Southwest Broward/Northwest Dade Subregional Study - Phase 2

Prepared by

The South Florida Regional Planning Council

July 1990

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Final Draft

Prepared by
The South Florida Regional Planning Council
July 2, 1990

ACKNOWLEDGEMENTS

The staff of the South Florida Regional Planning Council would like to thank everyone who has participated in the development of the Southwest Broward Northwest Dade Subregional Study. This report is the result of the efforts of numerous people who have contributed their time and talents to the development of the study. In particular, we would like to acknowledge the efforts of the technical committee chairs:

Water Resources	Jean Evoy	Principal Planner, Dade County Planning Department
Wetlands	Jim Goldasich	Principal Biologist, Keith and Schnars, P.A.
Surface Water Management	Jim Jackson	Intergovernmental Program Representative, South Florida Water Management District
Transportation	David Plummer	President, David Plummer and Associates
Potable Water, Wastewater, and Solid Waste Infrastructure	Mike Wanchick	Administrator, Broward County Planning Council

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Phase 2

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SOUTHWEST BROWARD/NORTHWEST DADE SUBREGIONAL STUDY
Phase 2

FINAL DRAFT

I. INTRODUCTION

The Southwest Broward/Northwest Dade Subregional Study area encompasses approximately 200 square miles in southwest Broward County and northwest Dade County (Figure 1). The study area was chosen because it is a relatively undeveloped part of the region, portions of which have been experiencing growth pressures. The study has been completed in two phases.

In August 1988, Council staff assembled a working group of agency and local government representatives to address issues related to the study area. The working group met on a regular basis for ten months and assisted staff in compiling existing information regarding land use, natural resources and infrastructure in the study area from published sources and agency documents. Compilation of the information resulted in the Phase 1 report which was completed in June 1989.

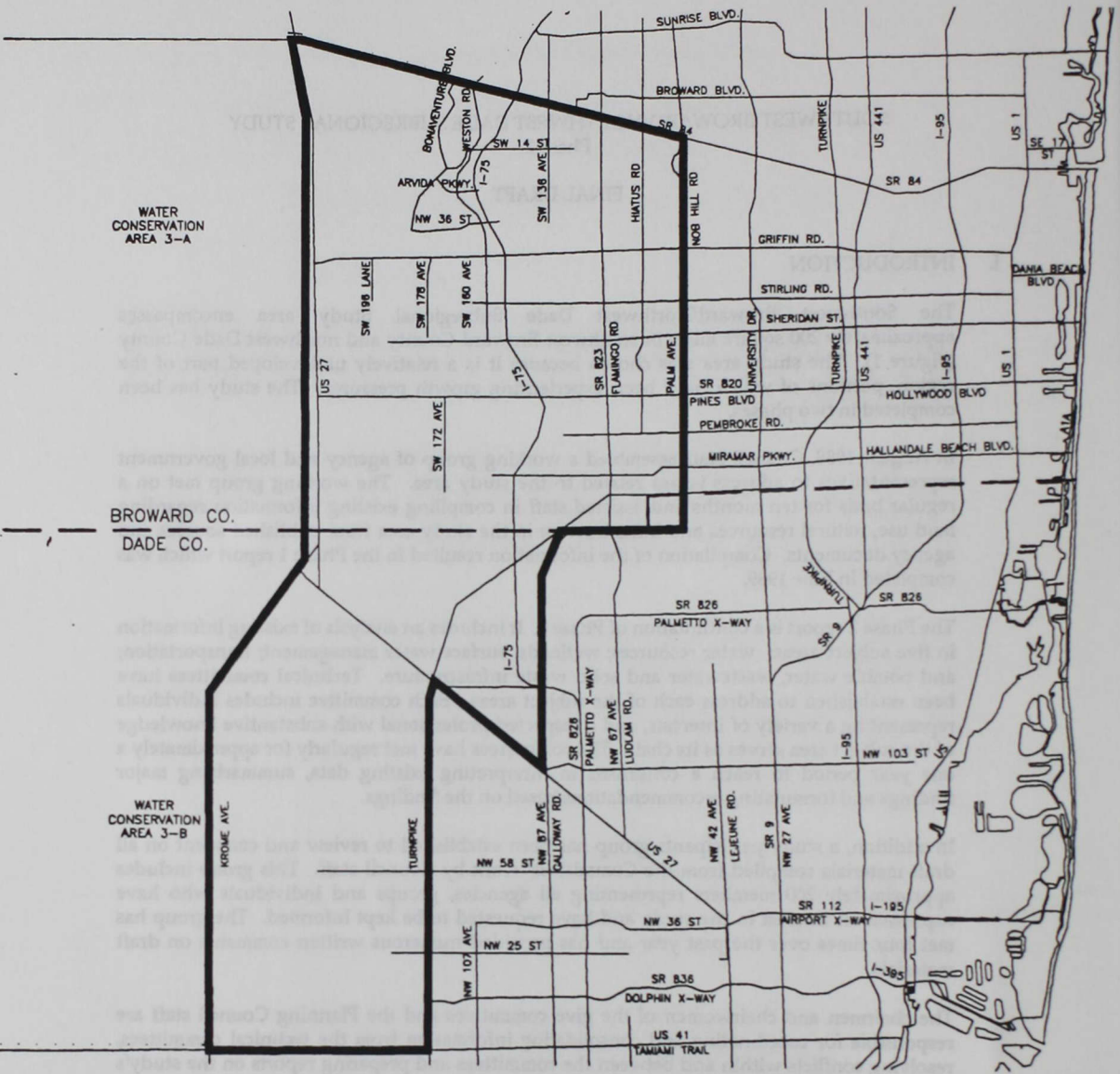
The Phase 2 report is a continuation of Phase 1. It includes an analysis of existing information in five subject areas: water resources; wetlands; surface water management; transportation; and potable water, wastewater and solid waste infrastructure. Technical committees have been established to address each of the subject areas. Each committee includes individuals representing a variety of interests, and a respected professional with substantive knowledge of the subject area serves as its chair. The committees have met regularly for approximately a one year period to reach a consensus in interpreting existing data, summarizing major findings and formulating recommendations based on the findings.

In addition, a study participants group has been established to review and comment on all draft materials compiled from the Committees' work by Council staff. This group includes approximately 200 members representing all agencies, groups and individuals who have expressed an interest in the study and have requested to be kept informed. The group has met four times over the past year and has provided numerous written comments on draft materials.

The chairmen and chairwomen of the give committees and the Planning Council staff are responsible for coordinating and consolidating information from the technical committees, resolving conflicts within and between the committees and preparing reports on the study's findings and recommendations.

Local governments and permitting agencies may use the information in this study as well as information referenced in this study to assist in their decisions, to modify local and regional comprehensive plans and to establish priorities and planning initiatives in areas identified as requiring additional consideration.

This report has been organized by subject. Data, information and analysis on each subject is followed by a summary of findings with corresponding recommendations for each major subject area. An executive summary containing the entire set of the study's findings and recommendations accompanies this report.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study

Study Area Boundary

Source: South Florida Regional Planning Council

FIGURE 1

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II. LAND USE

A. Existing Land Use

The study area covers approximately 215 square miles of mostly undeveloped land. Most of the development that has taken place or been proposed is in Broward County, where a number of large-scale developments are under way or have received governmental approval. Dade County has restricted the area's development by setting its urban development boundary through 2010 at the Homestead Extension of the Florida Turnpike (HEFT). Broward County has not designated an urban development boundary.

The Broward County portion of the study area lies within the jurisdictions of five cities: Miramar, Pembroke Pines, Cooper City, Davie, and Sunrise, and in unincorporated Broward County. Most of the Dade County area falls within the jurisdiction of the county government with a small portion in the cities of Hialeah and Hialeah Gardens.

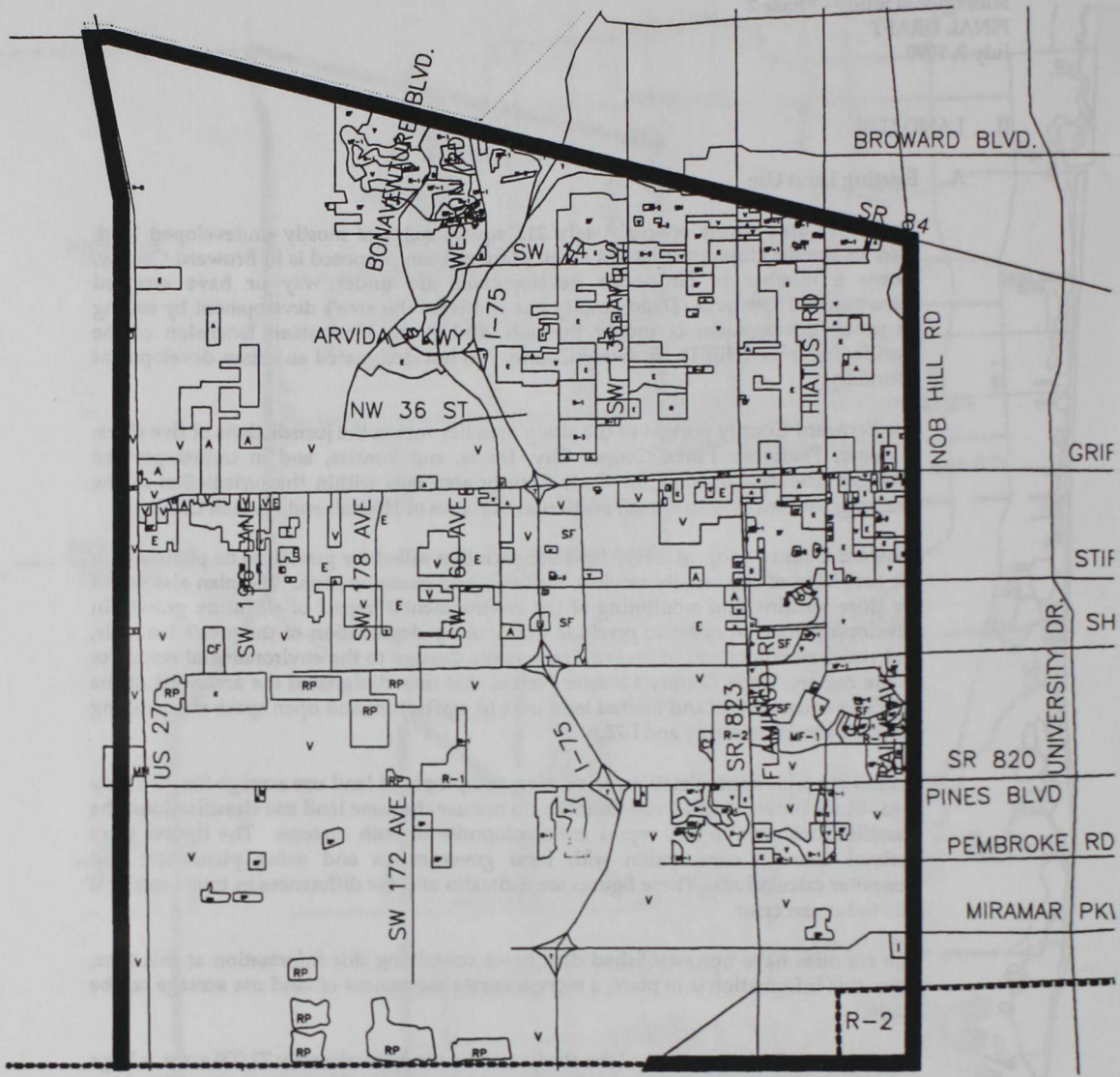
Broward County adopted a 1977 land use plan that called for growth to be phased with the provision of community services, facilities, and transportation. The plan also called for close scrutiny and monitoring of the environmental impact of all future growth in developing areas in order to preclude unnecessary degradation of the area's land, air, and water resources and to prevent irreversible damage to the environmental resources of the region. Dade County's Master Plan at that time designated the area west of the HEFT as conservation and limited land uses to agriculture and open space except along the Palmetto Expressway and I-75.

Table 1 contains approximations of existing and proposed land use acreage for the study area. Since Broward and Dade Counties do not use the same land use classifications, the classifications used in this report are a composite of both systems. The figures were derived through consultation with local governments and using planimeter and computer calculations. These figures are estimates and the differences in total acreage is due to human error.

The counties have not established data bases containing this information at this time. Once this information is in place, a more accurate assessment of land use acreage can be made.

The Broward County portion of the study area covers approximately 72,000 acres, a large part of which is either undeveloped or in agricultural use. The area north of Sheridan Street includes most of the existing residential acreage in the Broward section of the study area. As Figure 2 indicates, the majority of this housing is estate residential surrounded by undeveloped land, with higher densities close to I-75 and State Road 84.

In the Dade County portion of the study area (Figure 3), most of the land is designated as open land and environmental protection and is part of Dade's Northwest Wellfield protection area. The Dade County portion of the study area covers approximately 56,000 acres; 75 percent is undeveloped; eight percent is being mined; nine percent is agriculture; and the remaining eight percent includes residential development near Tamiami Trail and Okeechobee Road.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Broward County Existing Land Use

Study Area Boundary

E	Estate Density Residential	W	Water	I	Industrial & Office
SF	Low Density Residential	A	Agriculture	B	Business & Office
MF-1	Medium Density Residential	V	Open Land	O	Office/Residential
MF-2	High Density Residential	C	Conservation	RP	Rockmining
MH	Mobile Homes	T	Transportation	CF	Institutional & Public Facility
R-2	Parks & Recreation	U	Utilities		

Source: Broward County Comprehensive Plan 1989.

FIGURE 2

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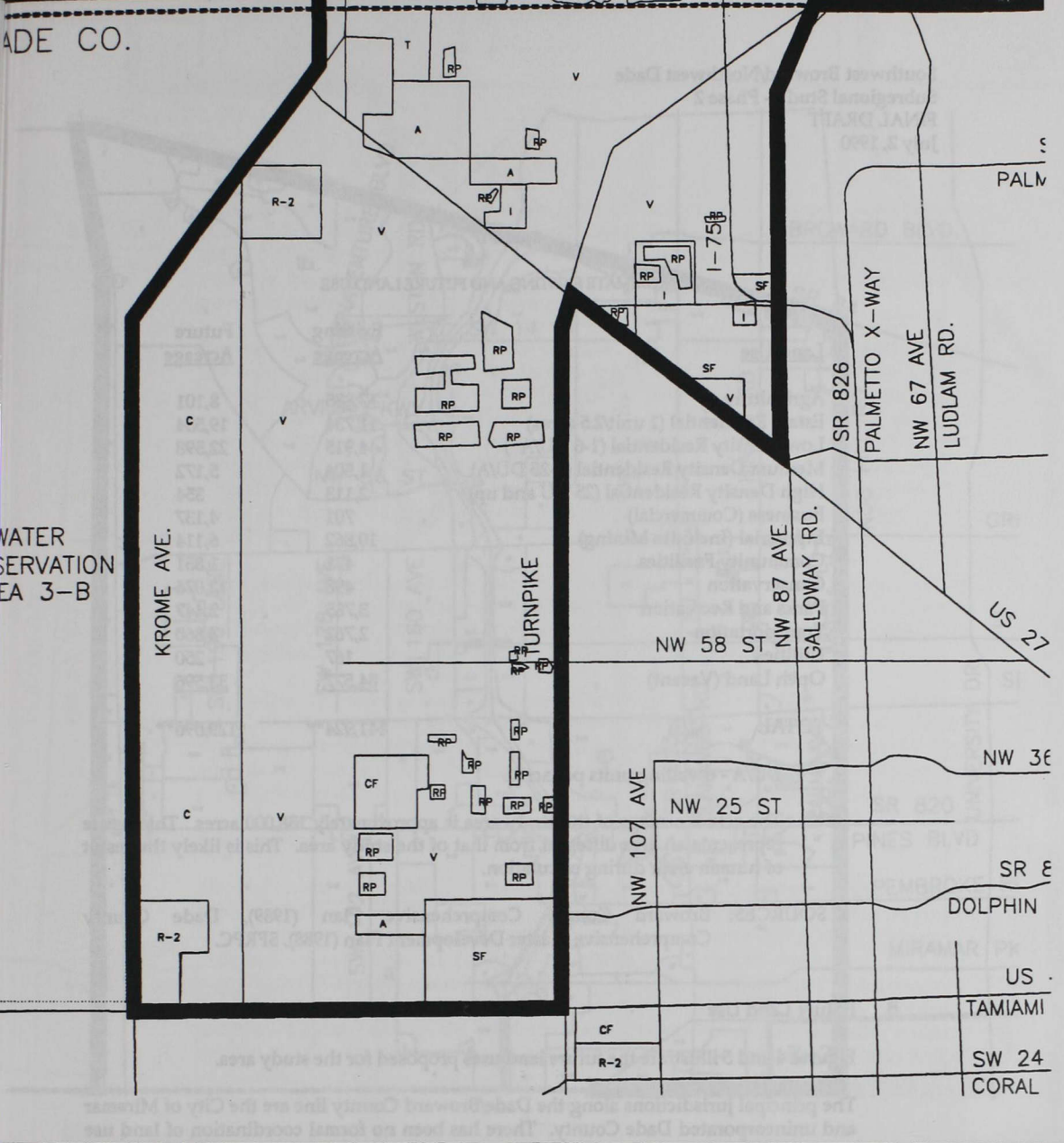

