed. Make sure to check the log after creation. If the log is clean and there are no errors, then go to the next step.

10. Run the Scripts for Time Series data transformation.
11. Run the script for constraints, (i.e,. empact_constraint.sql) by giving the following command
    Sqlplus empact/password@emond @empact_constraint.sql
12. Run the script for indices to create the index (i.e., empact_index.sql) by giving the following commands
    Sqlplus empact/password@emond @empact_index.sql
    Sqlplus empact/password@emond @empact_im_index.sql
13. Run the script to create the views of the data mart by giving the following command.
    Sqlplus empact/password@emond @empact_view.sql
14. Check the log files at all the stages and make sure the creation process is clean. Take the back-up at this stage. You are ready with the EMPACT database instance.

MAINTENANCE_SQL directory

This directory contains the scripts for maintenance of the data such as dropping objects or deleting data, etc.

The following are the files in this directory:

empact_drop_table.sql. This script contains the commands to drop the tables from the data mart. The sequence of dropping objects is important here. If you modify this script, make sure the integrity is maintained, as it is necessary to drop the tables otherwise it will give you an error.

empact_drop_index.sql. This script contains the commands to drop the indices from the data mart. This script is useful when you want to rebuild the index of the data mart.

empact_flush_table.sql. This script contains the commands to delete the data from all the tables. As with the empact_drop_table.sql script, the sequence of command is important here too. If you modify this script make sure to maintain this sequence otherwise it will give an error.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Empact Backup

For the backup of the Empact database instances the following script is provided.

empact_hot_backup.ksh

This is UNIX script and is created to take the hot backup of EMPACT database instances. The instance name is passed as a parameter at the runtime of this script. The script takes the Tablespaces in backup mode all at one time because there will be no transaction—this is a data mart and transactions will be done through the scripts only and those are scheduled. Some variables defined in this script must be declared first in order to execute this script properly. You can schedule the execution of this script at night-time when the hit for the queries are less. Before executing this script, make sure that the database instance is in ARCHIVELOG mode otherwise the script will generate an error. The script copies the files to file system and then once the files are copied and tablespaces are taken online, it compressed those files.

Example:

$ empact_hot_backup.ksh emonp > empact_hot_backup.log

This command will take the backup of emonp instance and will store the output to empact_hot_backup.log file which should be in /Oracle/local/log/ directory and after finishing the script, it will be e-mailed to all the DBAs of district.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Spatial

This contains two types of transformations, one is based on FME and one uses SQL*Plus. FME transformation is provided by means of mapping files, which are described in detail later in this section. SQL transformation is in the form of SQL scripts. The data and information coming from ESRI ArcInfo or ESRI export format is migrated using the FME mapping files while the information and data coming from WREP and DCVP databases (e.g., for station and site) are migrated through the SQL script which is also described in detail later.

Note: You must run the FME mapping files and related scripts only on the computer where FME (Feature Manipulation Engine, provided by Safe Software URL: http://www.safe.com) is installed. Also check the connectivity with Oracle using SQL*Plus or any other tool that you use to connect to Oracle.

FME Mapping Files

FME mapping files are located in the following directory:

$EMPACT_HOME\spatial\fme

The following is the list of features whose mapping files are in this directory along with the file name:

1. County	$EMPACT_HOME\spatial\county.fme
2. Basin	$EMPACT_HOME\spatial\basin.fme
3. Lake	$EMPACT_HOME\spatial\lake.fme
4. Park	$EMPACT_HOME\spatial\park.fme
5. Water Conservation Area	$EMPACT_HOME\spatial\wca.fme

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6. Canal	$EMPACT_HOME\spatial\canal.fme
7. Preserve	$EMPACT_HOME\spatial\preserve.fme
8. Highway	$EMPACT_HOME\spatial\highway.fme

These files contain the mapping information required to transfer the DATA from ArcInfo to Oracle Spatial.

The following features have their own directory:

1. Land Use	$EMPACT_HOME\spatial\landuse
2. Wetland	$EMPACT_HOME\spatial\nwi

Each directory contains separate mapping files for the listed feature for each of the counties within the South Florida Water Management District (e.g. landuse has 15 different files for 15 counties for the land use feature)

Again the land use feature's mapping files are used to migrate the data from ESRI ArcInfo coverage to Oracle® Spatial while the Wetland feature's mapping files are used to migrate the data from ESRI Export (e00) format files to Oracle® Spatial. This is because, due to the large amount of data we are transferring, a lack of performance and when we tried using export format, it was increased significantly hence we have used this format for Wetland coverage.

IMPORTANT

The following procedure is to be done because the data for land use of Palm Beach County was giving the Oracle internal error when the FME was used. We have contacted FME regarding this but are still awaiting for the reply. Once you receive the new build of FME solving this problem, you can use following file to translate the data using FME.

D:\SFWMD\migrate_scripts\FINAL\spatial\fme\landuse

This directory contains the following files:

shp2sdo.exe

This is an executable file which is used to generate the three files, .sql, .dat and ctl files for creation of object, data file and SQL*Loader control file.

command syntax:

shp2sdo <shapefile> <layer-name> -g <geometry-col>
-i <id-col> -n -d
-x (<Xmin>,<Xmax>) -y (<Ymin>,<Ymax>)

<shapefile> = name of the shapefile to convert (do not include the .SHP suffix)
<layer-name> = name of the output layer and prefix for the generated output files
<geometry-col> = name of the geometry column in the output table
<id-col> = name of the id column

Xmin, Xmax, Ymin, Ymax: layer dimensions. If not specified, then the actual bounds of the shape file are used

Example:

shp2sdo G:\landuse\lu1995\pblu95 lu95_pb -i obj_id

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and it will generate the three files

lu95_pb.sql which contains the DDL command to create the table
lu95_pb.ctl which is the control file
lu95_pb.dat which contains the data

All these files are included in this directory.

