DEVELOPING AN INTEGRATED REAL ESTATE INFORMATION SYSTEM (IRIS) USING ARCGIS

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ABSTRACT

The South Florida Water Management District and the U.S. Army Corps of Engineers are embarking upon a massive, twenty-year environmental restoration project entitled the Comprehensive Everglades Restoration Plan (CERP). A large portion of the CERP Program involves the acquisition of land for regional water resource projects.

The Integrated Real Estate Information System (IRIS) provides the technology platform for the Real Estate Land Acquisition activities for the CERP Program. The foundation elements of this technology platform are from ESRI©, Oracle©, and Accela©.

Using ESRI ArcGIS 8.3 technology, GeoAnalytics and the District jointly designed, developed, and deployed a customized ArcMap editing environment with a versioned, multi-user, ArcSDE-Oracle Geodatabase. The ArcSDE-Oracle Geodatabase was developed after validating and integrating information from both the legacy Oracle and GIS databases.

INTRODUCTION

From north to south across Florida, the Everglades once extended from the Kissimmee chain of lakes region near Orlando to Florida Bay near the Florida Keys. Historic accounts have indicated that wading and migratory birds were so prolific that they darkened the skies. These sub-tropical wetlands supported a rich diversity of plants, fish, and other animals (Figure 1). Panthers, manatees, and deer were abundant.

Figure 1. The endangered Florida Panther in the Everglades

Human intervention began to change the Everglades in the late 1800s, when primitive canals were dredged to drain the wetlands of south Florida. Similar changes continued as more than 1,700 miles of canals and levees vastly changed the landscape, interrupting the Everglades' natural sheet flow and sending valuable freshwater to sea.

More than half the Everglades wetlands were lost to development. An ecosystem in peril, the Everglades was besieged with a number of problems. Fifty percent of its historic wetlands were lost; water quality has deteriorated; timing and water flows have been disrupted; and vast quantities of freshwater have disappeared.

Comprehensive Everglades Restoration Plan

South Florida Water Management District and the U.S. Army Corp of Engineers are embarking on the largest restoration project in the world to solve this situation. The Comprehensive Everglades Restoration Plan (CERP) is a $7.8 billion, 30-year plan to rescue the Everglades ecosystem through a specific series of ecological and water system improvements. The Plan was approved by Congress and signed into law by Executive order in December 2000. The goals of the Plan are to restore the water quality, water quantity, timing, and distribution in the Everglades. The cooperating partners include the District, the Army Corps of Engineers, federal, state, and local agencies, tribal authorities, and private sponsoring partners.

To accomplish these ecological and water system improvements, the restoration plan required that the South Florida Water Management District obtain more than 400,000 acres of land at an approximate cost of over $2.2 billion. Consequently, the District examined its land acquisition legacy system for tracking information from land purchase business processes.

THE LEGACY SYSTEM: ATLAS

In 1987, the District’s Land Acquisition Department internally developed the Advanced Technology Land Acquisition System (ATLAS), to manage their Real Estate business information. This legacy system consisted of two related data stores: an Oracle database and GIS database.

The ATLAS Oracle database (Figure 2) was originally developed to store the information from each landowner: name, address, and District assigned tract number. District staff members have described this legacy system as a glorified Rolodex (Figure 3). As the years went on, more than 168 related tables (thousands of fields) were added to this database, to track the extensive land acquisition business process and other ancillary information (e.g. parcel numbers, county location, and Section, Township, and Range).

Meanwhile, the GIS database (Figure 4) contained approximately 90 separate GIS data layers representing project boundaries (composed of 25,000 polygons). These GIS data layers were maintained as ESRI coverages and edited through ArcEdit. ArcPlot and ArcView were the mapping tools employed for map production.

Duplicate Information

Unfortunately, the GIS data layers contained similar information to the data stored in the ATLAS Oracle database. Maintaining redundant information in these separate databases had its obvious problems. Beyond the inefficiencies of redundancy and inconsistency, much of this data was at the core of major District projects and programs. Because this data was being gathered and stored in different databases and systems, they were relatively isolated from one another. As a result, mission critical information, which is obviously related, could not be easily or quickly accessed, shared, processed, and/or analyzed.

Database Evolution

Like many other early GIS systems, these isolated data stores came about naturally as the result of differing mandates, business systems, and technology. The situation had developed as a result of incompatibilities between hardware and software; and the inevitable consequence of formal and informal processes established over the years for gathering and storing information for use by individuals, divisions, and departments.