South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Dade County Existing Land Use

Study Area Boundary

E	Estate Density Residential	W	Water	I	Industrial & Office
SF	Low Density Residential	A	Agriculture	B	Business & Office
MF-1	Medium Density Residential	V	Open Land	O	Office/Residential
MF-2	High Density Residential	C	Conservation	RP	Rockmining
UD-SS	Urban Development Subject to Wetland Basin Study	T	Transportation	CF	Institutional & Public Facility
		R-2	Parks & Recreation		

Source: Dade County Planning Department and South Florida Regional Planning Council

FIGURE 3

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TABLE 1

APPROXIMATE EXISTING AND FUTURE LAND USE

Land Use	Existing Acreage	Future Acreage
Agriculture	17,885	8,101
Estate Residential (1 unit/2.5 acres)	11,734	19,534
Low Density Residential (1-6 DU/A*)	4,915	22,598
Medium Density Residential (7-25 DU/A)	1,504	5,172
High Density Residential (25 DU and up)	2,113	354
Business (Commercial)	701	4,137
Industrial (Includes Mining)	10,862	6,114
Community Facilities	421	1,851
Conservation	498	12,076
Parks and Recreation	3,785	2,447
Transportation	2,762	2,860
Utilities	167	250
Open Land (Vacant)	84,577	33,596
TOTAL	141,924**	129,090**

* DU/A - dwelling units per acre.

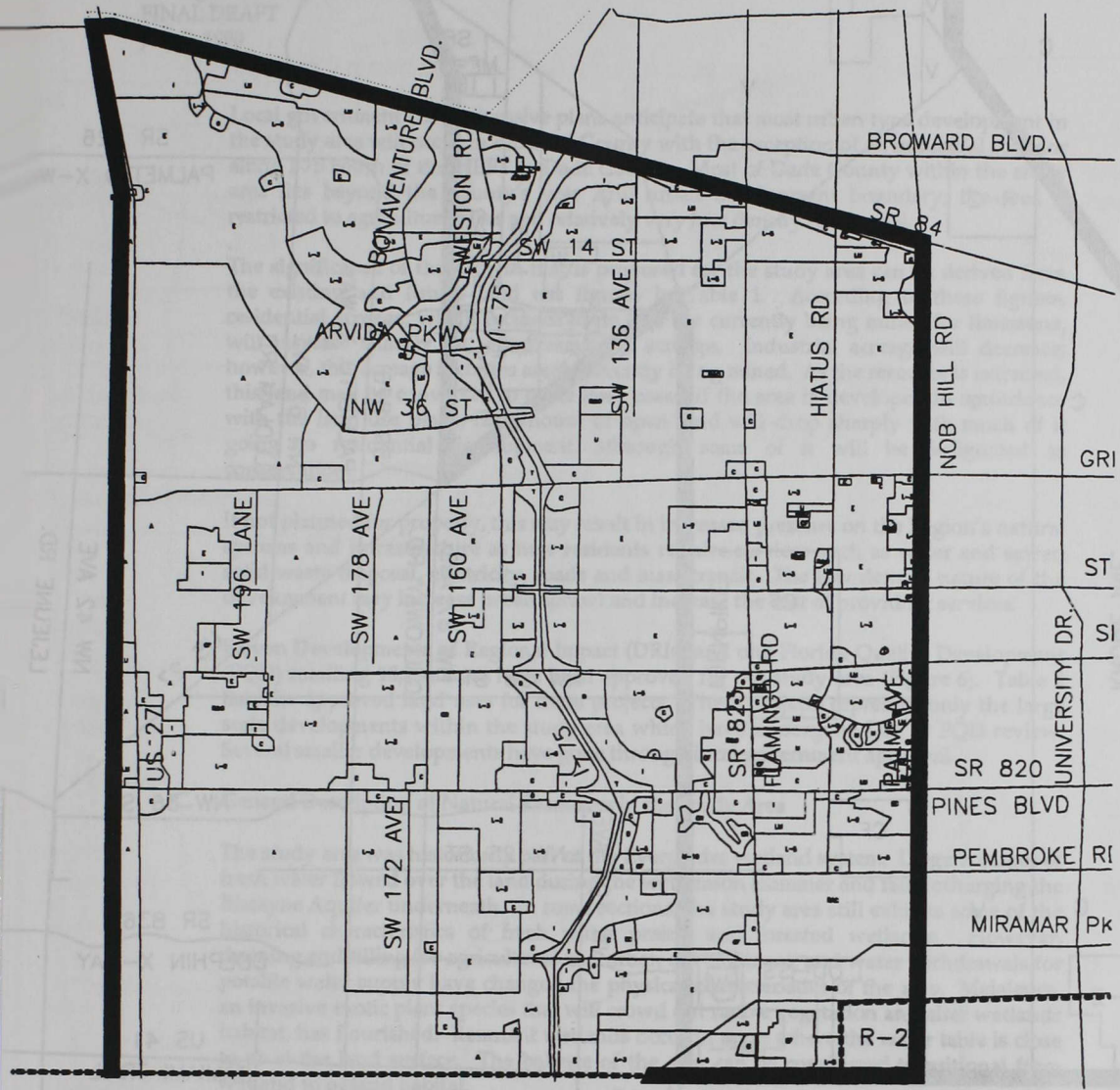
** The actual acreage of the study area is approximately 138,000 acres. This figure represents an area different from that of the study area. This is likely the result of human error during calculation.

SOURCES: Broward County Comprehensive Plan (1989), Dade County Comprehensive Master Development Plan (1988), SFRPC.

B. Future Land Use

Figures 4 and 5 illustrate the future land uses proposed for the study area.

The principal jurisdictions along the Dade/Broward County line are the City of Miramar and unincorporated Dade County. There has been no formal coordination of land use across jurisdictional boundaries; however, both the City of Miramar and Dade County considered existing land use in the adjoining jurisdiction. The Miramar Comprehensive Plan discusses the Dade County 58th Street landfill and impacts on Miramar wellfields and the impact (including traffic) of the Opa Locka Airport and the 1.3 million square foot Dolphin (Robbie) Commercial Center and Stadium near the city border. The conclusion of the Miramar plan is that Dade County's proposed land uses are generally compatible with Miramar's proposed uses.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Broward County Future Land Use

Study Area Boundary

E	Residential 1 DU/AC	C	Commercial	CR	Commercial Recreation
L-2	Residential 2 DU/AC	I	Industrial	CF	Community Facilities
L-3	Residential 3DU/AC	A	Agricultural	EC	Employment Center
L-4	Residential 4 DU/AC	O	Office Park	R&O	Recreation & Open Space
L-5	Residential 5 DU/AC	U	Utilities	RAC	Regional Activity Center
LM	Residential 10 DU/AC	T	Transportation		

Source: Broward County Comprehensive Plan 1989.

FIGURE 4

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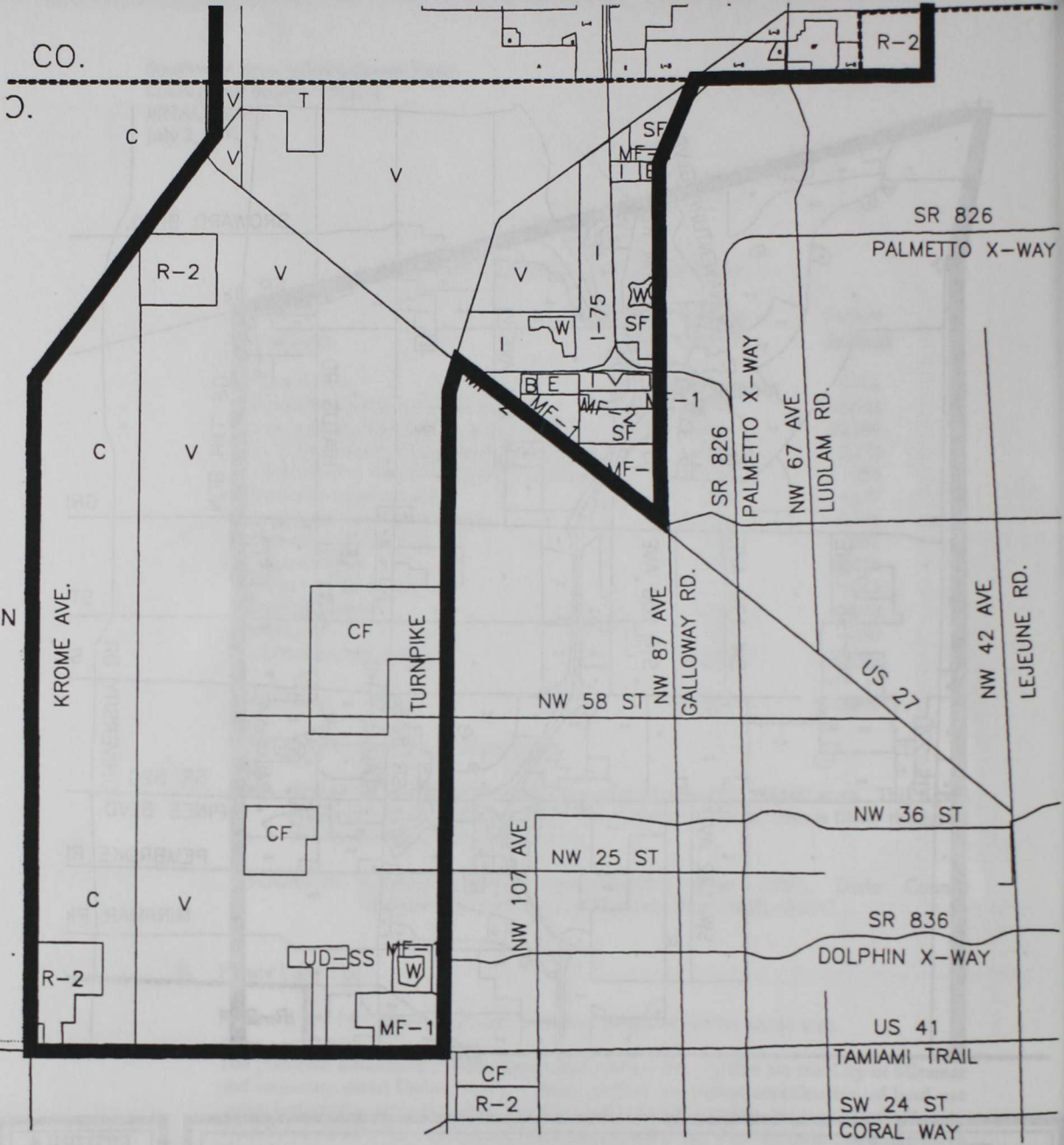

South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Dade County Future Land Use

Study Area Boundary

E	Estate Density Residential	W	Water	I	Industrial & Office
SF	Low Density Residential	A	Agriculture	B	Business & Office
MF-1	Medium Density Residential	V	Open Land	O	Office/Residential
MF-2	High Density Residential	C	Conservation	RP	Rockmining
UD-SS	Urban Development Subject to Wetland Basin Study	T	Transportation	CF	Institutional & Public Facility
		R-2	Parks & Recreation		

Source: Dade County Comprehensive Development Master Plan.

FIGURE 5

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Local government comprehensive plans anticipate that most urban type development in the study area will occur in Broward County with the exception of an industrial corridor along I-75 south of the HEFT in Dade County. Most of Dade County within the study area lies beyond the county's year 2010 urban development boundary; the area is restricted to agricultural uses and relatively very low density residential.

The significance of the growth that is proposed for the study area can be derived from the existing and future land use figures in Table 1. According to these figures, residential acreage, which includes areas that are currently being mined for limestone, will increase sharply, as will commercial acreage. Industrial acreage will decrease; however, this acreage includes areas currently being mined. As the resource is extracted, this land may be converted to other land uses. If the area is developed in accordance with the land use plans, the amount of open land will drop sharply with much of it going to residential development, although some of it will be designated as conservation.

If not planned for properly, this may result in increased pressure on the Region's natural systems and infrastructure as new residents require services such as water and sewer, solid waste disposal, electricity, roads and mass transit. The low density nature of the development may increase urban sprawl and increase the cost of providing services.

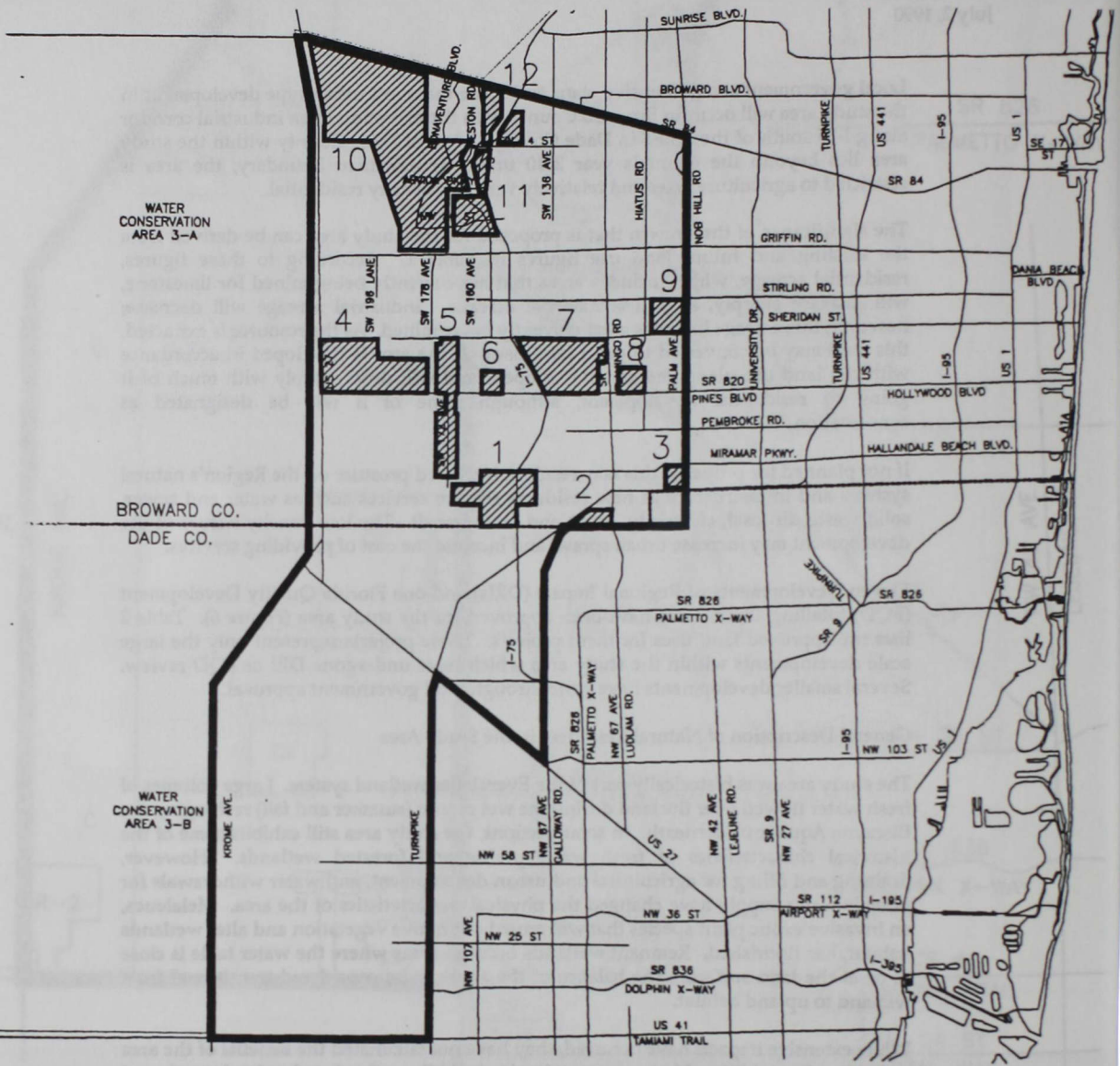
Eleven Developments of Regional Impact (DRIs) and one Florida Quality Development (FQD) totalling 18,936 acres have been approved for the study area (Figure 6). Table 2 lists the approved land uses for these projects. These projects represent only the large scale developments within the study area which have undergone DRI or FQD review. Several smaller developments have gone through local government approval.