Then run the following command:

sqlplus empact/password@emonp @lu95_pb.sql

It will create the table. Here you can give the different username password specifications. After that run the following command:

sqlldr empact/password@emonp control=lu95_pb.ctl data=lu95_pb.dat

and it will insert the data in the above created table. After running this, run the script landuse_of_pb_trns.sql to pull this data into the SP_LANDUSE table by giving following command:

sqlplus empact/password@emonp @landuse_of_pb_trns.sql

Then you can delete the table LU95_PB created by the above procedure.

Full Migration

For all the above features, the mapping files are provided and also the master script using DOS commands is provided by NOVARA. You must use the DOS batch file for most of the cases where you want to transfer all the data.

The name of the script (DOS batch file) is as follows:

$EMPACT_HOME\spatial\trans_fme.bat

This dos batch file requires the following syntax:

trans_fme.bat (username) (password) (Oracle_service_name)

trans_fme.log

Note: for most of the cases, when you want to translate the data, use the above command only. A separate command for each feature listed later in this section is not advisable, as it will not maintain the data integrity of spatial data.

Selective Migration

The above file contains the commands to execute the fme.exe file using the mapping files described above. That is used for full translation while if you want to migrate a selective feature, there are two methods described below:

Command Mode:

Command mode can be used in the command window and it requires some parameters as given here:

fme.exe (mapping_file_name) —_Oracle_UserName (username) —_Oracle_Password (password) —DestDataset (Oracle_service_name)

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GUI Mode:

The mapping files also give you the capability to run it in GUI mode and give the parameters interactively. For this, open Windows Explorer, go to the directory where the mapping file is, right click on the file and click on "FME: Translate" option. It will open the FME window and will ask for the parameters. The parameters description is as follows:

- Coverage Directory. This parameter requires the directory and file name in which the ArcInfo data is.
- Minimum X. Enter the minimum X coordinates of the boundary of the feature.
- Minimum Y. Enter the minimum Y coordinate of the boundary of the feature.
- Maximum X. Enter the maximum X coordinates of the boundary of the feature.
- Maximum Y. Enter the maximum Y coordinate of the boundary of the feature.
- Username. Enter the Oracle User Name.
- Password. Enter the Oracle Password. It won't display on the screen for security purposes.
- Service Name. Enter the service name of the Oracle instance in which you want to migrate the data. Again, before giving all these three parameters, first check and make sure that the connectivity is there.

Once you give all the parameters and click on the OK button, the translation will start. At this stage, if you want to cancel the translation, you can by clicking the CANCEL button on the window. For source directory, make sure the specified drive and directory exists and you have a read permission on them. If you want to browse and select the directory, you can do it by clicking on the ARROW button on the right side of the text box of the directory.

Default for all the parameters are given but you can modify them. Also, the parameters Minimum X Minimum Y, Maximum X and Maximum Y do not have any impact as it is not overwritten on the one which we have given in the creation script. So if you want to actually modify, go to the table creation script and modify the parameters and run that.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Editing the Mapping Files

In this section, the command and parameters are provided which are used in the FME mapping files.

Note: It is not advisable to edit the commands with the comments "Do Not Delete the Following" unless and until you refer to the MANUALS of FME.

Commands

- GUI. With this command you can display and prompt for the variables and titles. Following are the options available and the syntax of that.
- TITLE. Used to display the title of the window of GUI. Example: GUI TITLE County DATA Translation - SFWMD.
- INTEGER. Used to prompt for the integer type of variable. Note: In the example, "Dimension:" is the prompt to display. Same is for all the following commands Example: GUI INTEGER _Oracle_Dimension Dimension.
- FLOAT. Used to prompt for the float type of variable. Example: GUI FLOAT _Oracle_Minx Minimum X.
- CHOICE. Used to display the list box from which the user has choice to select. Example: GUI CHOICE _Oracle_Indicies Yes%No%Incremental Create Indicies.
- TEXT. Used to prompt for the text type of variable. Example: GUI TEXT _Oracle_UserName User Name.
- PASSWORD. Used to prompt for the password type of variable (* will be displayed at the time of key strokes). Example: GUI PASSWORD _Oracle_Password Password.
- DEFAULT_MACRO. Usually this is used in combination with GUI, to specify the default value of that particular variable. Example: DEFAULT_MACRO _Oracle_UserName empact.
- LOG_FILENAME. With this command, you can specify the log file where the log will be generated for particular mapping file. Default is same as the mapping filename with extension .log. Example: LOG_FILENAME ./log/county.log.
- LOG_APPEND. Here you can give YES or NO. if you give YES, the next time you run the translation, log will be appended to the log file otherwise original log file will be deleted and new log will be generated. Default is "NO". Example: LOG_APPEND NO.
- READER_TYPE. This is the command where you can specify the reader type i.e. format of the source file (e.g., E00 for ESRI export format, ARCINFO for ESRI ArcInfo coverage etc.) Example: READER_TYPE ARCINFO.
- WRITER_TYPE. This command is to specify the writer type (e.g., Oracle for Oracle relational model, Oracle® 8i for Oracle objects relational Model etc.) Example: WRITER_TYPE Oracle® 8i.
- Oracle8I_SERVER_TYPE. This command is used to indicate which format the data should be translated into (either relational or object) Default is Oracle® 8i.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Understanding the FME Mapping File

FME mapping files are separated in two sections. One section consists of the definition and assignment of values to the variable and set the environment for the translation in which the above mentioned commands are used. The other section consists of the mapping of source attributes to the destination attributes as well as the parameter and variables we have defined in the previous section.