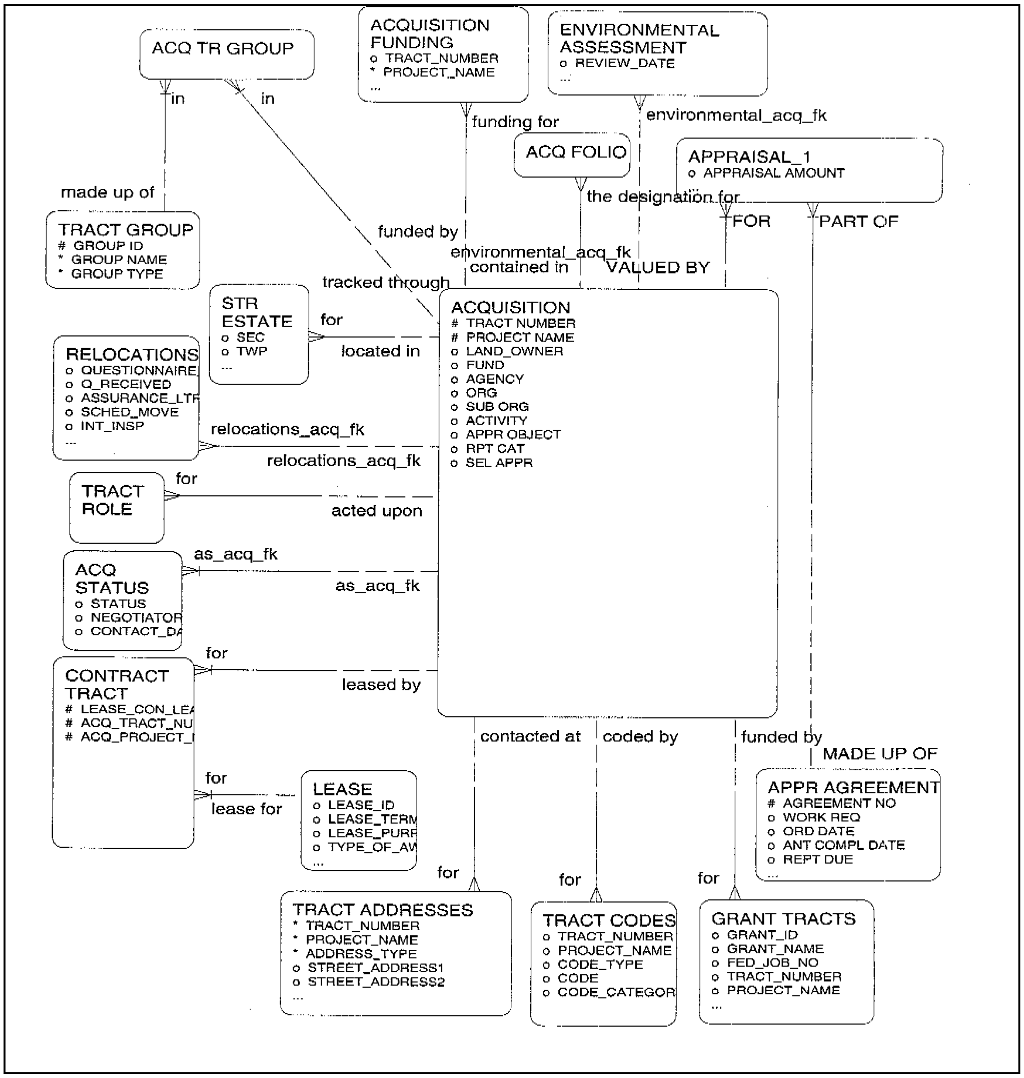

Figure 2. ATLAS Oracle database design diagram

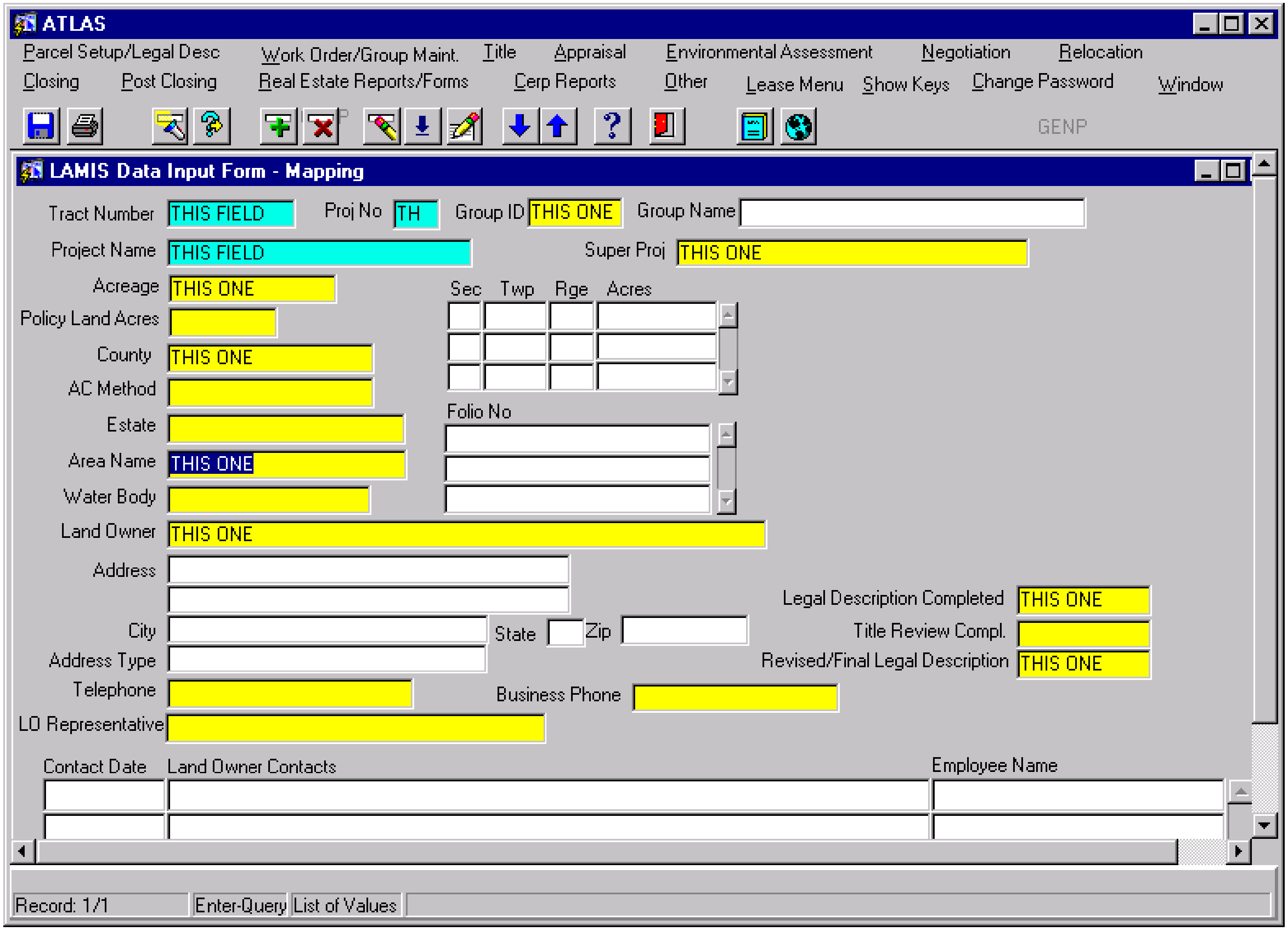

Figure 3. ATLAS Oracle forms user interface

Arc

Arc: items %.ecb%/sfwmdown.pat

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	AREA	8	18	F	5		-
9	PERIMETER	8	18	F	5		-
17	SFWMDOWN#	4	5	B	-		-
21	SFWMDOWN-ID	4	5	B	-		-
25	TYPE	3	3	I	-		-
28	ACCURACY	2	2	I	-		-
30	ACRES	4	12	F	2		-
34	LAMISACRES	4	12	F	2		-
38	PROJECT	40	40	C	-		-
78	WMD#	6	6	C	-		-
84	TRACT#	8	8	C	-		-
92	GRANTOR	24	24	C	-		-
116	FEEOWNER	24	24	C	-		-
140	ESTATE	12	12	C	-		-
152	OWNER	24	24	C	-		-
176	LOT#	6	6	C	-		-
182	BLOCK	6	6	C	-		-
188	SUBDIV	100	100	C	-		-
288	PROTLANDS	1	1	C	-		-
289	SOR	1	1	C	-		-
Continue?							
290	COMMENTS	250	250	C	-		-
540	INSIDE	4	5	B	-		-
544	REFNO	6	6	I	-		-
550	CELL#	6	6	C	-		-
556	PTRACT#	8	8	C	-		-
564	ACQ-ID	44	44	C	-		-
608	FOLIO	13	13	C	-		-
621	FUNDING	24	24	C	-		-
645	UPDATED	8	10	D	-		-

Figure 4. ATLAS GIS coverages database design

Information Isolation

Also, in order to implement the policy directives and complete mandated projects to protect the water resources of more than 6 million people in the region, information-processing solutions were often developed in isolation, to quickly meet immediate and very specific needs. Furthermore, adequate solutions to integrate disparate technologies did not exist until recently.

Unfortunately, the District legacy system for land acquisition would not be able to effectively and efficiently manage the large volume of new information to support the restoration plan. Therefore, the legacy system was inadequate to fulfill the needs of the mandate set forth in the Comprehensive Everglades Restoration Plan.

THE VISION: INTEGRATION

Across the agency, a large, multi-departmental committee of District staff members created a bold new vision to bring technology together and leverage it fully. The Information Technology Convergence (ITC) initiative was this bold new vision; its purpose was to integrate GIS, web, and database systems to create an enterprise information infrastructure. Specifically, the vision was to make technologies work together to analyze, store, and distribute critical data and information to serve District staff and the general public.