C. General Description of Natural Resources in the Study Area

The study area was historically part of the Everglades wetland system. Large volumes of fresh water flowed over the land during the wet season (summer and fall) recharging the Biscayne Aquifer underneath. In some sections, the study area still exhibits some of the historical characteristics of fresh water prairie and forested wetlands. However, draining and filling for agricultural and urban development, and water withdrawals for potable water supply have changed the physical characteristics of the area. Melaleuca, an invasive exotic plant species that will crowd out native vegetation and alter wetlands habitat, has flourished. Remnant wetlands occur in areas where the water table is close to or at the land surface. The balance of the area can be considered transitional from wetland to upland habitat.

While extensive impacts have occurred, they have not eliminated the benefits of the area as habitat for wildlife. Many species of animals, both wetland and upland, are found throughout the study area. These values should not be dismissed because of alteration of the area from its previous state.

The Biscayne Aquifer, the primary source of drinking water for the nearly three million people in Broward, Dade and Monroe Counties, lies beneath the entire study area. Water enters the aquifer from rainfall and from the canals that lead from the Water



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Developments of Regional Impact

Study Area Boundary

1. Country Lakes
2. Bluegrass Lakes
3. Miramar Park of Commerce
4. Chapel Trail
5. Silver Lakes F.Q.D.
6. Pembroke Pines Regional Center

DRI Boundaries

7. Pembroke Meadows
8. Pembroke Lakes Regional Center
9. Embassy Lakes
10. Weston
11. Tishman Speyer-Increment II
12. 84 South

Source: South Florida Regional Planning Council and Broward County Office of Planning.

FIGURE 6

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TABLE 2

DEVELOPMENTS OF REGIONAL IMPACT AND FLORIDA QUALITY DEVELOPMENTS

Project	Dwelling Units (acres)	Industrial in sq. ft. (acres)	Commercial in sq. ft. (acres)	Office in sq. ft. (acres)	Hotel Rooms (acres)	Other* (acres)	Total Acres
Country Lakes	5,100	1,621,000	1,142,000	504,000	-		
Bluegrass Lakes	2,700 (318)	-	200,000 (20)	-	-	(140)	(478)
Miramar Park of Commerce	-	1,365,000 (127)	-	735,000 (40)	-		(167)
Chapel Trail	3,200 (437)	1,274,000 (73)	285,000 (26)	709,000 (42)	-	(723)	(1,301)
Silver Lakes	6,498 (2,166)	-	758,000 (98)	553,000 (66)	300 (19)		(2,349)
Pemb. Pines Reg. Ctr.	-	-	1,300,000 (105)	-	-		(105)
Pembroke Meadows	4,339 (488)	3,116,000 (259)	632,000 (61)	1,019,000 (85)	-	(580)	(1,473)
Pemb. Lakes Reg. Ctr.	900 (40)	-	1,755,000 (46)	575,000 (36)	200 (6)	(40)	(168)
Embassy Lakes	1,796 (365)	-	185,000 (20)	-	-	(247)	(632)
Weston	20,642 (4,836)	105,000 (853)**	2,398,000 (316)	1,027,000 N/A	-	(3,491)	(9,496)
84 South	1,998 (304)	440,000 (68)	579,000 (54)	95,000 N/A	130 (11)	(226)	(663)
Tishman-Speyer	-	5,222,000 (604)**	419,000 N/A)	2,134,00 N/A	600 N/A		(604)
TOTAL	47,173 (9,485)	13,143,000 (2,104)	9,690,000 (827)	7,387,000 (307)	1,230 (36)	(6,177)	(18,936)

* This category includes community facilities, roads, parking, surface water management, rights-of-way, etc.
** The land use in the application for development approval (ADA) is shown as Industrial/Office/Commercial (I/O/C).
N/A - The information is not available (see note).

NOTE: The applications for these projects were submitted before there was an "office" land use category in the Broward County Comprehensive Plan. In this table, "Office" is considered a commercial land use and is included as commercial acreage, unless otherwise indicated.

SOURCE: SFRPC

Conservation Areas. Because much of the study area is undeveloped land, it is an important recharge area for the aquifer. Most of the Dade County portion of the study area is within the protection area of the Northwest Wellfield, which supplies water to northern Dade County.

D. Special Land Use Planning Issues

1. Groundwater and wellfield protection

The study area is important in terms of aquifer recharge due to its large open areas and highly permeable substrate. The Northwest Wellfield occupies the majority of the Dade County portion of the study area. A portion of the protection area for the proposed Dade County West Wellfield is within the study area. Broward County is proposing a new regional wellfield just outside the study area. Any future land use decisions must consider these facts. These issues are discussed in greater detail in the water resources section.

2. Proposed air facilities

Two airports are proposed for the study area: a major commercial airport in Dade County west of the HEFT near the Dade/Broward County line, and a general aviation facility east of U.S. 27 and South of S.R. 84 near the Weston DRI. The Dade County facility is proposed primarily to relieve commercial air traffic at Miami International Airport. The Broward County airport, if approved, will alleviate the general aviation traffic at North Perry and Fort Lauderdale-Hollywood International airports. Both of the sites are undergoing evaluation for natural resource and socioeconomic impacts. They are discussed in more detail in the transportation section of this report. As the plans for these airports are advanced, consideration of existing and proposed land uses in the area must be taken into consideration.

E. Findings and Recommendations

1) Findings: **Land Use Coordination and Compatibility**

- The existing and proposed land uses within the study area vary in intensity.
- While Chapter 163, F.S., and Rule 9J-5, F.A.C., require intergovernmental coordination in land use planning, this only applies to adjacent local governments.
- Land use decisions in the study area may affect non-adjacent local governments.
- There is minimal land use coordination between Dade and Broward Counties and municipalities within the study area.

Recommendation

Proposed land use changes in the study area should be more closely coordinated between the counties as well as municipalities. A procedure for facilitating the coordination of land use changes shall be developed by the South Florida Regional Planning Council.

2) Finding: **Airport Planning**

- **If built, the proposed northwest Dade County airport will create additional land use conflicts in the study area.**

Recommendation

All proposed land use changes in the study should be reviewed with consideration for compatibility with the proposed northwest Dade County airport. In addition, the proposed northwest Dade County airport should be planned with consideration given to the existing and proposed land uses in the area.

III. NATURAL SYSTEMS

A. Water Resources

1. Introduction

The land elevation in the study area is relatively low, and the water table - the Biscayne Aquifer, South Florida's source of drinking water - is close to the surface. Drainage is poor. However, the soils in this area attenuate contaminants better than more mineralized, better drained soils.

Engineering techniques may lower the water table to dry the land and make it suitable for development, but this is likely to accelerate salt water intrusion problems in the eastern part of the region and reduce the already-limited supply of drinking water (Tuckett, 1989). Development involves removing the natural soils which provide a protective layer above the aquifer and replacing them with more porous soils.

2. Water Quantity Issues

a. Water storage and delivery

The continued growth and diversification of South Florida pose unique challenges for water management. Surface and ground water resources know no political boundaries. The study area and the entire South Florida Region is part of a larger hydrologic system. Its origins are in the Kissimmee River Basin north of Lake Okeechobee. The Basin drains south, to Lake Okeechobee. Historically, Lake Okeechobee would overflow its banks during the rainy season, providing a southward sheet flow of water to Florida Bay. Through drainage and hydrologic engineering, the natural system has been altered significantly. Canals have been built to drain the land, provide flood protection, and aid in water delivery to the Everglades Agricultural Area (EAA) and wellfields for Palm Beach, Broward, Dade and Monroe Counties. Water is also delivered to Everglades National Park through this system. Water Conservation Areas (WCAs) have been designed for water storage and fish and wildlife management. The system made South Florida habitable and led to an increasing variety of demands for water resources.

Delivery of water to wellfields is vital to maintaining adequate water supplies as well as minimizing groundwater contamination within the cones of influence for wellfields. During the wet season, rainfall replenishes the aquifer. During the dry season, the wellfields rely on water stored in Lake Okeechobee, the WCAs and the aquifer and delivered through the canal system to replenish the aquifer. During years of normal rainfall, the water levels in the lake reach 15.5 to 17.5 feet national geodetic vertical datum (NGVD) which has allowed for an ample supply of water for use during the dry season (SFWMD, 1989). Water is also stored in the WCAs for the purpose of flood control and maintenance of natural systems. WCAs 3A and 3B are most directly related to the study area. Water is released from the lake to the WCAs during times of low water to supply the areas south and east with drinking water and Everglades National Park with water for ecosystem

management. As demand increases and water becomes more scarce, important policy decisions must be made regarding the priority of water allocation and delivery.

Dade County and the SFWMD have an unwritten agreement that would deliver 500 cubic feet per second of water down the Miami Canal to recharge the Northwest Wellfield. However this water has not been delivered and canal recharge of the wellfield is through the Snapper Creek Extension Canal flowing north from the Tamiami Canal (Hernandez, Dade County DERM, 1990, personal communication). There has been no agreement between the district and Broward County regarding assurances of water delivery during the dry months to the proposed South Regional Wellfield (Shair, Broward County Water Resources Management Division, 1990, personal communication).

The SFWMD has begun implementation of the Surface Water Improvement and Management (SWIM) Plan for Lake Okeechobee. This includes information regarding both water quantity and water quality which will ultimately affect South Florida. The district is currently completing the SWIM plan for the Everglades and WCAs. This also includes both water quality and water quantity issues. The most notable is the allocation of water resources for natural habitat protection as well as public water supply.

b. The Biscayne Aquifer

The main source of water in the study area, and the Region, is the Biscayne Aquifer. This is a highly permeable limestone aquifer capable of high yields with some wells in Miami's municipal system able to pump 7,000 gallons per minute or 10 million gallons per day (MGD) (USACE, 1989). It is also the most intensely used of all Florida's aquifers.

The aquifer is recharged primarily by rainfall, which averages 60 inches in South Florida. Of this, it is estimated that only 20 inches recharge the aquifer; an average of 14 inches runs off into surface waters and the remainder is lost to evaporation and evapotranspiration. Water is also stored in the aquifer for use during times of low water. During times of low rainfall, water is delivered by canals from the water conservation areas and from Lake Okeechobee to the vicinity of the wellfields. Water levels in most canals are controlled by pumps and structures installed to reduce salt water intrusion. This helps maintain the proper groundwater elevation in the wellfields. The canals also provide drainage and flood control.

c. Water level trends

Water levels in the study area historically are high; above the land surface a large part of the year. Drainage for development has lowered the water table and reduced the length of time groundwater is at or above the land surface. Water resources are now part of a managed system of canals and control structures. The SFWMD controls water levels through management of the

primary canal system. Secondary drainage providers regulate water levels in sub-basins throughout the study area in accordance with the criteria and schedules set by the SFWMD.

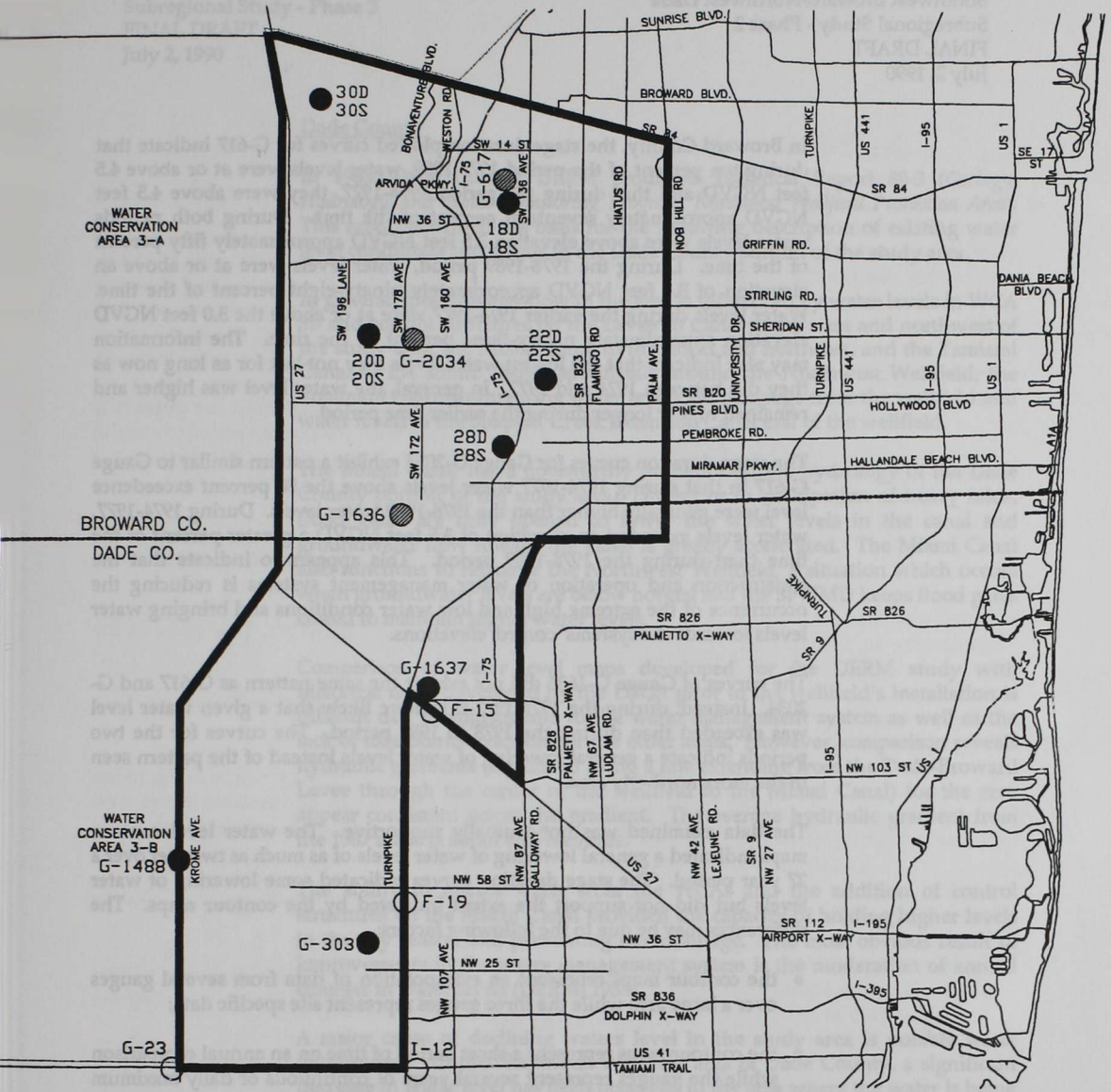
There is no comprehensive groundwater level data for the study area. For this report, data was available from three wells in Broward County (Figure 7) and from the Northwest Wellfield area in Dade County. In order to fully evaluate water resources on a larger than local scale, more comprehensive data must be gathered.