The Mapping Definition section consists of the definition of source and destination objects and the relation between the attributes of source and destination.

Full description of the mapping section is out of the scope here, but for that you can refer the FME documentation. However some understanding and the entries we have made is described here.

Following is the listing from mapping file:

```
ARCINFO_DEF DBASINS_poly
    DBASINS_    binint
    BASIN       char(25)
```

In this section, the source object description is given. First line indicates the reader type (i.e., ARCINFO) and the name of the source object (i.e., DBASINS_poly), followed by the definition of attributes for that object.

```
Oracle8I_DEF SP_BASIN
    Oracle_model        object
    Oracle_create_indices $(_Oracle_Indicies)
    Oracle_index_commit_interval $(_Oracle_IndexCommitInterval)
    Oracle_levels       $(_Oracle_Levels)
    Oracle_numtiles     $(_Oracle_NumTiles)
    Oracle_min_x        $(_Oracle_Minx)
    Oracle_min_y        $(_Oracle_Miny)
    Oracle_max_x        $(_Oracle_Maxx)
    Oracle_max_y        $(_Oracle_Maxy)
    Oracle_dim          $(_Oracle_Dimension)
    OBJECT_GID          varchar2(32)
    GEOM                geometry
    BASIN_NAME          varchar2(40)
```

In this section of mapping, the writer type is defined (i.e., Oracle® 8i) in this example followed by the object name in which the data will be transferred (i.e., SP_BASIN) here.

The first 10 parameters pertain to the metadata of the spatial and index creation and the rest of the three are the definition of attributes of the object.

```
ARCINFO DBASINS_poly
    e00_type    e00_poly
    DBASINS_ %DBASINS_
    BASIN       %BASIN
```

In this section, the value of source attributes is assigned to the variable qualified by %.

```
Oracle® 8i SP_BASIN
    Oracle_type         Oracle_area
    OBJECT_GID          @Concatenate ("13", %DBASINS_)
    BASIN_NAME          %BASIN
```

continued on next page

continued from previous page

In this section the value assigned to the variable is now reassigned to the destination attributes. Here we can use the functions to manipulate the source value. In above example, the value of DBASIN_ variable is concatenate with "13" (i.e., constant) used for the basin coverage.

Note: All the coverages have one unique constant assigned in the EMPACT data mart.

If you have more questions regarding this, please refer to the FME documentation manual.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Time Series

Migration Procedure for Time Series Data

Time series data comes from DBHYDRO. We are migrating the data as per the selected tables.

First we will migrate the master table data then child tables.

The following are the master tables:

DM_AGENCY,
DM_FREQUENCY,
DM_RECORDER,
DM_STATISTIC_TYPE,
DM_GROUP,
DM_CODE,
DM_DATE_QUALITY,
DM_DATA_TYPE,

(**Note:** We are filtering the 32 data types while migrating it to EMPACT. TS_VALID_DATATYPE is designed to store the valid data type for the ease of maintenance).

And the following are the transactions:

KEYWORD_TAB:
DM_MISSING_AND_GAP
DM_DAILY_DATA
DM_RANDOM_DATA

Water quality data tables:

SAMPLE:
COMMENTS

This migration procedure is divided into a few steps:

1. One time Full Migration for all the master, transaction and water quality data
2. Weekly (or regular time interval) update of transaction tables that takes care of new insertion, updates and deletions

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Step-by-Step Procedure for Full Migration

- **Step 1.** First of all run the script for the master table that will migrate all the master table data using Sql*plus. This will migrate all master data from DBHYDRO into the EMPACT data mart. Here all the data is migrated based on direct insert statement. Each and every master table script run by this script will create log file in the log directory. This will help to find successful operation or failed one. The following are the tables that will be migrated using this script. DM_AGENCY, DM_FREQUENCY, DM_RECORDER, DM_STATISTIC_TYPE, DM_GROUP, DM_DATA_TYPE , DM_CODE, DM_DATE_QUALITY. Run the ts_migrate.sql script
- **Step 2.** Then transfer the data for keyword tab table using ts_keyword_tab.sql. This script will filter the 32 data types decided in design phase and migrate in to ts_keyword_tab table. The lookup table for this 32 data type is TS_VALID_DATATYPE. Run the ts_keyword_tab.sql script (USAGE @ts_keyword_tab) This is a dedicated transaction to rollback segment RBS_LARGE.
- **Step 3.** The next step is to transfer the data for ts_missing_and_gap table using Ts_missing_and_gap.sql script. Run the ts_missing_and_gap.sql script (USAGE @ts_missing_and_gap.sql). This is a dedicated transaction to rollback segment RBS_HUGE.
- **Step 4.** Transfer the data for ts_random_data using ts_random_data.sql script. Run the ts_random_data.sql script (USAGE @ts_random_data).
- **Step 5.** Transfer the data for ts_daily_data table using ts_daily_data.sql script. Run the ts_daily_data.sql script (USAGE @ts_daily_data). This is a dedicated transaction to rollback segment RBS_LARGE. This is a big transaction. So, we have created rollback segment RBS_LARGE for this transaction. Its size is 600 MB.
- **Step 6.** Water quality data. Run the ts_Remark.sql script (USAGE @ts_remark.sql). Run the ts_sample.sql script (USAGE @ts_sample.sql). This is a dedicated transaction to rollback segment RBS_HUGE.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Update on Regular Intervals

Follow the steps to update the EMPACT data mart at regular intervals

Use the following script to keep track of deleted data into DBHYDRO and deleting the same from EMPACT at regular intervals. Run the script ts_deleted_data.sql for keep track of deleted data in DBHYDRO (Usage @ts_deleted_data). This is a dedicated transaction to rollback segment RBS_HUGE.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Intermedia

Please refer to the Oracle® Intermedia user's guide and reference manual.