It was based on the concept that many of the District's most important projects are extremely dependent on their ability to broadly and seamlessly use GIS, web, and database systems. When these types of information are integrated, access to all sorts of information will be widely available, enabling more effective analysis and decision-making.

Integrated data will also be far easier to maintain and use, increasing staff productivity and efficiency while significantly improving Quality Control, the integrity of data, and reducing redundant efforts. With these types of benefits, the process of integrating data was considered a prudent investment for the District's Land Acquisition Department.

Based on this integrated vision, the Land Resources Department developed a conceptual design for a new system around the existing ATLAS technology (Figure 5).

THE NEW SYSTEM: IRIS

In an effort to achieve this integrated vision, the Land Acquisition Department and GeoAnalytics designed, developed, and implemented an Information Technology Convergence system, the Integrated Real Estate Information System (IRIS) (Figure 6). The new system allows storing, maintaining, and accessing both spatial and tabular data. For GIS data management purposes, the two major GIS technology components are the Tract Editor GIS application and the IRIS SDE Geodatabase. For tabular data management activities, the IRIS Tabular Database and Accela Automation application have been implemented. For the integration bridge between the spatial and tabular data, the Accela GIS Viewer application provides data access to the user via ArcIMS technology.

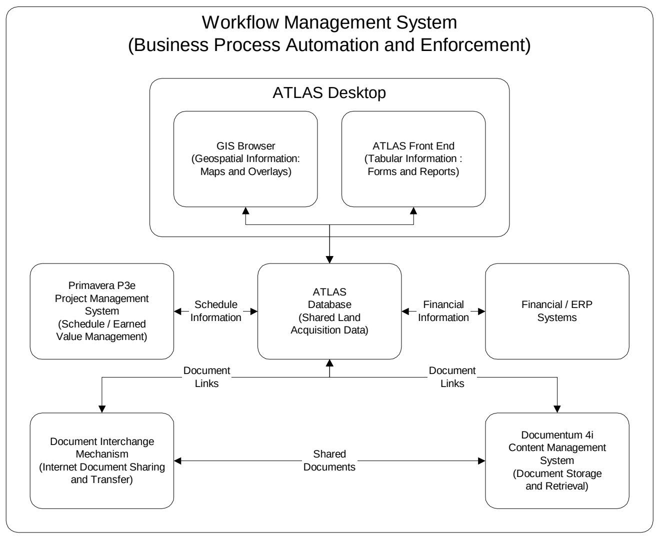

Figure 5. ATLAS conceptual design with systems integration

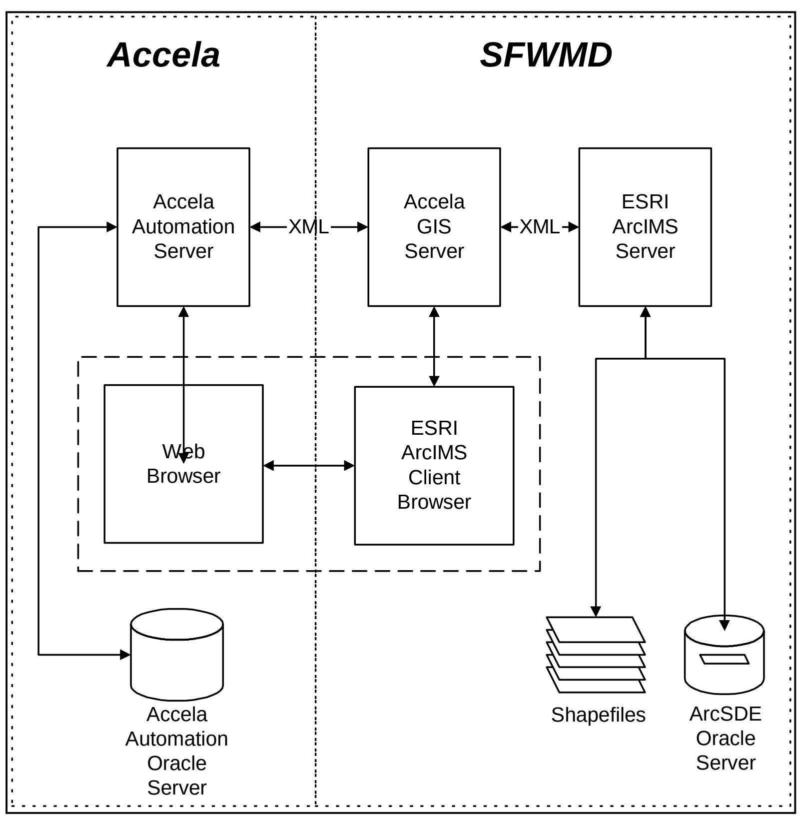

Figure 6. IRIS systems design diagram

Tract Editor GIS Application

The SFWMD IRIS Tract Editor GIS application was developed using the ESRI ArcGIS 8.3 ArcMap interface with ArcObjects (Figure 7). The Tract Editor contains a task bar that enables the user to perform the application functions as a step-by-step workflow process. Therefore, only the relevant tools to the current task are enabled, while all other unrelated tools are temporarily disabled. This approach enables the application to keep track of all edits the user performs throughout their session. At the end of the editing session, the GIS editor checks in the multi-versioned edited personal geodatabase for the QA/QC manager, who approves and posts all the edits done back to ArcSDE geodatabase. The process of posting the edits to ArcSDE uses the disconnected editing technology available from ESRI.