Broward County

Existing water level information within the Broward County portion of the study area includes ground and surface water level gauge records and water level contour maps. Water level contour maps have been prepared by the United States Geological Survey (USGS) twice a year for more than 27 years. Generally, the maps have been produced to show water levels near the end of the wet season and the dry season. These maps were used in the following description of water level trends in Broward County. Gauging stations for both surface and ground water levels are maintained by the USGS with some having periods of record predating 1960. Surface water gauging stations have also been maintained by the South Broward Drainage District and Broward and Dade Counties. Gauge data ranges from continuous-record hydrographs to weekly water level measurements. The gauges are located in the northeast, central, and southern portions of the Broward County portion of the study area. The gauges used for this analysis are G-617, G-2034 and G-1636.

An examination of the water level contour maps for Broward County indicates that water levels within the study area are generally higher in the western areas and decline to the east. There also seems to be a general lowering of water levels within the study area over time. North of the C-11 Canal, water levels seem to have declined approximately one foot in elevation over the last 27 years. It now appears that water elevations of seven feet NGVD and above are less likely to occur or to extend as far east as the maps indicate for the period of and before the early nineteen seventies. This trend appears to be exhibited in both the wet season and the dry season.

In the study area between the C-11 Canal and the C-9 Canal, the water level contour maps seem to indicate a decline over time in water level of approximately two feet. Elevations of six feet NGVD that appear early in the record during the wet season seem to have declined to four feet NGVD with sporadic occurrences of five feet NGVD. Dry season water levels may not have declined to the same extent as wet season water levels, but appear to have changed from a high of six feet NGVD to four feet NGVD and five feet NGVD. The higher water levels of both the wet season and the dry season now appear to be confined to areas closer to WCA 3 than they were prior to the middle nineteen seventies. This constriction seems to be more pronounced between Pines Boulevard and the C-9 Canal than between Pines Boulevard and the C-11 Canal.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Existing Groundwater Monitoring Wells

- Study Area Boundary
- Groundwater Monitoring Wells
- Canal Monitoring Wells
- Groundwater Gauges

Source: United States Geological Survey, Dade County Department of Environmental Resources Management and Broward County Environmental Quality Control Board, Broward County Water Resources Management Division.

FIGURE 7

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May 1990

In Broward County, the stage duration plotted curves for G-617 indicate that during ten percent of the period 1978-1989, water levels were at or above 4.5 feet NGVD and that during the period 1974-1977, they were above 4.5 feet NGVD approximately seventeen percent of the time. During both periods water levels were above elevation 3.5 feet NGVD approximately fifty percent of the time. During the 1978-1989 period, water levels were at or above an elevation of 3.0 feet NGVD approximately ninety-eight percent of the time. Water levels during the earlier 1974-1977 were at or above the 3.0 feet NGVD elevation approximately ninety-three percent of the time. The information may also indicate that the lowest water levels may not last for as long now as they did between 1974 and 1977. In general, the water level was higher and remained higher longer during the earlier time period.

The stage duration curves for Gauge G-2034 exhibit a pattern similar to Gauge G-617 in that during 1974-1977 water levels above the 50 percent exceedence level were generally higher than the 1978-1989 water levels. During 1974-1977, water levels exceeded an elevation of 3.5 feet NGVD a greater percent of the time than during the 1978-1989 period. This appears to indicate that the construction and operation of water management systems is reducing the occurrence of the extreme high and low water conditions and bringing water levels towards the systems' control elevations.

The curves of Gauge G-1636 did not exhibit the same pattern as G-617 and G-2034. Instead, during the 1974-1977 it is more likely that a given water level was exceeded than during the 1978 to 1989 period. The curves for the two periods indicate a general lowering of water levels instead of the pattern seen in the more northerly area.

The data examined was not mutually supportive. The water level contour maps indicated a general lowering of water levels of as much as two feet over a 27 year period. The stage duration curves indicated some lowering of water levels but did not support the extent indicated by the contour maps. The differences may be due to the following factors:

- the contour maps represent an extrapolation of data from several gauges over a large area while the three gauges represent site specific data;
- the contour maps represent a short period of time on an annual comparison while the gauges represent several years of continuous or daily maximum groundwater levels; and
- surface water effects may be more strongly represented in the contour maps.

Therefore, the gauges may not be representative of the general conditions within the study area and the contour maps may not represent the condition at a specific location or time.

Dade County

In 1988, Dade County DERM produced Technical Report 88-3 (*Geology, Hydrology, and Water Monitoring Program, Northwest Wellfield Protection Area*). This report provided the basis for the following description of existing water level conditions and trends in the Dade County portion of the study area.

In general, groundwater flow in the area is influenced by water levels in WCA 3B and control structures on the Levee 30 Canal to the west and northwest of the study area, the Miami Canal to the north and northeast, and the Tamiami Canal to the south. More specifically around the Northwest Wellfield, the dominant factors influencing water levels are pumpage from the wellfield and water levels in the Snapper Creek Extension Canal east of the wellfield.

The Miami Canal has a noteworthy influence on the hydrology of the Dade County portion of the study area. During or in anticipation of heavy rains, flood gates are fully opened to lower the water levels in the canal and groundwater flow toward the canal is greatly accelerated. The Miami Canal also functions to recharge the Northwest Wellfield, a situation which occurs when groundwater levels are below normal and the SFWMD keeps flood gates closed to maintain higher water levels.

Comparison of water level maps developed for the DERM study with historical maps developed by the USGS prior to the wellfield's installation is difficult due to adjustments to the water management system as well as the lack of data points available for the older maps. However, comparison reveals hydraulic gradients (calculated along a line extending from the Dade-Broward Levee through the center of the wellfield to the Miami Canal) for the area appear consistent across the gradient. The average hydraulic gradient from the 1987 maps is about 0.25 feet/mile.

The ability to release water from the WCAs and the addition of control structures on the Miami Canal provided the capacity of holding higher levels in the dry season and preventing overdrainage. The most obvious result of improvements in the water management system is the moderation of annual changes in water levels (DERM, 1988).

A major cause of declining waters level in the study area is potable water withdrawals. In the Northwest Wellfield area of Dade County, a significant decrease in water level has been observed in the area where the water is being withdrawn.

Decision makers will continue to confront the issues of water delivery for public supply competing with the need for water for agriculture, industry and natural resource protection and enhancement. There is a continuing attempt to balance the allocation of water throughout not only the study area, but the Region. The system must be able to supply enough water of adequate quality to sustain hydrologically sensitive habitats, recharge wellfields from which potable water is drawn, and support agriculture.

3. Water Quality Issues

a. Land use patterns

The major findings and recommendations of a study on land use issues in an area encompassing the Broward County portion of the study area, *Southwest Broward County Study* (SFWMD, 1982) found that the physical and chemical characteristics of the aquifer limit the mobility of many contaminants and that water quality in the area was generally poor. Specifically, the study noted increases in chloride concentrations since 1971, and color and dissolved oxygen exceeding EPA standards. With respect to land uses, the study concluded that general water quality in the study area should not degrade if future development proceeds in accordance with the recommendations of the 1982 *Southwest Broward County Study* and use of best management practices are incorporated into surface water management systems. The major recommendations of the 1982 study were as follows:

- Industrial Zoning Categories should be reevaluated based on potential adverse water resource impacts.
- Broward County should initiate a program to evaluate those areas in the study area with potential for wellfield development.
- Broward County should develop a wellfield protection ordinance for cones of influence.
- Landfill sites should be evaluated with consideration given to depth to the water table. Landfill design should incorporate impermeable liners with leachate collection and treatment facilities to prevent contamination of the aquifer.
- A study should be undertaken to determine the effect of septic tanks on the study area.
- A vigorous program at the local level requiring the incorporation of best management practices into new drainage systems is necessary to protect the surface water quality of the area.
- A comprehensive monitoring program needs to be conducted to more closely assess the shifts in water quality brought about by urban development.

Many of the recommendations of the SFWMD's 1982 study of the area have been carried out, including the development of Broward County's wellfield selection and protection program and the location and design of the Broward County Interim Contingency Landfill. While EQCB reports that all of the recommendations have been initiated or addressed, several important recommendations need further development. These include the implementation of a comprehensive water quality monitoring program, development of a vigorous program of best management practices at the local level and the completion of a study of the impact of the septic tanks.

Since 1982, there has been little change in the Dade portion of the study area while Broward has witnessed a general intensification of land uses. Intensive rock mining has occurred in both portions of the study area. Between 1979 and 1985 the Florida Department of Environmental Regulation (DER) reports receiving 60 permit applications for rock mining in the two counties. Because of the nature of the industry, it can be assumed that most of these applications were in or near the study area. Of these, 50 were exempt from permitting, three were withdrawn, four were issued, two were denied and there was one active (DER, 1985). The U. S. Fish and Wildlife Service has characterized certain aspects of water quality and provided guidance for future protection of habitat disturbed by rock mining in South Florida in a study completed in 1984 (USDI, 1984) Generally, the study concluded:

- there was no pattern showing annual variations of alkalinity and hardness common to all lakes,
- annual variability within a lake for pH, conductivity, and transparency was small,
- annual variations for total phosphorus, total nitrogen, and chlorophyll a varied by lake but were all classified as oligotrophic or oligotrophic-mesotrophic (sterile) lakes, and
- No significant correlation among mean depth, age, or surface area of each lake and total phosphorus, total nitrogen, or chlorophyll a was found.

Another significant trend in land uses in the study area has been the development of plant nurseries in both counties. Because of their heavy use of fertilizers and pesticides, these nurseries may have a significant affect on water quality. These are discussed in greater detail in the next section.

Although designated land use intensities have increased, a large portion of the study area is still planned for very low intensity agricultural uses (maximum densities not to exceed one dwelling unit per two and one half gross acres). As a result, there is continuing pressure for land use changes which increase the overall density, especially in the Broward County portion of the study area.

b. Water quality in the study area

Dade County

In the Dade County portion of the study area, the major pollution concerns are industrial uses, rock mining, illegal dump sites, nursery operations, underground storage tanks and demolition landfills.

Dade County has maintained four ambient surface and three groundwater monitoring stations within the study area since the early 1980s (Figure 7). Land in the vicinity of two of the groundwater monitoring sites (G-1488 and G-3103) is vacant, the third (G-1637) is near an industrial area. In 1983, higher than normal magnesium, sodium and chloride concentrations were detected at

these groundwater stations. 1-2-dichloroethane was found at station G-3103. Water from these stations routinely has high levels of color which increases the trihalomethane (THM) formation potential when this water is used as a source of potable water. Phenol concentrations are also high in this area due to the presence of the exotic plant species Melaleuca. During 1983 canal waters routinely exceeded state and county coliform standards. This is indicative of contamination by human and animal waste.

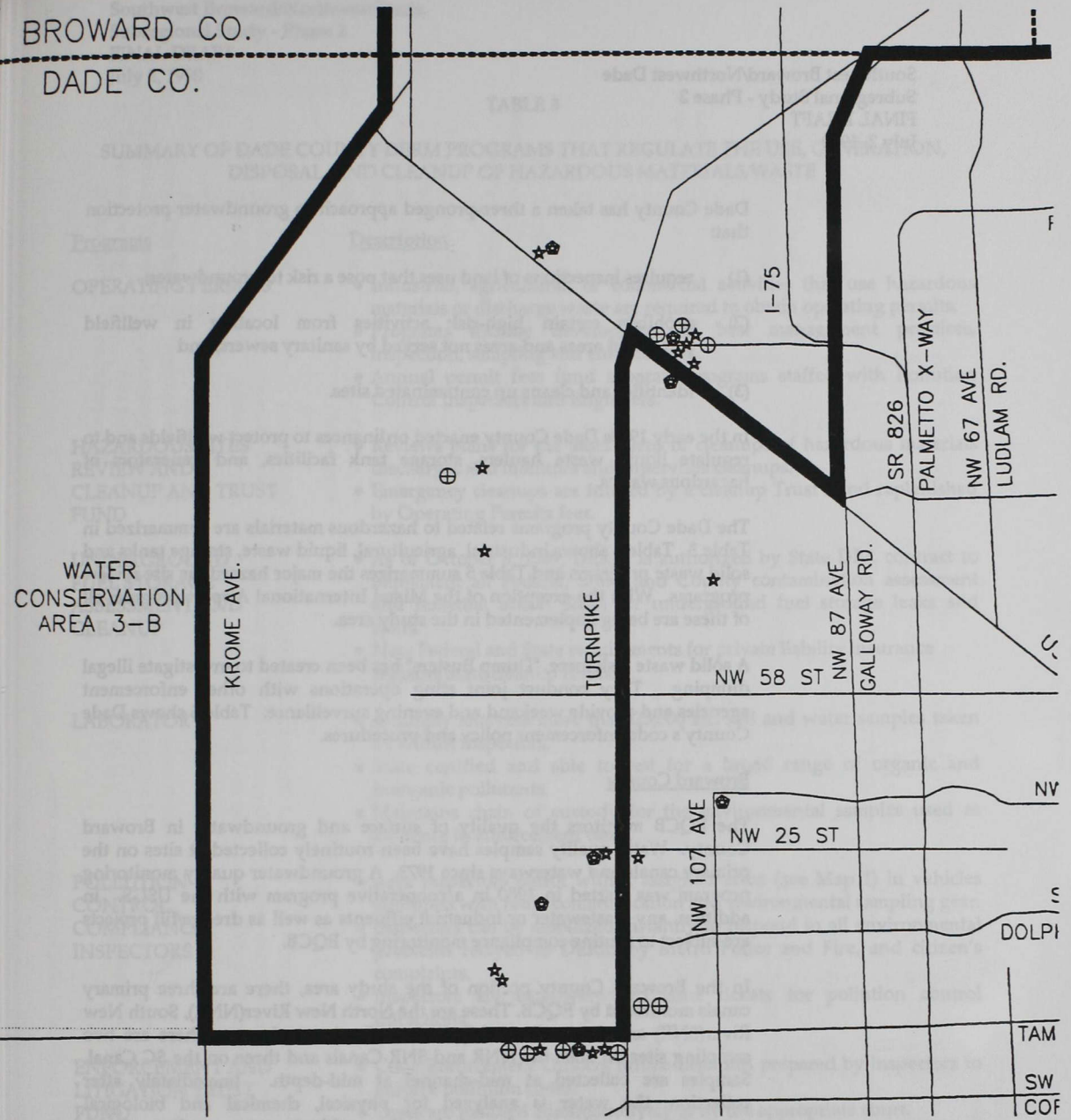
Volatile organic compounds (VOCs) were only sampled from monitoring well G-1488. In 1984 elevated chloride concentrations were found at two wells, probably as a result of canal recharge from mineralized waters originating from the EAA. One of the sites was G-1488. No volatile organics were detected, but high levels of iron were found in two of the wells, possibly due to erosion of the well casings. Higher than average levels of ammonia and total organic nitrogen were found in the canals. This is likely related to high organic matter count in muck soils. Other than agricultural runoff, no other pollution problems were observed in the canals during 1984. No herbicides were detected in surface waters.

In 1985 high levels of color and chloride continued to be found and manganese was above average at two wells. Selenium, which is indicative of pollution from paints, dyes, electrical apparatus and insecticide sprays, exceeded water quality standards at two wells during the dry season. All canals exceeded county and state standards for coliform bacteria.

Since 1986, the Dade County ambient groundwater monitoring network in the study area was augmented by the addition of almost 50 sampling stations as part of the Northwest Wellfield project. These include deep (55 feet) and shallow (20 feet) wells, two surface water sites in the Snapper Creek Canal, one surface water site along the Miami Canal and sampling from two of the production wells. Twenty-two of these stations are located within the study area.