Source: "EMPACT User Guide, EMPACT Data Mart," March 2001, Novara Comp Services, Inc.

Appendix D: Stakeholder Recruitment Tools/Agenda

Meeting Agenda

EMPACT: Environmental Monitoring Public Access & Community Tracking

The Living Everglades Stakeholders Meeting

SFWMD B50 Building

NT PC Training Room

January 30, 2002

Objective of the Workshop: To obtain specific stakeholder review, feedback, and contributions for improving the site, as well as the training workshop format.

Noon	Arrival and lunch
1:00	Brief updates on project (Big picture – Brian Turcotte, SFWMD)
1:30	Overview of site design changes (Trudy Morris, SFWMD)
2:00	Discussion and suggestions from stakeholders
2:30	Pilot Training Workshop (Loisa Kerwin & Alana Edwards – CES)

- Spring training workshops schedule and partners
- Overview of watershed
- Demonstration of tools to enhance research & education projects
- Tutorial on data retrieval and application
- Learn how to build your own profile

3:00	Participants navigate the site
	Complete worksheet questions
	Complete workshop evaluation
3:20	Wrap-up comments
3:30	Thanks and departure

Web Site Evaluation for Workshop Attendees

EMPACT: Environmental Monitoring Public Access & Community Tracking

The Living Everglades

"Public Reporting and Dynamic Access: Changing Regional Environmental Health of South Florida's Everglades Ecosystem"

Web Site Development

Worksheet

Date:_____

The objective of this workshop is to obtain feedback and constructive suggestions for improving EMPACT's The Living Everglades web site. Please remember that the web site is still a prototype undergoing design changes. Your feedback is critical to the success of this project. Please take a few minutes to give us some insight and your perspective by providing some information that can be used to improve the site.

Remember that the site should be easy to use, yet informative and interesting for a wide range of audiences including the general public, teachers, environmental professionals, and the media. The site is now undergoing design changes that will improve these characteristics:

- Artistic and creative aspects
- Lay out and user-friendliness
- Ease of navigation through site, and
- Outlining the types of data accessible.

1. Please help us to improve The Living Everglades web site by offering constructive suggestions. First, clearly indicate the section of the site, and then list the change or additions that would improve the section indicated.

_____
_____
_____
_____
_____
_____
_____

2. Please list any web resources that you want to be certain are linked to The Living Everglades web site.

_____
_____
_____
_____

3. In the Everglades Information section there are Frequently Asked Questions (FAQs). Please develop at least two FAQs questions that a new user to the site would ask in order to gain more background knowledge about the The Living Everglades. For example, "What agencies are responsible for the restoration of the Everglades?"

_____
_____

4. In the Obtaining Data sections, there are "predefined queries" that are statements used to focus a data search. Please develop three predefined queries, one for each of the data parameters: water quality, hydrology and weather. To help ensure that there are predefined queries addressing all 16 counties, please develop queries that are specific for your geographic region.

The query must specify a time range, location and data parameter in order to retrieve and graph the requested data. An example of a new query could be: "Average monthly water levels for Lake Okeechobee in the years 2000-2002".

5. Which topic in the Fun section of The Living Everglades web site did you find most interesting - Coloring Books, Games, web Post Cards or Fun web Links? How could this section be improved?

Workshop Evaluation Form

This evaluation form is a review of the training workshop format and facilitators, not the web site, as the site is still under development. In your opinion, please respond with a score within the range of 1-5, with 5 indicating the highest score and 1 indicating the lowest score. Please fill in the blanks for the open-ended items.

Strongly agree (5), Agree (4), Neither agree nor disagree (3), Disagree (2), Strongly disagree (1)

	(5)	(4)	(3)	(2)	(1)
1. The facilitator had a strong understanding of the topic.					
2. The facilitator(s) were organized and well prepared.					
3. The specific objectives for this workshop were clearly stated and accomplished in a clear, sequential manner.					
4. The tutorial was clear and understandable.					
5. The workshop clearly demonstrated the applications available on the web site.					
6. The workshop allowed sufficient time for independent navigation of the web site.					
7. The workshop allowed sufficient time for completion of the worksheet.					
8. The training workshop was valuable to me in order to learn the potential applications of the web site.					
9. I will be willing to host an EMPACT training workshop for my organization.					

1.The best features of this training were:

_____

_____

_____

_____

2.Areas for improvement in the training workshop:

_____

_____

_____

_____

12. Please list any other comments, suggestions, requests, or concerns:

_____

_____

_____

_____

Appendix E: Frequently Asked Questions

1 Why are the Everglades at risk?

Water management is the primary challenge facing the Everglades. Thousands of acres of the original Everglades have been drained, developed, or farmed, and a complex system of water controls divert water from the Everglades. Additional stresses include pollution, introduction of non-native species, species loss, and habitat loss.

2 What is being done to restore the Everglades?

A decades-long, $8 billion effort is currently underway to restore the Everglades, which is being funded by both government monies and taxpayer dollars.

In 1992, the U.S. Army Corps of Engineers was authorized to develop a comprehensive plan to restore and preserve South Florida's natural ecosystem, while enhancing water supply and maintaining flood protection. The resulting Central and South Florida Project Comprehensive Review Study—commonly called the Restudy— culminated in the development of a Comprehensive Everglades Restoration Plan (CERP). The CERP was submitted to Congress in April 1999 and approved in December 2000. The CERP is the "road map" for restoring and protecting the Everglades.