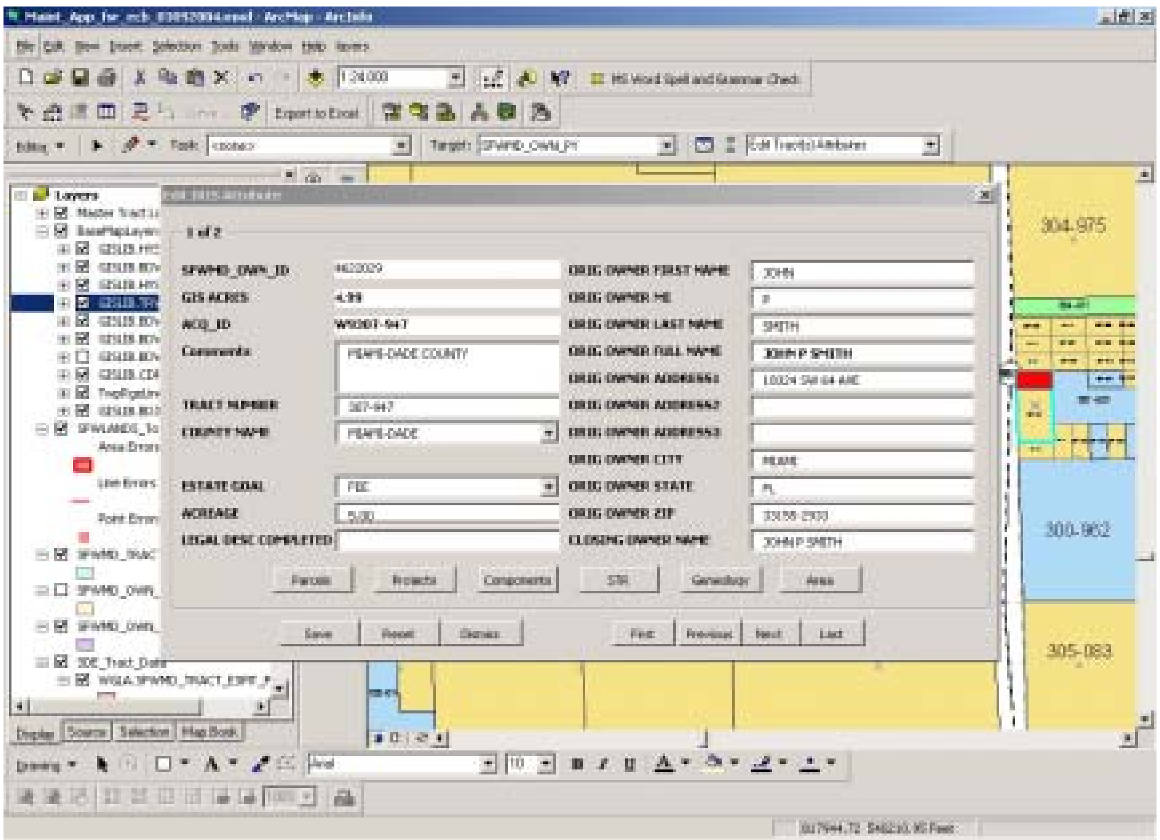

Figure 7. Tract Editor GIS Application

IRIS GIS Geodatabase

The SFWMD IRIS GIS Tract Editor Application provides the toolset to maintain the IRIS GIS data layers in a versioned, multi-user ArcSDE-Oracle Geodatabase (Figure 8). In this figure, the table grouping in the middle in yellow represents the SFWMD LAND Geodatabase (WGLA schema). The table grouping on the left side in blue represents the SFWMD Transfer Tables (IRISUPDATE schema).