Currently, Dade County tests water samples bimonthly for ammonia and chlorides, and annually for 220 synthetic chemicals such as volatile organics, phthalates, chlorinated pesticides and hydrocarbons. There have been no detections of organics in the study area since 1986, nor were organophosphates or carbonate pesticides detected during a one time sampling of the shallow wells. To the east of the study area, toluene and dichlorobenezene have been detected in the vicinity of the 58th Street landfill and resources recovery plant. The levels of ammonia and chloride compounds within the study area reflect uncontaminated, background conditions.

To illustrate the proliferation of underground storage tanks and their potential for contamination, Figure 8 shows the locations of the tanks in Dade County with probable fuel leaks and industrial waste sites.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Sites Storing Hazardous Materials in Dade County

Study Area Boundary

- ☆ Facilities using & storing small quantities of hazardous materials
- ⬟ Facilities using & storing large quantities of hazardous materials
- ⊕ Underground Petrochemical Storage

Source: Dade County DERM.

FIGURE 8

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May 1990

Dade County has taken a three-pronged approach to groundwater protection that:

(1) requires inspections of land uses that pose a risk to groundwater;

(2) prohibits certain high-risk activities from locating in wellfield protection areas and areas not served by sanitary sewers; and

(3) identifies and cleans up contaminated sites.

In the early 1980s Dade County enacted ordinances to protect wellfields and to regulate liquid waste haulers, storage tank facilities, and generators of hazardous wastes.

The Dade County programs related to hazardous materials are summarized in Table 3. Table 4 shows industrial, agricultural, liquid waste, storage tanks and solid waste programs and Table 5 summarizes the major hazardous site review programs. With the exception of the Miami International Airport program all of these are being implemented in the study area.

A solid waste task force, "Dump Busters" has been created to investigate illegal dumping. They conduct joint sting operations with other enforcement agencies and provide weekend and evening surveillance. Table 6 shows Dade County's code enforcement policy and procedures.

Broward County

The EQCB monitors the quality of surface and groundwater in Broward County. Water quality samples have been routinely collected at sites on the primary canals and waterways since 1973. A groundwater quality monitoring program was started in 1980 in a cooperative program with the USGS. In addition, any wastewater or industrial effluents as well as dredge/fill projects are subject to routine compliance monitoring by EQCB.

In the Broward County portion of the study area, there are three primary canals monitored by EQCB. These are the North New River(NNR), South New River(SNR) and Snake Creek(SC) Canals. In the study area, there are two sampling sites on both the NNR and SNR Canals and three on the SC Canal. Samples are collected at mid-channel at mid-depth. Immediately after collection, the water is analyzed for physical, chemical and biological parameters in order to characterize the ambient water quality of the waterways. Samples are analyzed for temperature, turbidity, pH, specific conductance, salinity, dissolved oxygen, biochemical oxygen demand (7-day), total organic carbon, organic nitrogen, total ammonia nitrogen, total nitrogen, nitrates, nitrites, total nitrogen, total phosphorous, and the bacteriological indicators - total coliform, fecal coliform and fecal streptococci. Each of these tests defines a specific condition of the aquatic system.

TABLE 3

SUMMARY OF DADE COUNTY DERM PROGRAMS THAT REGULATE THE USE, GENERATION, DISPOSAL, AND CLEANUP OF HAZARDOUS MATERIALS/WASTE

Programs	Description
OPERATING PERMITS	• Industrial, agricultural, or commercial activities that use hazardous materials or discharge waste are required to obtain operating permits. • Programs include development of best management practices, inspection, sampling and enforcement. • Annual permit fees fund separate programs staffed with Pollution Control Inspectors and Engineers.
HAZARDOUS SITES REVIEW AND CLEANUP AND TRUST FUND	• Reviews plans for the assessment of cleanups of hazardous materials discharges and monitors and supervises cleanups. • Emergency cleanups are funded by a cleanup Trust Fund replenished by Operating Permits fees.
UNDERGROUND FUEL STORAGE ASSESSMENT AND CLEANUP	• As of October 3, 1989, DERM is authorized by State DER contract to implement all Federal, State, and County contamination assessment and remedial action plans for underground fuel storage leaks and spills. • New Federal and State requirements for private liability insurance replaces State cleanup funds.
LABORATORY	• Annually analyzes more than 25,000 air, soil and water samples taken by DERM inspectors. • State certified and able to test for a broad range of organic and inorganic pollutants. • Maintains chain of custody for the environmental samples used as evidence in enforcement cases.
POLLUTION CONTROL COMPLIANCE INSPECTORS	• Area inspectors patrol within assigned areas (see Map 1) in vehicles equipped with radio communication and environmental sampling gear. • Inspectors can be mobilized instantly to respond to all environmental problems relayed to DERM by Metro Police and Fire, and citizen's complaints. • Inspectors are empowered to issue tickets for pollution control infractions.
ENFORCEMENT AND LITIGATION TRUST FUND	• Code Enforcement Officers utilize case files prepared by inspectors to enforce pollution codes. • Cases are handled administratively or by the appropriate court. • Monetary penalties obtained from litigation are used to finance DERM enforcement activities.
THE SPECIAL TASK FORCE	• Teams are comprised of staff from the Compliance Inspectors Program in cooperation with the FBI and Metro Police on Federal investigations. • Teams provide around the clock surveillance to meet special enforcement needs.

SOURCE: Metro Dade Department of Environmental Resources Management, 1990

TABLE 4

DADE COUNTY
COUNTYWIDE OPERATING PERMITS PROGRAMS

Pollution Source	Permit Program	Description	Examples of Facilities	Types of Hazardous Materials/Waste
Industrial	IW*	Operating permits are required from all activities which: 1. generate hazardous waste 2. discharge wastewater to the ground 3. use or store hazardous materials and are on septic tanks. Permitted activities are subject to best management practices, inspections, permit conditions, and may require pretreatment prior to discharge.	Electroplating, tank farms, engine repair, textile dyeing	Any one of 934 hazardous materials on DERM's published list
Agricultural	AW	Packing houses, agrichemical and fuel storage and handling, and farm machine repair facilities are permitted and inspected for adoption of best management practices.	Packing houses, farm machine maintenance facilities	waste oil, produce washwater agrichemicals
Liquid Waste	LIQUID WASTE HAULER	Commercial haulers of all liquid, industrial, hazardous, and biohazardous waste are required to submit monthly reports to DERM for quantity, type and destination of waste, including Federal manifests documenting origin to delivery of all hazardous wastes.	Septic tank pumpout trucks, sludge haulers, waste oil and biohazardous transporters	oil and radiator fluid, septic and sludge, hazardous and biohazardous materials
Fuel and Chemical Storage	STORAGE* TANKS	All new and existing underground storage tanks holding fuel or hazardous materials must maintain monthly inventory records, stall, monitoring wells, and comply with installation and containment regulations.	Gas stations, Chemical supply, Airport fueling.	fuels, solvents, synthetic chemicals
Solid Waste	RESOURCE* RECOVERY FACILITIES	All public and private facilities which receive, compost, recycle, or landfill solid waste are reviewed and permitted for facility location and operational practices.	Resources Recovery, landfill operations, composting and recycling operations	all solid waste including demolition debris, but not hazardous

* Facilities generally prohibited as new uses in most wellfield protection areas.

TABLE 5

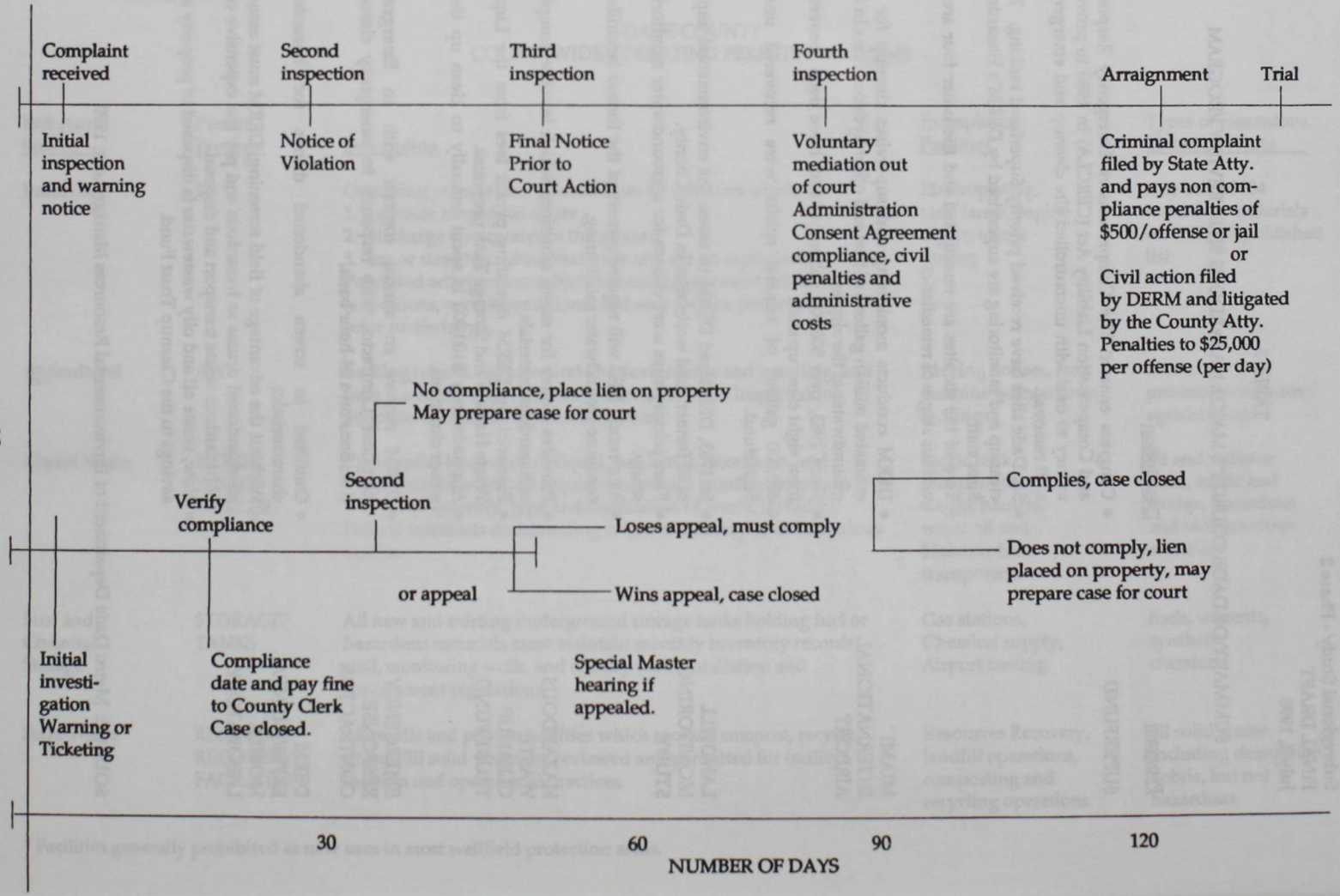
SUMMARY OF DADE COUNTY'S MAJOR HAZARDOUS SITES REVIEW PROGRAM

Program	Description
SUPERFUND	• Congress enacted The Comprehensive Emergency Response and Compensation Liability Act (CERCLA) in 1980 to provide money to deal with uncontrolled site cleanup and emergency spill removal. • Six Dade sites have received priority Superfund ranking. The cleanup and monitoring are supervised by DERM's Hazardous Sites staff. • Two of the six sites are remediated and the other four are in various stages of remediation.
MIAMI INTERNATIONAL AIRPORT	• DERM conducts monitoring and supervises cleanup for an estimated million gallons of fuel and other hydrocarbons in the groundwater at the airport. • Since 1983, over 300,000 gallons of fuel have been recovered from eight clean up sites. • 400,000 gallons of mineral spirits were recovered under Superfund.
LANDFILL MONITORING STUDY	• In 1983, DER hired DERM to assess the environmental impact of 50 former solid waste sites in Dade County. • Four priority sites were chosen for a groundwater monitoring study. • As a result, DER will require owners of the former landfills to continue groundwater monitoring.
HAZARDOUS WASTE CLEANUP TRUST FUND	• Provides money for minor situations which involve dumping of hazardous materials. • Financed by DERM operating permit fees from the Liquid Waste Haulers and Storage Tank programs. • Approximately $100,000 is spent annually to clean up these minor situations.
EMERGENCY RESPONSE CONTRACTOR	• DERM renews an annual contract with an Emergency Response Contractor who responds to emergency cleanup situations on a 24-hour basis.
DERM EXPERIMENTAL MOBILE LABORATORY	• Outfitted to screen abandoned drums for hazardous characteristics. • Without the advantage of field screening, DERM must assume all abandoned drums as hazardous and pay the expensive cost of hazardous waste transport and disposal. • Now, waste oil and oily wastewater is disposed of properly at a savings to the Cleanup Trust Fund.

SOURCE: Metro Dade Department of Environmental Resources Management, 1990

TABLE 6

DADE COUNTY'S CODE ENFORCEMENT POLICY AND PROCEDURES



Water quality standards for many of these parameters, but not all, have been set by the State of Florida (Chapter 17-3, F.A.C.) to carry out the purpose of the Clean Water Act and by the EQCB Code of Regulations. All of the canals and waterways in Broward County have been designated by the state as Class III for recreational use and propagation of fish and wildlife. This is the regulated use for which water quality standards have been set (Chapter 17-3, F.A.C. and BCEQCB CR, Ch. 27-5).

While there is not a standard for specific conductance, it is a useful indicator of the origin of a water mass and can be useful in the detection of highly mineralized discharges. The western reaches of the primary canals, especially in the study area, have a much higher mineral content than the eastern, urbanized reaches. (The mineral content is measured indirectly by specific conductance.) The high specific conductance readings for stations in the western reaches of the primary canals reflect origin of the waters in these canals: the conservation areas and groundwater. Fresh water in the eastern reaches of the primary canals is primarily from the immediate urban drainage basin and reflects the lower mineral content of urban runoff.

The stations in the western reaches of the primary canals in Broward County and the canals that discharge to WCA 3A continue to demonstrate low levels of oxygen with frequent violations of the county's 4.0 mg/l standard that was typical of the area in 1989. Total organic carbon (TOC) continued to be high for the western reaches of the primary canals and canals that discharged into WCA 3A during 1989 and low in the eastern reaches and tidal waters of the county. TOC levels tend to be low for stations with high dissolved oxygen levels and high for stations with low dissolved oxygen levels.

Nutrient concentrations for 1989 were low and reflect the fact that it was a dry year. The lowest concentration of phosphorous occurred in the western reaches of the Snake Creek, South New River, and North New River Canals. By comparison the phosphorous concentrations of the Hillsboro canal and the canals discharging from the agricultural areas of Palm Beach County into Conservation Area 3A, however, were high. Total Nitrogen (TN) levels tend to be higher than the county's 1.5 mg/l standard in all western reaches of the primary canals and the discharge canals to the WCA 3A. Annual average TN concentrations were highest for the Hillsboro and South New River Canals.

In general, the water quality of a canal or waterway reflects the uses of the lands from which it drains. Direct urban and rural area runoff contaminated with wastes; direct and indirect discharges from wastewater treatment plants, industry, and other businesses; and contaminated groundwater seepage from septic tank areas and agricultural areas constitute the major sources of pollution of the canal system.

Historically, municipal and private sewage treatment plants discharged millions of gallons a day of treated wastes into canals and waterways. Consequently, many of these receiving waters could not meet water quality standards and thus could not support the designated use for recreation and propagation of fish and wildlife.