The CERP is part of a larger effort to restore the Everglades ecosystem and provide for a sustainable South Florida. This larger effort is being developed under the direction of the South Florida Ecosystem Task Force by federal, state, local, and tribal leaders. The task force is focusing on bringing together over 200 restoration projects under one framework.

3 What is the role of the South Florida Water Management District (SFWMD) in the Everglades restoration plan?

The SFWMD's mission is to manage and protect South Florida's water resources by balancing and improving four major elements: water quality, flood control, natural systems, and water supply. The SFWMD's main responsibility is operating and maintaining the Central and Southern Florida Flood Control Project, built by the U.S. Army Corps of Engineers to harness the water resources of South Florida. The project consists of 1,800 miles of canals and levees, 200 water control structures, and 16 major pump stations.

To implement the CERP, the SFWMD is collaborating with the U.S. Army Corps of Engineers and the Florida Department of Environmental Protection to provide the right amount of water and the right flow conditions to the Everglades while providing water for urban and agricultural needs for a 50-year population projection. To complete this task, the SFWMD and its partners are developing new management tools, conducting scientific and economic studies, carrying out public outreach activities, and implementing engineering projects.

4 What kind of data does the SFWMD collect?

The SFWMD collects data on water quality, hydrology, and flora/fauna species distributions from individual research projects and approximately 6,000 monitoring stations throughout South Florida. Some examples of the many types of data collected include water pollution

and salinity data, water flow, inundation patterns, species population and nesting data for wading birds, and plant spatial coverage data.

The SFWMD also manages environmental reference documents on the goals and status of Everglades restoration projects, geographic information system (GIS) data that map and describe the features of South Florida, and audio and video files that provide a closer look at the wildlife and water resources of the Everglades.

5 Why are these data useful for the public to access?

By accessing the SFWMD's comprehensive environmental measurement data, the general public will be able to determine the current health of the Everglades ecosystem. Water quality and hydrology measures describe the quality of wildlife habitat and the suitability of water and wildlife resources for human consumption. By comparing the Everglades restoration goals outlined in the SFWMD environmental reference documents to available data describing the current status of the Everglades ecosystem, the general public can assess the progress of restoration projects.

6 Where can a user access *The Living Everglades* site?

Users can access *The Living Everglades* web site through the SFWMD's home page at <http://glades.sfwmd.gov>.

7 What are the primary kinds of data that are available on the site?

Through the map-based query option, users can access data on water quality and hydrology in the Everglades ecosystem, environmental reference documents, and audio and video files. Biological data will be made available once CERP partners mutually agree on performance measures for the data and when all of the appropriate data are gathered together.

8 What were the basic steps to setting up *The Living Everglades* site?

The SFWMD first developed a data mart to contain the information that it wanted to make accessible to the public via *The Living Everglades* web site. To create this web-accessible data mart, the SFWMD used Oracle® 8i database server software, which is able to store environmental measurement data as well as GIS data and audio, video, and document files.

To create a user-friendly, web-based interface to the data mart, the SFWMD developed a web site design, and underlying this design, a software application consisting of the Oracle® 9iAS application/web server, MapXtreme® for Java™ mapping software, KavaChart charting software, and other components.

9 What resources were expended to develop *The Living Everglades* web site?

To develop *The Living Everglades* web site, the SFWMD hired software consultants, purchased software, and provided management time for planning, direction, and review. The costs to complete the data mart and web site design were approximately $200,000; however, the costs for other agencies and organizations could be less, because SFWMD could provide programming code for the data mart schema and web site design to others at no cost.

Contact Brian Turcotte, 561 682-6579, or Marie Pietrucha, 561 682-6309, for more information.

10 Can other agencies or organizations create a web site similar to *The Living Everglades*?

Yes. This EPA EMPACT technology transfer manual can get you started; however, you will ultimately need the technical assistance of software consultants to create this type of web site. Contact Brian Turcotte, 561 682-6579, or Marie Pietrucha, 561 682-6309, of the SFWMD for more information.

11 Why involving stakeholders in a project like *The Living Everglades* web site is important?

For *The Living Everglades* web site, the stakeholders consisted of Florida citizens, including students and teachers, the general public, and environmental scientists. The SFWMD's goal for *The Living Everglades* web site was to ensure that all Florida citizens could assess the progress of Everglades restoration projects. To achieve this goal, the SFWMD needed to work with each group of stakeholders to create a web site that served their needs and provided a user-friendly interface.

12 What lessons did The SFWMD learn while developing *The Living Everglades* web site?

The SFWMD learned a number of lessons when developing *The Living Everglades* web site. The SFWMD recommends the following when constructing your web site:

- **If possible, use only one IT company for both the data mart and the user interface.** The SFWMD hired one IT company to develop the data mart and a second IT company to create the web site interface. Using different IT companies for each of these tasks slowed down the development process. If two IT companies are necessary, be sure to facilitate the communication between all parties through explicit Statements of Work.
- **Set aside funds for teaching staff new technology.** The SFWMD did not realize that it was required by its change control procedures (i.e., procedures to protect the information security of in-house computer systems) to use in-house IT staff to implement the middle tier technology in SFWMD's production environment. The SFWMD did not initially budget for this and therefore needed to spend extra time teaching IT staff the new technology, performing coordination, and providing the desired oversight. The SFWMD found it challenging to develop mentoring methodologies for agency staff for this new technology.
- **Take steps to avoid IT bottlenecks.** The SFWMD encountered several IT bottlenecks because it had difficulty obtaining a timely commitment of hours from SFWMD database administrators and UNIX system administrators to perform certain necessary tasks. To avoid this problem, the SFWMD recommends ensuring IT management and rank-and-file employees commitment from the beginning, and not just the approval of executive management. The SFWMD spent a lot of time educating IT management (four training sessions in 2 years). Realize that your IT department will usually be very busy and understaffed and might experience staff turnover. Stakeholder interest (see Chapter 6) and feedback might refuel interest among upper management, who then can provide relief to overburdened IT staff.