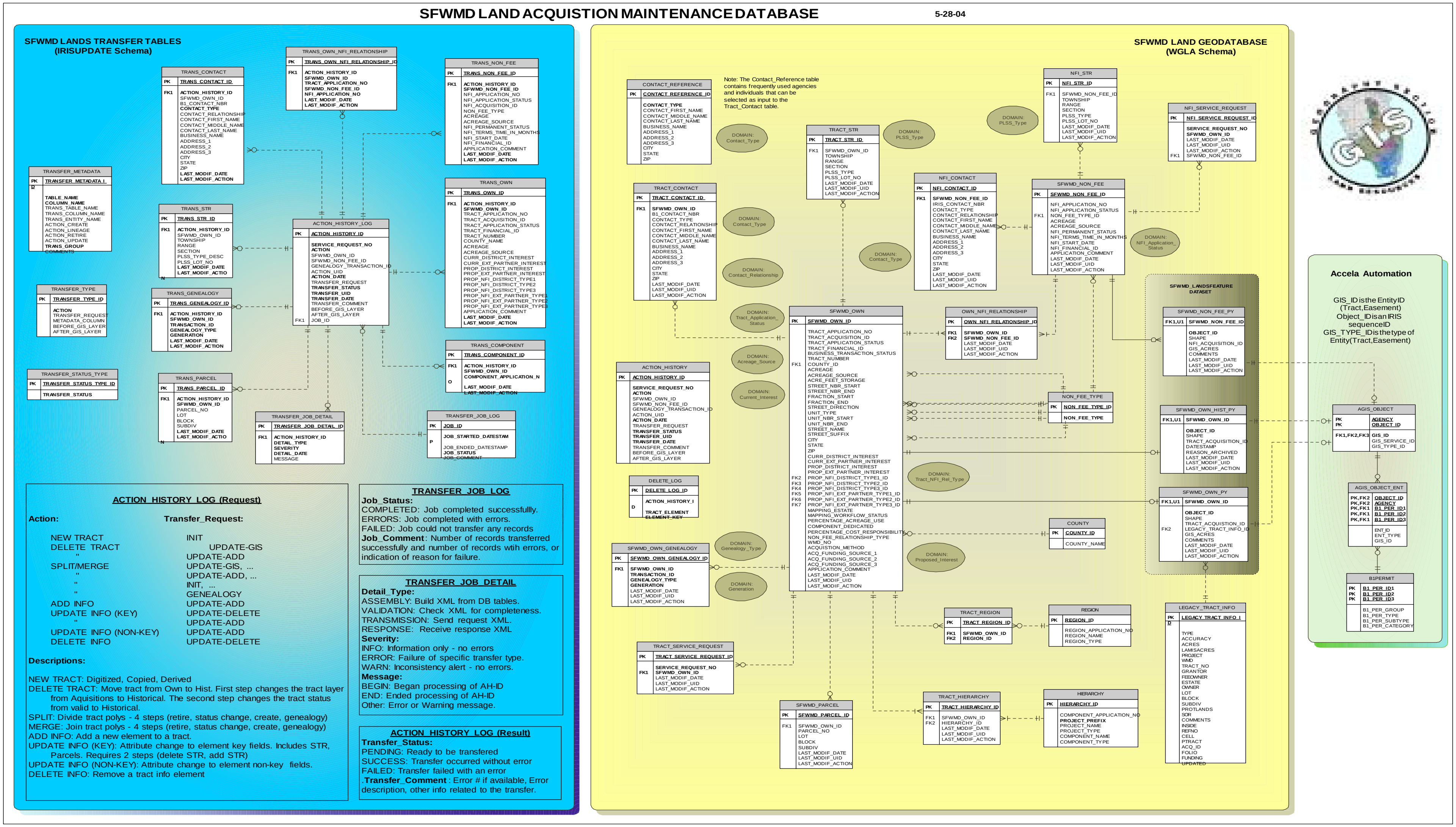

Figure 8. IRIS SDE Geodatabase and Transfer Tables

Spatial data stored in the IRIS Geodatabase consists of one feature dataset containing four related feature classes and one or more standalone feature classes. The primary feature dataset in the geodatabase is SFWMD_LANDS, which serves as a container for logically related feature classes and tables. Within the SFWMD_LANDS feature dataset, the three feature classes are:

1. the TRACTS layer which is comprised of tract polygon boundaries,
2. the EASEMENTS layer which is comprised of easements granted by the District,
3. the HISTORY layer which contains time-stamped copies of all edited tract polygons

The IRIS Geodatabase was designed and developed with the following concepts in mind:

- Tracts are the geographic unit of land management that underlay all District Land Acquisition activities.
- Tract polygons indicate contiguous areas of ownership created by dissolving adjacent parcel boundaries where the owner is the same.
- Tracts are either lands that are owned or proposed for acquisition by the District and its partners, or tracts are easements granted to the District.
- Easements granted over District owned lands to other entities are represented by polygons in the EASEMENTS layer within the SFWMD_LANDS feature dataset.

Whenever a tract polygon is edited, for merging or splitting, deleting or modifying, the original polygon is copied to the HISTORY feature class. Therefore, it is possible to reconstruct the appearance of the tract layer at any point in time based on the copy of the polygon and a time-stamp. The polygons in the history layer retain their original IDs, which are also recorded in the tract genealogy table. This table, combined with the series of changes to geometry stored in the history layer, will allow users to reconstruct the chain of ownership in space as well as time.