Overall, water quality in the primary canals and waterways in Broward County has improved since the early 1980's when direct discharge of treated sewage into surface waters was common. In addition, the requirement of best management practices for stormwater management has helped improve surface water quality. Dissolved oxygen, nutrient concentrations, and bacteria are probably the best indicators of this overall improvement in water quality. In those waters that had historically received discharges from wastewater treatment plants, dissolved oxygen levels have risen to levels that can again support desirable species of fish and other aquatic organisms; and nutrient concentrations and bacteria indicators of fecal contamination have dramatically dropped to all time lows.

The EQCB has a county-wide groundwater quality monitoring program that includes 61 wells at 30 locations. Initially, the sampling locations were selected to provide a network of wells that allow the quality of water flowing to and in the major wellfields to be monitored. However, the need to characterize and monitor the quality of groundwater in more rural areas of the county resulted in the installation of additional well clusters in Parkland and southwest Broward, in response to the recommendation made in the South Florida Water Management District's *Southwest Broward Study*, 1982. Today there are five monitoring well locations within the study area, each location having a shallow and a deep well. The shallow wells range from 11 feet to 34 feet in depth and the deep wells range from 60 feet to 95 feet in depth. Shallow and deep wells have the same identification number with the shallow well indicated by the letter 'A' in the ID number. Figure 7 shows the location of the wells and Table 7 lists the wells by name and identification number. The wells at site 30 are representative of waters seeping from the WCA 3A into the study area, wells at locations 18 and 20 are more representative of low density residential, wells at location 22 are representative of a recreational area and wells at location 28 are representative of the undeveloped area in the southern portion of the Broward County section of the study area. Samples are collected semiannually and analyzed for the water quality constituents listed in Table 8.

Groundwater contains a wide variety of dissolved inorganic and organic chemical constituents in various concentrations. These result from chemical and biological interactions between groundwater and the geologic materials through which it flows. The inorganic constituents are normally classified according to relative abundance. The major constituents occur mainly in ionic form and are commonly referred to as major ions. The six major ions are calcium, magnesium, sodium, bicarbonate, chloride, and sulfate. Usually, these six ions occur in concentrations greater than five milligrams per liter (mg/l) and account for over 90 percent of the total dissolved solids in water. Boron, carbonate, fluoride, iron, nitrate-nitrogen, potassium, and strontium are usually minor constituents occurring at concentrations between 0.01 mg/l and 10 mg/l. Inorganic constituents usually occurring at less than 0.1 mg/l are classified as trace constituents. The presence and concentration of the numerous trace elements are dependent upon the mineralogy of the geological formation of the aquifer. Natural conditions and activities of man can cause these constituents to be found at higher levels.

TABLE 7

BROWARD COUNTY AMBIENT GROUNDWATER QUALITY MONITORING WELLS

Map #	Name	I.D. #	Depth	Lat/Long
18D	West Davie	G-2365	22.5	260505080204701
18S	West Davie	G-2365A	7.8	260505080204702
20D	W. Rolling Oaks	G-2368	18.1	260202080230701
20S	W. Rolling Oaks	G-2368A	3.5	260202080230702
22D	C.B. Smith Park	G-2369	20.6	260046080190701
22S	C.B. Smith Park	G-2369A	5.2	260046080190702
28D	Flamingo	G-2374	29.0	255905080194001
28S	Flamingo	G-2374A	10.4	255905080194002
30D	Weston	G-2373	18.3	260752080253701
30S	Weston	G-2373A	6.4	260752080253702

SOURCE: EQCB, 1989

TABLE 8

WATER QUALITY CONSTITUTENTS TESTED IN BROWARD COUNTY EQCB AMBIENT GROUNDWATER QUALITY MONITORING PROGRAM

1. Water temperature
2. Specific Conductance
3. pH
4. Nitrite-Nitrogen
5. Total Ammonia-Nitrogen
6. Ortho-Phosphate-Phosphorus
7. Sodium
8. Potassium
9. Calcium
10. Magnesium
11. Chloride
12. Sulfate
13. Iron
14. Fluoride
15. Nitrate-Nitrogen
16. Carbonate
17. Bicarbonate
18. Alkalinity
19. Total Dissolved Solids
20. Total Organic Carbon
21. Mercury
22. Cadmium
23. Copper
24. Zinc
25. Arsenic
26. Lead
27. Barium
28. Manganese
29. Nickel
30. Chromium
31. Selenium
32. Silver
33. Cyanide
34. Benzene
35. Bromodichloromethane
36. Bromoform
37. Bromomethane
38. Carbon Tetrachloride
39. Chlorobenzene
40. Chloroethane
41. 2-Chloroethylvinyl Ether
42. Chloroform
43. Chloromethane
44. Dibromochloromethane
45. Dichlorodifluoromethane
46. 1,1-Dichloroethane
47. 1,2-Dichloroethane
48. 1,1-Dichloroethane
49. Trans-1,2 Dichloroethane
50. 1,2 Dichloropropane
51. CIS-1,3 Dichloropropene
52. Trans-1,3 Dichloropropene
53. Ethyl Benzene
54. Methylene Chloride
55. 1,1,2,2-Tetrachloroethane
56. Tetrachloroethane
57. 1,1,1-Trichloroethane
58. 1,1,2-Trichloroethane
59. Trichloroethene
60. Trichlorofluoromethane
61. Toluene
62. Vinyl Chloride
63. 1,2-Dibromoethane
64. 1,3-Dichlorobenzene
65. 1,4-Dichlorobenzene
66. 1,2-Dichlorobenzene

SOURCE: EQCB, 1989

The total concentration of the six major ions make up the bulk of the total dissolved solids. Groundwater contamination usually results in a change in the total dissolved solids and in the relative abundance of the major ions. In general the water type of the study area is Calcium-bicarbonate.

The data shows that the water (both shallow and deep) in the northwest part of the study area tends to be quite different from the rest of the study area. Sodium, chloride, and magnesium account for a greater percentage of the total dissolved solids than in the other wells. The sulfate ion is also absent at this location and the total dissolved solids concentration are much higher than in other parts of the study area.

The EQCB and DER standard for total dissolved solids is 500 mg/l. Samples from wells G-30D, G-30S, G-20D, G-20S, G-18D, and G-18S typically exceed this value. However, there have been no exceedences of the DER secondary drinking water standards for sodium, chloride, or sulfate.

The concentrations of various forms of nitrogen (nitrate, nitrite, and ammonia) along with iron (Fe) and total organic carbon (TOC) also are quite variable with depth and among individual monitoring locations. In general, nitrates(NO3-N) and nitrites(NO2- N) tend to be high; and Fe, TOC and ammonia(NH4-N) tend to be low in the shallow wells in residential and recreational area locations while the opposite in deeper wells at the same location and the wells at the undeveloped locations in the study area. This is suggestive of the use of fertilizers and septic tanks in residential areas, farms, and recreational areas impacting on the quality of water in the shallow portion of the aquifer. The State standard for NO3-N is 10 mg/l. The concentration of NO3-N in several samples from Well G-20S in the residential area and well G-18S located on a small farm (in close proximity to the septic tank and drinking water well) exceeded this value. The potable well for the farm house and stock water well near the barn were also sampled and NO3-N concentrations were 9.64 mg/l for the potable well but none was detected the stock watering well. The owner was able to change over to his barn well and abandon his house well to supply drinking water to the house.

Heavy metals are typically non-detected or found at trace concentrations in the study area. While one sample from G-2373A in 1987 had a concentration of 34 micrograms per liter (ug/l) of cadmium that exceeds the EQCB groundwater standard and State drinking water standard of 10 ug/l, no other samples from this well or other wells have concentrations of heavy metals that exceed appropriate standards. This single, isolated exceedence is not indicative of a problem.

Contamination of groundwater and drinking water supplies by volatile organic compounds (VOCs) has been the major ground water contamination problem in South Florida. Contamination of groundwater with VOCs is primarily related to the industrial use.

Over the past four years of monitoring there have been no positive detections of VOCs in the ten monitoring wells in the study area. However, the groundwater south of the Broward County Landfill, Davie, and a few residential wells in Sunshine Ranches above Palomino Road have been found to contain vinyl chloride at concentrations at and below five ug/L. Traces of toluene and benzene have also been detected in the plume emanating from the landfill.

The EQCB programs for resource protection include hazardous materials control, wastewater discharge effluent regulations, underground storage tanks, ground and surface water quality, and wellfield protection. The Water Pollution Control Program is divided into two sections; the Industrial Section and the Domestic Section. The Industrial Section basically has twelve programs: Storage Tank Licensing, Compliance Verification, Hazardous Material Licensing, Hazardous Waste Assessment, Infectious Waste Licensing, Industrial Sludge Hauler Licensing, Transfer Station Licensing, Industrial Wastewater Treatment Licensing, Industrial Pre-treatment Licensing, Wellfield Protection, Early Detection Incentive, and Environmental Assessment. Tables 9 and 10 describe the Industrial and Domestic Section Activities. Table 11 lists contaminated sites within the study area involved in settlement and/or remediation through the Broward County EQCB.

TABLE 9

BROWARD COUNTY
INDUSTRIAL SECTION ACTIVITIES

Permit Program	Description
Storage Tank Program Licensing	There were estimated to be 1,202 facilities in Broward County at the end of this fiscal year. Licenses require the following: the number and size of the storage tanks on site and their installation date; plus the installation of various preventive devices such as monitor wells, line leak detectors, overfill protection, secondary containment and other anti-spell devices. In addition the license applies conditions to the operation, construction or closure of the facility.
Compliance Verification	EQCB conducts on-site inspections to verify proper record keeping, accuracy of reported information, compliance with underground tank and piping retrofit dates, compliance with tank closure and/or abandonment requirements, that construction work is done by specialty contractors specifically licensed for this work, that all preventive devices are in place and operating properly, that facilities within wellfield areas have proper secondary containment if required, that no spills are detectable in monitor wells, and that motor fuel registration placard is properly displayed.
Hazardous Material Licensing	Any facility within Broward County that uses, handles, or stores hazardous materials or generates hazardous waste is required to obtain an EQCB Hazardous Material License.
Hazardous Waste Assessment	EQCB has now completed the fifth year of the survey. The contractor list originally contained 8,800 names. This list was expanded by EQCB to about 30,000 names and then winnowed down to 10,934 of which 8,860 were the original list. Of these firms, 2,341 or 21.41 percent were hazardous waste generators, 5,321 or 48.66 percent were non-generators, and 3,272 or 29.93 percent were out of business.
Infectious Waste Licensing	The purpose is to register all generators, haulers, transfer stations and disposers of infectious waste within the County.
Industrial Sludge Hauler Licensing	Companies that transport and pick up or drop off hazardous wastes within Broward County are required to obtain an EQCB Industrial Sludge Hauler License.

Transfer Station Licensing	There are no lawful disposal sites for hazardous wastes within Broward County; however, numerous facilities treat or temporarily store hazardous wastes before shipping them to other disposers or reclaimers. These facilities are required to be licensed by EQCB, which periodically inspects them for compliance with license conditions and local, state, and federal regulations.
Industrial Wastewater Treatment Licensing	Since 1984, EQCB regulations permit no new industrial wastewater discharges to ground or surface water other than through a sanitary sewer system to a wastewater treatment plant. Industrial Wastewater Treatment licenses are issued only to direct dischargers of industrial effluent to drainfields, etc., if their discharges existed prior to 1984.
Industrial Pre-treatment Licensing	Industrial users that produce wastewater that may be deleterious to industrial plant processes or, if they dispose of significant amounts of hazardous materials, are licensed and required to maintain effluents within plant or federal categorical standards, in order to protect the facility, the receiving waters, and to produce Class I sludge in their solids processing.
Wellfield Protection	In mid-April of 1989, the County Commission transferred the responsibility for the Wellfield Protection program from the Water Resources Management Division of the Office of Environmental Services to the EQCB. Prior study had indicated that EQCB Haz Mat licenses provided more protection than Wellfield Protection licenses in Zone 3. Therefore, all firms with Haz Mat licenses in that zone were notified that the Wellfield license was no longer necessary. In the event that firms held Wellfield licenses and not Haz Mat, the wellfield licenses remained in effect until the Haz Mats were obtained. At present there are 104 outstanding Haz Mat Wellfield licenses for Zones 1 and 2.
Early Detection Incentive	The EDI program deals with the cleanup of storage tank facilities that are contaminated with petroleum products used as vehicular fuels.
Environmental Assessment	This is a contamination cleanup program which deals with sites that have chemical contamination by hazardous materials of any sort as well as petroleum products and that are not eligible for the Early Detection Incentive Program.

SOURCE: Broward County Environmental Quality Control Board, 1990

TABLE 10

BROWARD COUNTY
DOMESTIC SECTION ACTIVITIES

Permit Program	Description
Front Desk - Construction Plan Review	The primary duty of this group is the review of construction plans prior to building permit approval for those uses requiring EQCB approval.
Domestic Sludge Hauler Licensing	Companies and vehicles that haul domestic wastes from septic tanks, grease traps, ships, wastewater treatment plants, lift stations, and wet wells, are required to be licensed by EQCB.
Wastewater Collection System Licensing	Construction plans are reviewed and licenses for both EQCB and DER are issued for wastewater collection systems.
Plat and Site Plan Review	Applications for plat and/or site plan approvals are reviewed for wastewater treatment plant capacity, possible air pollution problems, possible industrial problems or licensing requirements, site contamination, etc.
Wastewater Treatment Plant Licensing	Both existing and new wastewater treatment plants are licensed. If wastewater capacity is under .5 MGD, the EQCB also does the State permitting in addition to EQCB licensing.

SOURCE: Broward County Environmental Quality Control Board, 1990

TABLE 11

BROWARD COUNTY
CONTAMINATED SITES

Name/Address	EQCB ID# Lead Agency	Comments
HAZARDOUS WASTE		
1. Broward County Landfill 4001 S.W. 142 Ave., Davie	88050790 EPA	Formal closure - SUPERFUND Start date - 5/88
2. Community Asphalt Corp. 17351 Hollywood Blvd.	85100166 DER	RISK ASSESSMENT Start date - 10/85
3. Diesel Truck Spill 19600 Pines Blvd., Pembroke Pines	88050775 EQCB	Informal closure - INACTIVE Start date - 5/88
4. Ireco Chemicals, Inc. 4101 S.W. 196th Ave., Miramar, FL 33332	85080534 EQCB	Informal closure - INACTIVE Start date - 8/85
5. Mack Industries 3501 S.W. 172nd Ave., Miramar, FL 33027	88040739 EQCB	Informal closure - INACTIVE Start date - 4/88
6. Parcel #1, Shops at Cooper City Flamingo Rd. at Sheridan St. Cooper City	87070469 EQCB	Informal closure - INACTIVE Start date - 7/87
7. Scott Systems, Inc. Pines Blvd. at Palm Ave. Pembroke Pines	87100578 EQCB	Informal closure- Start date - 10/87
8. Bonaventure Golf Course 200 Bonaventure Blvd. Fort Lauderdale, FL 33326	89091049 EQCB	Formal closure - Process involving necessary ground-water/soil remediation Start date - 9/88
9. CB Smith Park 900 North Flamingo Rd.	89051002 EQCB	Informal closure - Process involving necessary soil remediation Start date - 9/88
10. Century Village Maintenance Facility	89101078 EQCB	Rick assessment Start date - 10/89

	Name/Address	EQCB ID# Lead Agency	Comments
PETROLEUM			
1.	Florida Offset/Gannett Co., Inc. 10315 USA Today Way Miramar, Florida 33025	06-0016	Low level contamination, conducting monitoring only, remediation may be required in future depending on results of monitoring
2.	Amoco Station #17024 10070 Pines Blvd. Pembroke Pines, Florida 33025	06-8958	REIMBURSEMENT. Contamination assessment report has been approved, remedial action plan to be prepared
3.	Farm Store #1067 12351 Northwest 18th Street Pembroke Pines, Florida 33026	06-5918	State cleanup site
4.	Farm Store #1061 11345 Stirling Road Cooper City, Florida 33026	06-6151	State cleanup site
5.	Mobil Station #02-608 12351 Taft Street Pembroke Pines, Florida 33026	06-7024	State cleanup site
6.	Rinker Materials, Pembroke Pines 17301 Pines Boulevard Pembroke Pines, Florida 33026	06-7036	State cleanup site
7.	Mobil Station #02-AMC 200 Southwest Flamingo Road Pembroke Pines, Florida 33027	06-7025	State cleanup site
8.	Cherokee Crushed Stone, Inc. 17351 West Pines Boulevard Pembroke Pines, Florida 33029	06-8556	REIMBURSEMENT. Contamination assessment report defining extent of contamination being prepared
9.	Cumberland Farms #0951 12450 State Road 84 Fort Lauderdale, Florida 33325	06-2873	REIMBURSEMENT. State DE reviewing remedial action plan
10.	Shell Station, Westgate 16000 State Road 84 Sunrise, Florida 33326	06-6837	REIMBURSEMENT. Contamination assessment report of contamination being prepared

11.	Mobil Station #02-AER 15988 State Road 84 Sunrise, Florida 33326	06-7021	State cleanup site
12.	Cooper City, City of Public Works Department 11551 Southwest 49th Street Cooper City, Florida 33330	06-0471	REIMBURSEMENT, in remediation
13.	Imagination Farms 13000 West Orange Drive Davie, Florida 33330	06-6833	REIMBURSEMENT, under investigation

SOURCE: Broward County, Environmental Quality Control Board, 1990

Florida Department of Environmental Regulation Programs

In 1984, FDER completed surface water quality assessments for south Broward County and north Dade County. There are 12 sampling sites within the study area, all in primary or secondary drainage canals. The assessment showed that most of the canals did not meet state water quality standards. Within the study area, the most prevalent problem was low dissolved oxygen, indicating little biological activity and a low level of productivity. This may be due to other factors such as poor circulation.