- **Web site content management requires management attention to ensure resources are used effectively and without redundancy.** The SFWMD found that maintaining metadata for documents in the Oracle® interMedia portion of the data mart and linking documents to spatial features was a part-time job on a continuing basis for a content manager. web site content management is a new discipline and requires management attention to ensure resources are utilized effectively and without redundancy. The SFWMD sees the data mart as a content management system. It notes that its data mart is complementary to commercial content management systems since it extends functionality that is not part of any commercial package. On the other hand, the data mart does not replace commercial content management offerings because such offerings have robust workflow built into them to handle version control and approval.
- **Address data security.** The SFWMD data mart is created from documents and data stored in different places and is backed up incrementally on a daily basis with a full backup performed each week. If the database were lost or corrupted it could be re-created. For additional security, the database tables are "owned" by a single Oracle schema for which password access is limited to a few key individuals, all of the data tables have public synonyms, and the pseudo-user "public" has "read access" to all tables.
- **Consider the pros and cons of using software consultants.** Software consultants can provide for faster development of sophisticated web sites and can bring new expertise in-house; however, they are generally more expensive per hour than in-house staff, and finding consultants with an environmental background might be difficult. Although in-house staff are usually less expensive per hour than consultants, there is always the risk of "staff flight" after providing training on new technology. On the other hand, in-house staff might become more dedicated to the project because they have had the chance to develop the web site.
- **Budget extra time for deliverable review.**

Appendix F: Glossary

A

Active Server Pages: A specification for a dynamically created web page that utilizes ActiveX scripting—usually VB Script or Jscript code. When a browser requests an ASP page, the web server generates a page with HTML code and sends it back to the browser; therefore, ASP pages are similar to CGI scripts, but they enable Visual Basic programmers to work with familiar tools. (Definition from <www.webopedia.com>.)

Alkalinity: The capacity of bases to neutralize acids. Lime, for example, is an alkaline substance that can be added to lakes to decrease their acidity.

API (application program interface): A set of routines, protocols, and tools for building software applications. A good API makes developing a program easier by providing all the building blocks for a programmer to put together. (Definition from <www.webopedia.com>.)

Application: Software that performs a function for users.

Application server: A program that handles all application operations between users and an organization's back-end applications or databases. In the case of *The Living Everglades* web site, the applications include mapping and charting software, and the database includes the data mart.

Archival database. The database that includes all of an organization's environmental measurement data but is only accessible to the organization and not to the public.

ASP.NET: A server-side web technology created by Microsoft®. ASP.NET takes an object-oriented programming approach to web page execution. Every element in an ASP.NET page is treated as an object and run on the server. Because the code is run straight from the processor, pages load much faster than classic Active Server Pages, where embedded VBScript or JScript had to be continuously interpreted and cached. (Definition from <www.webopedia.com>.)

B

C

Client: Clients are computers on which users run applications. Clients rely on servers for resources, such as files, devices, and sometimes processing power. (Definition from <www.webopedia.com>.)

Client/server architecture: Design of a computer system or web site that involves at least two networked computers—the client and the server.

ColdFusion: A product that includes a server and a development toolset designed to integrate databases and web pages. Cold Fusion web pages include tags written in Cold Fusion Markup Language (CFML) that simplify integration with databases and avoid the use of more complex languages like C++ to create translating programs. (Definition from <www.webopedia.com>.)

Crash: A serious computer failure. A computer crash means that the computer itself stops working or that a program aborts unexpectedly. (Definition from <www.webopedia.com>.)

D

Data access/delivery system: A system for providing users with access to environmental data that includes a database query and a method for displaying query results.

Database: A collection of data organized by fields, records, and files. A field is a single piece of information; a record is a complete set of fields; and a file is a collection of records. (Definition from <www.webopedia.com>.)

Database management system (DBMS): A collection of computer programs that enables users to store, modify, and extract information from a database. (Definition from <www.webopedia.com>.)

Database server: Computer system that processes database queries.

Data mart. A subset of an archival database. In the case of *The Living Everglades* web site, the data mart includes the SFWMD data that are accessible to the public.

Data transfer: Transmittal of data between one computer and another (e.g., between the web server and the user's computer).

DBHYDRO: The SFWMD's archival database.

Dissolved oxygen: The oxygen freely available in water, which is vital to fish and other aquatic life and for the prevention of odors. Dissolved oxygen levels are considered one of the most important indicators of a water body's ability to support desirable aquatic life. Secondary and advanced waste treatments are generally designed to ensure adequate dissolved oxygen in waste-receiving waters.

Download: The process of copying a file (e.g., database query results) available through a web site to a user's computer.

Drop-down list: A drop-down list is a box with an arrow that a user can click to view a number of choices that can be selected.

E

Ecological monitoring: Monitoring of ecosystem characteristics that can impact wildlife habitat and water quality.

Ecological restoration: Actions to restore ecological processes to their natural state, thereby restoring wildlife habitat and water quality.

Ecosystem: All of the interacting organisms in a defined space in association with their inter-related physical and chemical environment.

Entity relationship diagram: A diagram that shows a database structure.