The feature-linked annotation is the District's tract number derived from the ACQ_ID field, a unique identifier, used to track the land acquisition business process.

The SDE Geodatabase is located at the District in West Palm Beach, Florida, on a server in the GIS Services Section of the Information Technology Department.

Building the IRIS Geodatabase

To build the IRIS Geodatabase, the Land Acquisition GIS Support Division and GeoAnalytics migrated from ESRI coverages to ArcSDE-Oracle and ArcGIS 8.3 technologies. A major data validation effort occurred to identify and resolve any inconsistencies between the two legacy ATLAS databases, (1) the Oracle database and (2) the ESRI coverages. This was a monumental undertaking.

The data validation effort involved a significant amount of time and patience. SQL statements and ArcInfo AMLs were written to identify many of these inconsistencies.

Reconciling these inconsistencies involved a variety of research activities with a feedback loop between the District and GeoAnalytics.

In some cases, it was easy to identify which database held the correct information. In other cases, however, it took numerous hours of research time since many of the records had not been accessed for decades. This process of inconsistency checking was conducted for all of the 25,000 records.

Once the data validation effort was completed, the data was migrated into the versioned, multi-user ArcSDE-Oracle Geodatabase and the ATLAS Oracle database at the District.

IRIS Tabular Database

The tabular data is stored in an Oracle database on a server hosted by Accela, Inc. at the Qwest Communications Center in Sunnyvale, California and is served over the Internet (Figure 6). The technology utilized is Accela Automation (Figure 9) and the Accela GIS Viewer (Figure 10).