The following is a summary of the three major state laws regarding water quality:

- **Chapter 298, Florida Statutes - Drainage and Water Control**

  Review of water management plans from water control districts.

- **Chapter 373, Florida Statutes - Water Resources**

  Permits for water consumption, regulation of wells, and management and storage of surface waters. In South Florida, these duties have been assigned to the South Florida Water Management District.

- **Section 403.918, Florida Statutes - Criteria for Granting or Denying Permits.**

  Requires that reasonable assurance be given that water quality standards will not be violated.

c. Impact of nursery operations

Container nurseries are year-round operations that capitalize on heavy local rainfall and an abundant supply of irrigation water from the Biscayne aquifer. Nurseries are often chemical-intensive, frequently applying a broad spectrum of pesticides, fertilizers and other agrochemicals. DERM inspections of nurseries in north Dade have revealed widespread occurrence of improperly constructed or abandoned wells. Such wells may act as conduits for direct introduction of surface contaminants into groundwater. Some wells supply water for "fertigation" systems (where fertilizer is dispersed via irrigation pipes, but there is lack of proper equipment to prevent chemicals from flowing back into the supply well. Back flow prevention has also been found lacking for water lines serving agrochemical mixing operations.

A number of the chemicals commonly used in container nurseries have been identified by EPA as compounds with a propensity to migrate to groundwater and contaminate drinking water supplies. This combination of agricultural and hydrogeological conditions raises concerns that routine application of agrochemicals by nurseries may contribute to groundwater pollution. This is

of special concern because many nurseries are located within or upstream of wellfield protection areas or in areas where residents obtain their drinking water through shallow private wells.

Other potential threats to groundwater include inadequate safety measures in storing fuels, lubricants and agrochemicals and improper disposal of liquid wastes from chemical mixing and equipment maintenance/repair operations. On-site disposal of solid wastes also may threaten drinking water supplies.

4. Wellfields

a. Wellfields in the study area

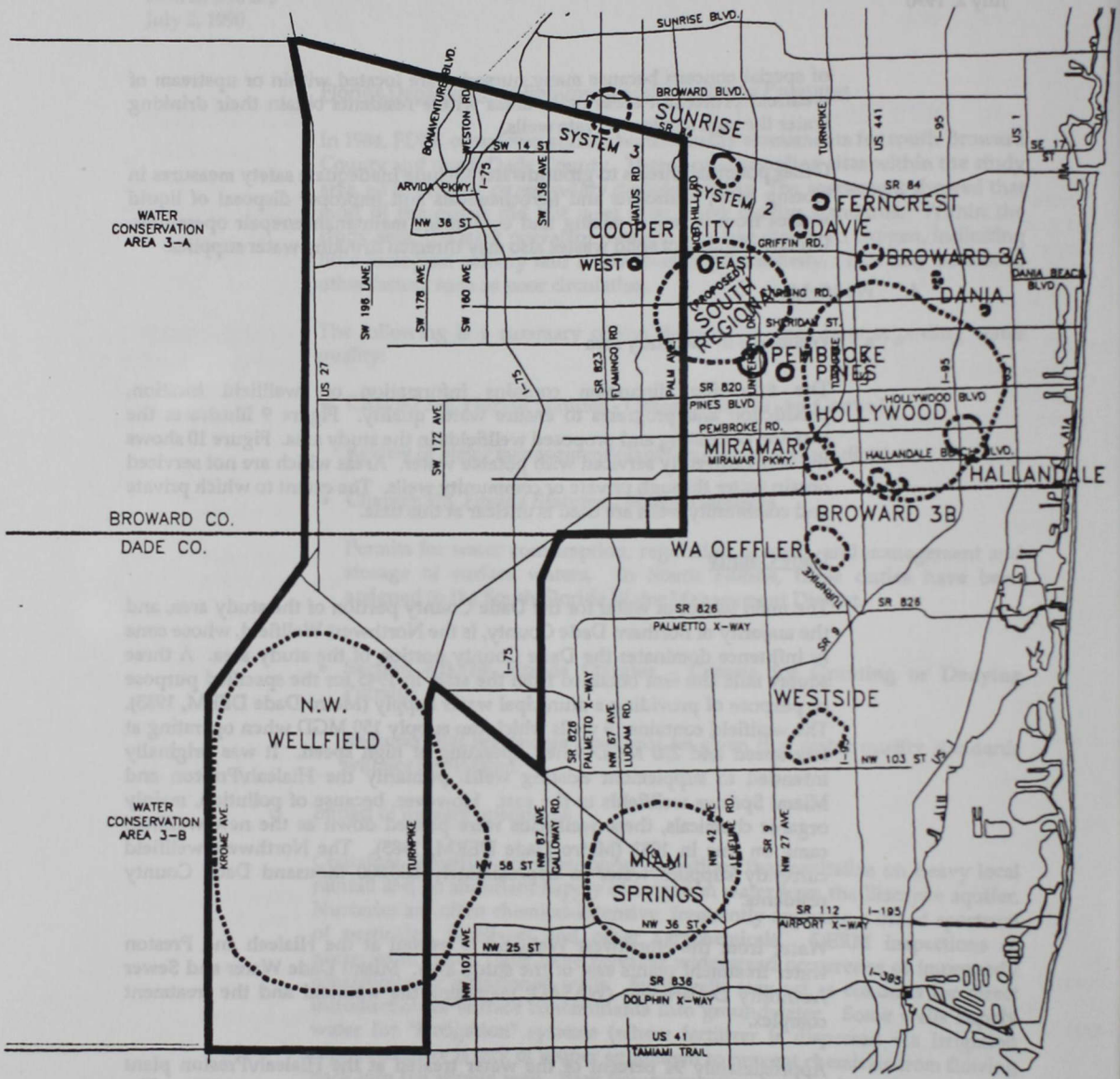
The following discussion contains information on wellfield location, production and programs to ensure water quality. Figure 9 illustrates the location of existing and proposed wellfields in the study area. Figure 10 shows the areas currently serviced with potable water. Areas which are not serviced obtain water through private or community wells. The extent to which private and community wells are used is unclear at this time.

Dade County

The main source of water for the Dade County portion of the study area, and the majority of northern Dade County, is the Northwest Wellfield, whose cone of influence dominates the Dade County portion of the study area. A three square mile site was obtained from the state in 1945 for the specified purpose of purpose of providing a municipal water supply (Metro Dade DERM, 1985). The wellfield contains 15 wells which can supply 150 MGD when operating at low speed and 220 MGD when operating at high speed. It was originally intended to supplement existing wells, primarily the Hialeah/Preston and Miami Springs wellfields to the east. However, because of pollution, mainly organic chemicals, these wellfields were phased down as the new wellfield came on line in 1983 (Metro Dade DERM, 1985). The Northwest wellfield currently supplies water to approximately 800,000 thousand Dade County residents.

Water from the Northwest Wellfield is treated at the Hialeah and Preston water treatment plants east of the study area. Miami Dade Water and Sewer Authority Department (WASAD) maintains the wellfield and the treatment complex.

Approximately 94 percent of the water treated at the Hialeah/Preston plant comes from the Northwest Wellfield (Metro Dade Planning, 1989). The wellfield along with the water drawn at the Hialeah/Preston complex, provides water for the area generally north of Flagler Street. While the majority of the study area is outside of the urban services boundary and does not receive municipal water, the area is crucial in the supply of potable water for the county.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Existing and Future Wellfields

Study Area Boundary

Regulatory Zones of Influence

Source: Dade County Department of Environmental Resources Management and Broward County Water Resource Management Division.

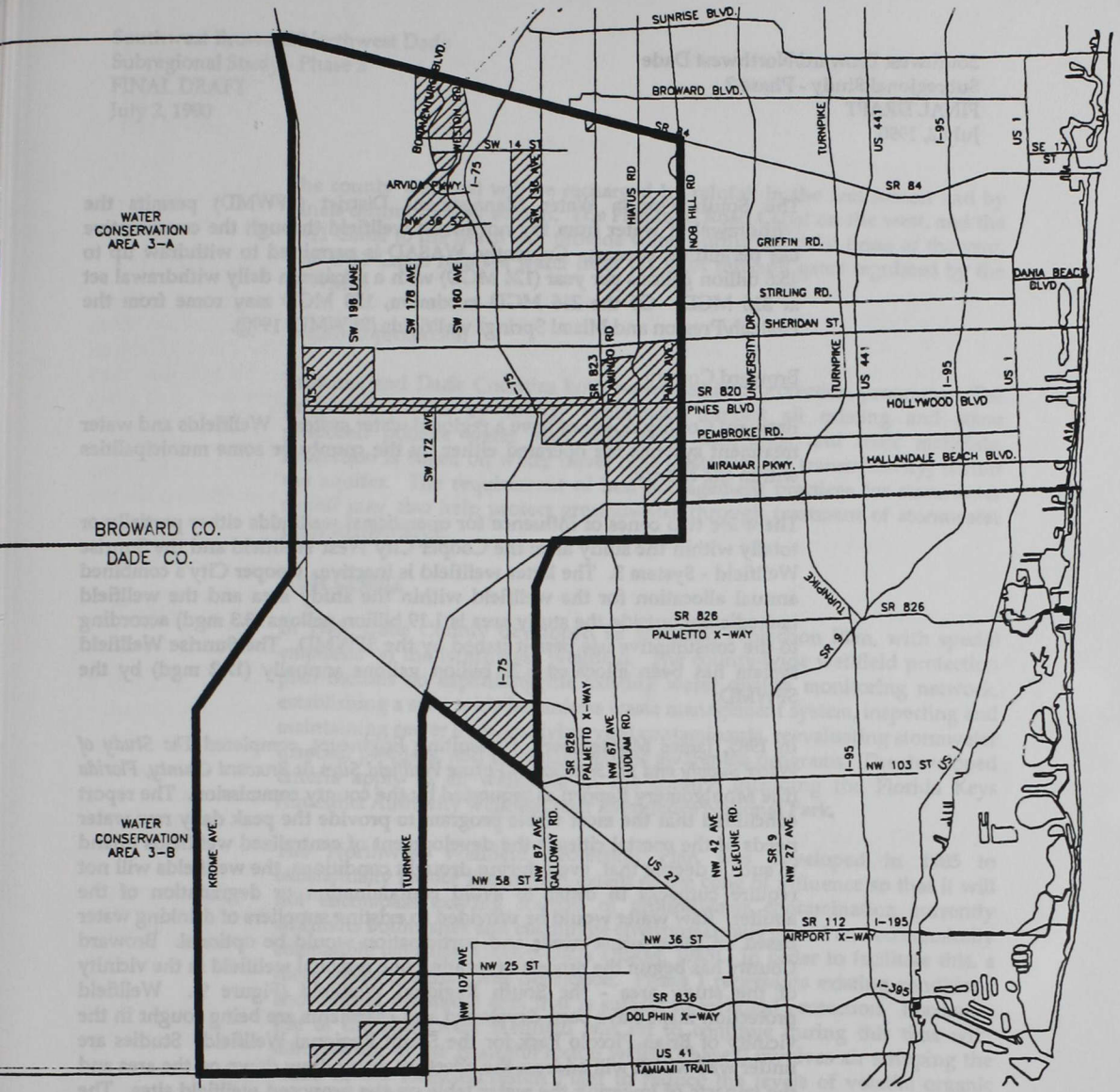
FIGURE 9

N

MILES

0 1 2 3

June 1989



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Method of Potable Water Service

Study Area Boundary

Areas Currently Served by a Centralized System

Areas Currently Served by a Private or Community System

Source: Metro Dade Water and Sewer Authority Department, Broward County Division of Water Resources, City of Miramar, City of Pembroke Pines, City of Sunrise, City of Cooper City, City of Davie and South Florida Regional Planning Council.

FIGURE 10

N

MILES

0 1 2 3

May 1990

The South Florida Water Management District (SFWMD) permits the withdrawal of water from the northwest wellfield through the consumptive use permitting process. Currently, WASAD is permitted to withdraw up to 45.6 billion gallons per year (124 MGD) with a maximum daily withdrawal set at 216 MGD. Of the 216 MGD maximum, 150 MGD may come from the Hialeah/Preston and Miami Springs wellfields (SFWMD, 1990).

Broward County

Broward County does not have a regional water system. Wellfields and water treatment systems are operated either by the county or some municipalities within the county.

There are two cones of influence for operational wellfields either partially or totally within the study area; the Cooper City West Wellfield and the Sunrise Wellfield - System 3. The latter wellfield is inactive. Cooper City's combined annual allocation for the wellfield within the study area and the wellfield immediately outside the study area is 1.19 billion gallons (3.3 mgd) according to the consumptive use permit issued by the SFWMD. The Sunrise Wellfield system has been allocated 6.29 billion gallons annually (17.2 mgd) by the SFWMD.

In 1985, James Montgomery, Consulting Engineers, completed *The Study of Water Supply and the Selection of Future Wellfield Sites in Broward County, Florida* (the Montgomery Report) as requested by the county commission. The report concluded that the most viable program to provide the peak daily raw water needs of the coastal cities is the development of centralized wellfields inland to such a degree that even during drought conditions, the wellfields will not require cutbacks in order to avoid contamination or degradation of the aquifer. Raw water would be provided to existing suppliers of drinking water based on their future needs and participation would be optional. Broward County has begun the process of locating one regional wellfield in the vicinity of the study area - the South Regional Wellfield (Figure 9). Wellfield protection maps have been developed and easements are being sought in the vicinity of Brian Piccolo Park for the South Regional Wellfield. Studies are under way which will address the effects of water draw down on the area and the impacts of lowering the water table on the proposed wellfield sites. The City of Miramar is also applying to the SFWMD for a consumptive use permit for a proposed wellfield in the city. The wellfield location is being targeted to be located within the Bluegrass Lakes Development of Regional Impact (near the bend in the Turnpike.) Currently, Dania and Hallandale have entered large user agreements to get water from the new county wellfield. The county will also supply water to their 3A treatment plant. The design capacity for the proposed South Regional Wellfield is 64.88 MGD. The maximum day raw water demand is predicted to be 63 MGD. The design capacity for the proposed Miramar wellfield is 3.0 MGD in 1990 with a projected increase to 4.5 MGD in 1995.