Environmental reference documents: Documents that describe the ecological restoration projects and goals of a particular agency or organization.

F

Fecal coliform bacteria: A bacteria found in the intestinal tracts of mammals. Their presence in water or sludge is an indicator of pollution and possible contamination by pathogens.

Firewall: An electronic system designed to prevent unauthorized Internet access to a private computer network. (Definition from <www.webopedia.com>.)

G

Gateway: A node on a computer network that serves as an entrance to another network. (Definition from <www.webopedia.com>.)

Geocoding: Computer-automated process that assigns coordinate values (e.g., latitude and longitude) to maps.

Geographic Information System (GIS): Tools used to store, transform, manipulate, analyze, and produce geographical data. These data may exist as maps, three-dimensional virtual models, tables, and/or lists. (Definition from <www.webopedia.com>.)

Graphical User Interface (GUI): The HTML links, icons, buttons, checkboxes, and drop-down lists that allow a user to tell the web site to perform certain commands with a click or two of a mouse button.

H

Hardware: Computer equipment, such as disks, disk drives, display screens, keyboards, printers, boards, and chips. (Definition from <www.webopedia.com>.)

HTML (HyperText Markup Language): Computer programming language used for creating web pages.

Hotlink (Hyperlink): An element in an electronic document that links to another place in the same document or to an entirely different document. Typically, users click on the hyperlink to follow the link. Hyperlinks are the most essential ingredient of all hypertext systems, including the World Wide Web. (Definition from <www.webopedia.com>.)

I

Icon: Icons are an integral part of any GUI. Icons are pictures that represent computer commands. Users simply click on the picture to initiate the command rather than typing programming code.

J

J2EE. Short for Java™ 2 Platform Enterprise Edition. J2EE is a platform-independent, Java™-centric environment for developing, building, and deploying web-based enterprise applications online. The J2EE platform consists of a set of services, APIs, and protocols that provide the functionality for developing multi-tiered, web-based applications. (Definition from <www.webopedia.com>.)

Java™: An object-oriented programming language that is often used to create web sites.

Java™ Server Pages (JSP). JSPs use scripts and work in tandem with HTML code, separating the page logic from the static elements, such as the actual design and display of the page. Embedded in the HTML page, the Java™ source code and its extensions help make the HTML more functional, for example, in dynamic database queries. JSPs are not restricted to any specific operating environment or server.

Java™ Virtual Machine: Software that interprets Java™ code.

K

KavaChart: KavaChart is the charting software used by the SFWMD to help create *The Living Everglades* web site. Visual Engineering, Inc. created KavaChart.

L

Library. In computer programming, a library is a collection of precompiled routines that a program can use. The routines, sometimes called modules, are stored in object format. Libraries are particularly useful for storing frequently used routines because programmers do not need to explicitly link them to every program that uses them. A computer program can automatically look in libraries for routines that it does not find elsewhere.

M

Map coverage: In GIS, a map that only displays one type of feature; for example, all canals or all watersheds in South Florida. By overlaying different map coverages in GIS, users can query the GIS system to complete analyses of the relationships between the features in the different map coverages.

MapXtreme® for Java™: Mapping software used by the SFWMD to create *The Living Everglades* web site. MapInfo® created MapXtreme® for Java™.

Mercury (Hg): A heavy metal that can accumulate in the environment and is highly toxic if breathed or swallowed. Heavy metals are metallic elements with high atomic weights (other examples are mercury, chromium, cadmium, arsenic, and lead) that can damage living things at low concentrations and tend to accumulate in the food chain.

Microsoft® Access: A database management system produced by the computer company Microsoft®.

Middle tier: The part of a three-tier client/server architecture that holds applications and the web server.

Monitoring station: Measuring devices at a particular geographical location used to collect environmental data.

MVC (Model-View-Controller) Architecture: MVC separates three distinct forms of functionality within an application. The Model represents the structure of the data in the application as well as application-specific operations on those data. A View (of which there may be many) presents data in some form to a user, in the context of an application function. A Controller translates user actions (mouse motions, keystrokes, etc.) and user input into application function calls on the Model, and selects the appropriate View based on user preferences and Model state. (Definition from CostXpress at <www.myetrip.com/CostExp/J2eeAndCe.html>)

N

Network: At least two computer systems linked together to perform a function.

Nitrate: A compound containing nitrogen that can exist in the atmosphere or as a dissolved gas in water and can have harmful effects on humans and animals. Nitrates in water can cause severe illness in infants and domestic animals. A plant nutrient and inorganic fertilizer,

nitrate is found in septic systems, animal feed lots, agricultural fertilizers, manure, industrial waste waters, sanitary landfills, and garbage dumps.

O

Object-oriented programming: A type of programming in which programmers define not only the data type for a database structure, but also the types of operations (functions) that can be applied to the data structure. In this way, the database structure becomes an object that includes both data and functions. In addition, programmers can create relationships between one object and another. For example, objects can inherit characteristics from other objects. One of the principal advantages of object-oriented programming techniques over procedural programming techniques is that they enable programmers to create modules that do not need to be changed when a new type of object is added. A programmer can simply create a new object that inherits many of its features from existing objects. This makes object-oriented programs easier to modify. To perform this type of programming, one needs an object-oriented programming language such as Java™. (Definition from <www.webopedia.com>.)

Object relational database: A relational database that can handle all types of data, including audio, video, and user-defined data types, and not only numerical data.

Operating environment (also called the platform): The state of a computer, usually determined by which programs are running and basic hardware and software characteristics. For example, when one speaks of running a program in a UNIX environment, it means running a program on a computer that has the UNIX operating system. (Definition from <www.webopedia.com>.)