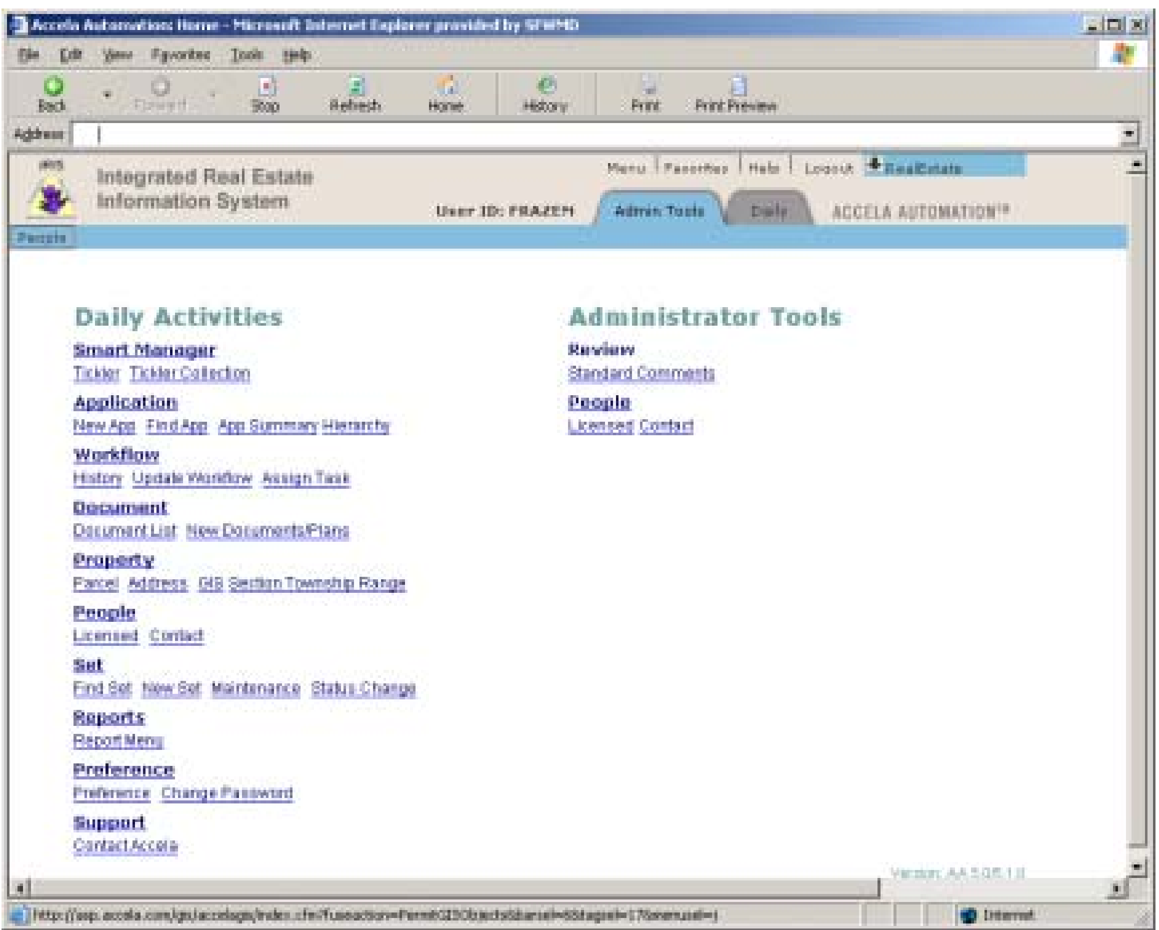

Figure 9. IRIS tabular interface delivered by Accela Automation via web browser

Accela Automation utilizes Macromedia Cold Fusion and the Accela GIS Viewer utilizes ArcIMS technology. The IRIS application and database are served by a series of application servers to a Web browser. This technology is currently available to all District offices, Field Stations, and Service Centers spread throughout the sixteen county region.

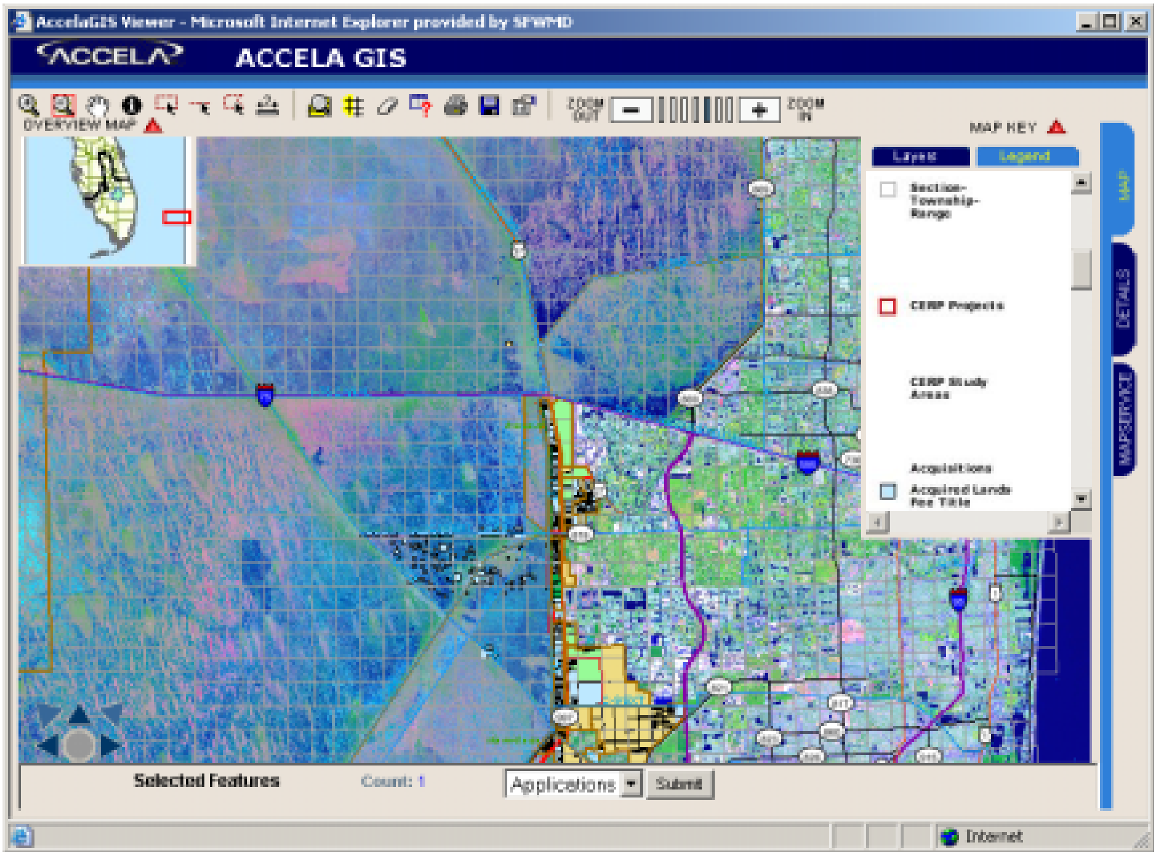

Figure 10. Accela GIS Viewer displays CERP project areas, District lands, and the developmental pressure from the urban areas adjacent to the Everglades.

By the summer of 2004, the District will utilize XML technology to integrate the ArcSDE-Oracle Geodatabase and the IRIS Oracle Database between Florida and California. This integration effort will allow the GIS Editors in the Department to access and modify the IRIS Database in California and the IRIS Geodatabase in Florida with the Tract Editor GIS application and an XML application.

CONCLUSION

As a truly integrated enterprise system, IRIS has a solid foundation, the ability to evolve with the emergence of new technologies in GIS, web and database systems, and will be able to aid in the "Restoration of America's Everglades" for many years to come.