Oracle: Computer company that primarily creates database products.

Oracle® interMedia: Data module in the Oracle® 8i database server that can hold audio and video files.

Oracle® Spatial: Data module in the Oracle® 8i database that can hold GIS data.

Oracle® Time Series: Data module in the Oracle® 8i database that can hold most types of environmental measurement data.

P

Pesticides: Substances or mixtures intended to prevent, destroy, repel, or mitigate any pest, or used as a plant regulator, defoliant, or desiccant.

pH: The pH level of a body of water is an expression of the intensity of its basic or acid condition. A body of water's pH level may range from 0 to 14, where 0 is the most acid, 7 is neutral, and 14 is most basic. Natural waters usually have a pH between 6.5 and 8.5.

Phosphorus: An essential chemical food element that can contribute to the eutrophication of lakes and other water bodies. Increased phosphorus levels result from discharge of phosphorus-containing materials into surface waters.

PHP: PHP Hypertext Preprocessor is a server-side, HTML embedded scripting language used to create dynamic web pages. Because PHP is embedded within tags, the author can jump between HTML and PHP (similar to Active Server Pages and ColdFusion) instead of having to rely on heavy amounts of code to output HTML. And, because PHP is executed

on the server, the client cannot view the PHP code. Its strength lies in its compatibility with many types of databases. Also, PHP can talk across networks. (Definition from <www.webopedia.com>.)

Plug-in: A hardware or software module that adds a specific feature or service to a larger system. For example, a number of plug-ins exist for Internet browsers to enable the display of different types of audio or video files. (Definition from <www.webopedia.com>.)

Portal product: Ready-made software that provides a central, browser-accessible resource of an organization's data via an Intranet or through the Internet.

Presentation layer: The presentation layer is everything that appears on the web site and can be thought of as the user interface as well.

Q

Query: A user's request for information from the environmental database.

R

Real-time data: Data that represent current conditions.

Relational database: A database management system that stores data in the form of related tables. Relational databases are powerful because they require few assumptions about how data are related or how it will be extracted from the database. As a result, the same database can be viewed in many different ways. (Definition from <www.webopedia.com>.)

Restoration: Refers to ecological restoration. Actions to restore ecological processes to their natural state, thereby restoring wildlife habitat and water quality.

S

Salinity: The percentage of salt in water.

Scalability: Ability of software and hardware to adapt to increased demands, such as the number of simultaneous users and the amount of data uploaded or downloaded per day.

Schema: The database structure. Usually represented by an entity relationship diagram.

Scripts: Commands that can be executed without user interaction. For *The Living Everglades* web site, the SFWMD uses scripts to update the data mart with data from DBHYDRO.

Server: A computer or device on a network that manages network resources. For example, a database server is a computer system that processes database queries. (Definition from <www.webopedia.com>.)

Servlet container: Software that handles servlets. Servlets are programs designed to be executed from within another application and are housed on the server.

Site map: On a web site, an index that lists all of the categories of information available on the site, how they are organized, and how they are related to each other.

Software: Computer instructions or data that perform certain functions for users.

Spatially relevant data: Data referenced to a specific geographic location.

Structured Query Language (SQL): A standardized query language for requesting information from a database. (Definition from <www.webopedia.com>.)

T

Temporally relevant data: Data from recent enough observations to allow for analysis of the current state of an ecosystem.

Three-tiered client/server architecture: A special type of client/server architecture consisting of three well-defined and separate processes, each running on a different platform: the user interface, which runs on the user's computer (the client); and the functional modules that actually process data. This middle tier runs on a server and is often called the application server. It is a database management system that stores the data required by the middle tier. This tier runs on a second server called the database server. (Definition from <www.webopedia.com>.)

Time-series chart: Chart indicating the time or date for each data observation.

Two-tiered client/server architecture: Refers to client/server architectures in which the user interface runs on the client and the database is stored on the server. The actual application can run on either the client or the server. (Definition from <www.webopedia.com>.)

U

UNIX: A type of operating environment.

URL (Uniform Resource Locator): The global address of documents and other resources on the World Wide Web. (Definition from <www.webopedia.com>.)

User: Anyone using a computer.

User-friendly: Refers to anything that makes using a computer easier for novices. (Definition from <www.webopedia.com>.)

User interface: Method by which a user interacts with a computer program.

V

W

Web browser: A software application used to locate and display web pages. The two most popular browsers are Netscape ® Navigator™ and Microsoft ® Internet Explorer™. (Definition from <www.webopedia.com>.)

Web server: A computer that delivers (serves up) web pages. Every web server has an IP address and possibly a domain name. Any computer can be turned into a web server by installing server software and connecting the machine to the Internet. (Definition from <www.webopedia.com>.)

Appendix G: Technical Contacts

For more information about the software products used by the SFWMD to construct *The Living Everglades* web site, contact the following vendors and technical specialists:

- **MapXtreme® for Java™.** Created and distributed by MapInfo®. Contact Paul Culligan, public sector accounts, at 518 285-7220. Web site: www.mapinfo.com.
- **Oracle® Corporation.** Call 1-800-ORACLE-1 or contact headquarters at: Corporate Headquarters, 500 Oracle Parkway, Redwood Shores, CA 94065, phone: 605 506-7000. Web site: www.oracle.com.
- **KavaChart.** Created and distributed by Visual Engineering, Inc. Phone: 650 949-5410 or e-mail: info@ve.com. Address: 164 Main Street, 2nd Floor, Los Altos, CA 94022. Web site: www.ve.com/index.html.

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Environmental Protection
Agency

Please make all necessary changes on the below label, detach or copy, and return to the address in the upper left-hand corner.
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