The county wellfield will be recharged by rainfall in the wet season and by canals during the dry season. The Flamingo Road Canal on the west, and the C-11 Canal to the north will provide water during the drier times of the year. The C-11 Canal receives water from WCA 3A through gates regulated by the SFWMD.

b. Wellfield protection

Broward and Dade Counties both have wellfield protection programs. The programs, passed by county ordinances, protect all existing and some proposed potable water well sites from hazardous and toxic materials. Protection is based on water travel time (distance and transmissivity) within the aquifer. The requirement of best management practices for stormwater runoff may also help protect groundwater through treatment of stormwater prior to discharge.

Dade County

In 1985, Dade County developed its Wellfield Protection Plan, with special emphasis on the Northwest Wellfield. The county-wide wellfield protection plan focuses on expanding the existing water quality monitoring network, establishing a state wide hazardous waste management system, inspecting and maintaining sewer lines, studying viral contaminants, reevaluating stormwater disposal practices, and improving public awareness programs. The developed criteria apply to all wellfields in the county, including the Florida Keys Aqueduct Authority wellfield near Everglades National Park.

The Northwest Wellfield Protection Plan was developed in 1985 to substantially reduce the eastern extent of the cone of influence so that it will not encompass existing sources of groundwater contamination currently within its boundaries and encourage environmentally sound and economically compatible land uses (Metro-Dade DERM, 1985). In order to facilitate this, a three phase program was developed. Phase 1 represents existing conditions and defines the initial area that is subject to wellfield protection. Maximum use of the Northwest Wellfield was set to continue during this time with minimal use of the Hialeah/Preston wells. Phase 2 involves air stripping the water at the Hialeah/Preston Plant to reduce the levels of volatile organic chemical (VOCs). The purpose of this is to increase the pumpage from these wells, thus decreasing the pumpage at the Northwest Wellfield causing the retraction of the cone of influence away from the contaminated portion of the aquifer. Phase 3 involve improvements to the water management infrastructure, such as deepening some existing canals and construction of new canals. This is the final stage of the program and will define the permanent protection area for the wellfield (Metro-Dade DERM, 1985).

Currently, Dade County is implementing Phase 1 of the plan. The air stripping system may come on line in late 1990. The improved canal system is under construction and may be completed at the same time (Hernandez, Metro Dade DERM, 1990, personal communication). A modification to the plan has been made in that the Hialeah and Preston treatment plant will continue to treat

water from the wellfields on site as well as the Northwest Wellfield, due to increased demand (Hernandez, Metro Dade DERM, 1990, personal communication).

There are various degrees and areas of protection in the Northwest wellfield area. In the permanent protection area there are 10, 30, 100, and 210 day zones of protection. There is a "buffer zone" east of the Snapper Creek Extension (SCE) canal which appears to have a degree of protection less stringent than west of the canal because the urban development boundary is aligned along the SCE and allows development to the east. Once the canal project succeeds in retracting the extent of the cone of influence to the SCE canal, the final protection boundary will not be set at the canal but will include a buffer zone east of the SCE canal. The two protection zones with less restrictions are not expected to remain in the permanent protection area. These two zones are east of the buffer zone that is east of the SCE.

The highest degree of protection is in the area west of the Homestead Extension of the Florida Turnpike. This is the primary recharge area of all the potable water resources for north Dade County. The land use designation here is Open Space which is consistent with the objectives of protecting groundwater quality.

A drought safety buffer zone provides the second degree of protection and is immediately west of the Snapper Creek Extension Canal. This area provides water flow to the wellfield during times of severe drought when there is insufficient water in the conservation areas and Lake Okeechobee to maintain the water elevations in the Snapper Creek Canal.

The remainder of the wellfield area comes under the third level of protection. This area contains water that is in the cone of influence temporarily. The water in these areas moves west, towards the wells. More liberal land uses are allowed in these areas.

Since 1982 Dade County has expanded its wellfield protection program to include regulations specifically designed for regional wellfields (Table 12).

Broward County

In 1984, Broward County established the Wellfield Protection Program to protect the county's existing and future water supplies from contamination. Zones of protection have been established around existing wellfields based on models of travel time of potential contaminants associated with specific land uses. The three zones of protection described in the ordinance are as follows:

Zone 1 The land between the wells and the 10 day travel time contour. The ordinance lists 192 substances that are prohibited.

Zone 2 The land between the 10 day and 30 day travel time contours. The ordinance provides for the control of regulated substances and inventory, containment, surveillance and monitoring of water resources in the area.

TABLE 12

LAND USE REGULATIONS FOR REGIONAL WELLFIELD PROTECTION AND HOW THE REGULATIONS ARE IMPLEMENTED

LAND USE REGULATIONS	HOW IMPLEMENTED
No new activities involving hazardous materials are allowed within Wellfield Protection Areas of the Northwest and West Wellfields and within the basic protection area for all other wellfields (excluding public utilities, rock mining, pre-packaged haz. mats. for domestic use & agriculture)	No BU-3 or IU zoning allowed in West and Northwest Wellfields, IW-6 and AW-6 permitting programs inspect all non-residential activities to ensure that no use conversions involve hazardous materials
No new non-residential activities except on sewers.	DERM plans review process.
BU-3 and IU zoning prohibited.	Wellfield Zoning Overlay Ordinance for West and Northwest.
Regulate existing uses handling hazardous materials.	Grandfathering and restrictive covenants. Reducing risks with operating permits. No expansion unless demonstrate decreased risk of contamination.
Expedited sewering of unsewered areas.	Creation of Special Taxing Districts and prioritization of unsewered areas.
Limiting residential density to reduce sewage loading for both septic tank and sewer.	Zoning rollbacks and zoning overlay, DERM plan review.
Zoning variances require 4/5 vote from Zoning Appeals Board	Zoning hearing and appeals process is more stringent than for outside of wellfield areas.
Removal or retrofitting of existing underground storage tanks.	Storage tank permitting program and DERM plan review.
Stringent stormwater disposal requirements and improved municipal system maintenance.	DERM plans review and creation of Stormwater Utility.
Prohibit pipelines transporting hazardous materials.	DERM plans review process.
Rock mining restricted but promoted as an acceptable land use.	DERM plans review process.

SOURCE: Metro Dade Department of Environmental Resources Management, 1990

Zone 3 The land between the 30 day and the 210 day travel contours, or the 30 day and one foot draw down contour, whichever is greater. In this area, regulated substances are inventoried and spills are monitored.

The wellfield protection ordinance authorized compensation to facility owners for the removal of pollution generating facilities from a Zone 1 protected area. Facilities generating pollution in Zones 2 and 3 are being required to take corrective actions. In April 1989, regulatory jurisdiction for the Wellfield Protection Program and water management was transferred from the Water Resources Management Division to EQCB. Within EQCB the program was merged into their larger existing network of water quality and environmental issues. The EQCB programs include hazardous materials control, wastewater discharge effluent regulations, underground storage tanks, ground and surface water quality, and wellfield protection.

All of the facilities in the county which were operating and considered to be potential polluters at the time of adoption of the ordinance have been brought into compliance. However, even successful programs can be improved. Enforcement personnel is needed to pursue those new facilities who have not applied for proper permits and to verify that facilities are actually built and storing hazardous materials the way in which they were designed and licensed.

5. On-site sewage disposal

The concern in the Region and in the study area about the potential adverse impacts to water quality and public health from the use of on-site sewage disposal systems (OSDS) is not new.

In Dade County, the county commission adopted county wide regulations in 1972. According to the Dade County Comprehensive Plan (1989), septic tanks can provide acceptable treatment for low density residential areas. However, "because of the relatively high bacterial content associated OSDS effluent, and the inability of the process to remove chemical constituents, the potential contamination to Dade's groundwaters could be considerable". The county's adopted OSDS regulations for residential uses consider the minimum lot size, equivalent residential density, whether a private well is on-site and type of development. Furthermore, the plan states that, given soil types, "no area in Dade County is particularly well suited" to OSDS use. This is reflected in the Dade County Comprehensive Development Master Plan and Chapter 24-13(5) of the Dade County Code.

Within Dade County, the only areas designated for residential uses are within incorporated areas of Hialeah and Hialeah Gardens which are within the county urban services area boundary. Since the county will not permit OSDS for uses outside the urban services boundary other than residential, and because the only residential uses will be those associated with agricultural development, applications for OSDS permits will be limited within the Dade portion of the study area.

Over a decade ago the Broward County Health Department staff reported to the county commission on this concern (Broward County Health Department, 1978).

One of the reports presented is entitled *Recommended Criteria for Water Supply and Sewage Disposal Facilities in Urban and Non-Urban Areas of Broward County, Florida.*

The 1978 report's study area overlaps a large portion of this study area from Pines Boulevard in Broward County to two miles south of the Broward/Dade county line, extending beyond the eastern boundary of the study area, and west to U.S. 27. The report describes the public health threat from OSDS use as minimal when densities remain low and proper maintenance is followed. However, as densities increase, so does the potential contamination of ground and surface waters. The conditions that make contamination so likely with dense OSDS use is the natural low land elevation, poor soils (for OSDS) and the shallow water table. In addition, the report comments that existing wastewater systems are not designed to treat many of the chemical substances that often find their way into the wastewater stream. The report led the county commission to prepare and adopt the Broward County Water and Septic Tank Ordinance (Article II 1/2). The ordinance is still one of the most stringent in the state going beyond the requirements of Rule 10D-6, F.A.C., the State of Florida's Standards for OSDS (Broward County, 1978).

a. Current data and analysis

To reduce the threat to public health from water contamination, the Water Quality Assurance Act of 1983 mandated that the Florida Department of Health and Rehabilitative Services supervise an OSDS research project on different types of environments to determine if they are polluting the ground water (Ayres and Associates, 1988). This ongoing research project is intended to provide information from which criteria may be developed for revised practices for installing and maintaining OSDSs in Florida. It is anticipated that Rule 10D-6 F.A.C., will be amended to include these recommended practices (Carlson, 1989).

It is documented, however, that proper installation and maintenance of an OSDS is critical to minimizing groundwater contamination. Soils play a vital role in preventing ground water contamination from human feces. Loading factors are of vital importance because they help prevent one aspect of over-saturating the soils. The final treatment of human wastes is performed in the soil. The soil removes those infective pathogens that otherwise contaminate the ground water. Other than the two types of drain fields allowed under county ordinance, absorption beds and trench systems, there are two remaining factors that minimize potential contamination. Separation between the disposed effluent level and the ground water level must be suitable to allow filtration of the effluent before reaching groundwater. State law requires a minimum distance of two feet between known ground water levels and the septic system. Some places in the county require three and four feet of separation. Finally, OSDS are prohibited in areas zoned for industrial uses or when hazardous materials may be reasonably expected to be used (Carlson, 1989).

The Broward County Environmental Quality Control Board's *Annual Report for Fiscal Year 1987/1988* documents the results of the ground water quality monitoring program the county has participated in since 1980. EQCB has five monitoring stations, with two wells per station, within the study area. The report documents that contamination of groundwater by volatile organic compounds (VOCs) has been the major ground water contamination problem in South Florida (EQCB, 1989). Septic tanks are a potential source of this pollutant. The proliferation of VOCs in the groundwater underscores the need for consumer education of the proper use and disposal of toxic substances and hazardous materials in septic systems.

The EQCB recently began investigating potential failed OSDS. This monitoring program is too site specific to provide data as to whether groundwater contamination from improperly treated human feces has occurred on a widespread basis.

The soils recommended in the treatment of pathogens from domestic wastes do not have the capacity to treat many of the household chemicals that find their way into drain fields via toilets and kitchen sinks. On-site disposal systems were never designed to treat such chemicals as discussed above. Even though many household and yard chemicals are defined as hazardous materials by county and federal regulations, and laws prohibit the disposal of such chemicals into the environment, the practice continues and the potential threat to groundwater exists. The proliferation of VOCs in the groundwater underscores the need for consumer education of the proper use and disposal of toxic substances and hazardous materials.

b. Alternatives

Rule 10D-6, F.A.C., and Broward County Ordinance Article II 1/2 recommend considering alternative wastewater treatment systems before applying for an OSDS permit. One alternative is hooking up to an available public or private sewer system. Some of the definitions of availability, as defined by the State of Florida are listed below (Carlson, 1990).

- If the system is not under a Department of Environmental Regulation moratorium.
- For estimated sewage flows of 600 or less gallons per day, availability is whether a sewer line exists in a public easement or right-of-way which abuts the property, and if gravity flow can be maintained from the building drain to the sewer line.
- For estimated sewage flows exceeding 600 gallons per day, availability is whether a force main, or lift station exists in a public easement or right-of-way which abuts the property or is within 100 feet of the property.
- The sewerage system has adequate hydraulic capacity to accept the quantity of sewerage to be generated by the proposed establishment.

While these recommendations for defining availability exist, the state does not require a home owner to hook-up to an available system. Broward County EQCB regulations prohibit the use of any OSDS after access to a public sanitary sewerage collection system is available. A collection system is available if it is in a public easement that abuts or is within 100 feet of the property and the sewage system's hydraulic capacity will not be exceeded by accepting the flow.

c. Regulation of systems

While Broward County is the permit grantor for OSDS in the study area, cities regulate building and zoning and have the authority to refuse to allow installation of an OSDS. The county Department of Health and Rehabilitative Services could not provide the number of permits for OSDS in the Study Area. Cooper City has no rules on requirements for hook-up to the municipal system. Yet, there are only six homes in the city currently on OSDS. Miramar prohibits septic tank use when sewer lines are available. Also, the city's Water Sewer Ordinance requires hook-up when service is provided. Davie and Pembroke Pines do not require hook-up to sewer systems when they become available. Sunrise reports no septic tank use within the city even though no ordinance exists which requires hook-up.

Similar to the assessment of the 1978 Broward County Health Department, the current staff of the department maintains the position that when proper installation and maintenance practices are followed, the potential for water contamination from human feces is low. Yet, the alterations to the land that must precede proper installation may pose potential adverse impacts to water supply and surface water management.

6. Findings and Recommendations

1) Findings: **Water Supply**

- The regional water system must serve the multiple and sometimes competing functions of water delivery, flood control and resource protection in a cost-effective manner. This necessitates balanced allocation of water resources.

- The study area receives most of its water from rainfall, but during low water conditions, it relies on SFWMD-regulated water delivery from the WCAs and Lake Okeechobee.

- Water from the Biscayne Aquifer may not be available at all times in sufficient quantities to support existing populations and the growth that is currently projected for the study area. Periodic mandatory water restrictions have been imposed. Restrictions as a management tool are the result of past and present ineffectual and fragmented management of the resource at both local and regional levels.

- Water is allocated by the SFWMD through the consumptive use permitting process. However, consumptive use permits do not provide assurance of receiving the permitted withdrawal amount at all times.

- Capital facility plans are usually for five or ten years; however, consumptive use permits are issued for two to five years in Broward County and 10 years in Dade County.

- Water level data examined for the study area is not mutually supportive. However, water level contour maps received indicate a general lowering of water levels by as much as two feet during a 27 year period. Stage duration curves indicate some lowering of water levels but not to the extent indicated by the contour maps. This may be due to the fact that contour maps represent an interpolation of data over a large area while a stage duration curve represents one geographic point.

- Data indicates that groundwater levels are falling within the study area and may decline sufficiently to have a negative effect on potable water supply and increase the possibility of salt water intrusion.

Recommendations

a) Water supply and drainage should be managed by all concerned agencies as components of a single water management system. SFWMD should work with local governments within the study area to refine basin management and water supply planning efforts using existing state, regional and local planning efforts. Water allocations should be based on sound regional modeling that addresses long term water needs and cumulative impacts.

b) Local governments within the study area, in conjunction with the SFWMD, should pursue water conservation measures in all new development or redevelopment. These should include:

   - maintenance or improvement where feasible of the aquifer recharge and storage potential of the Biscayne Aquifer;

   - further development of alternative water treatment technologies such as aquifer storage and recovery (ASR) technology and reverse osmosis pilot projects;

   - the exploration of best methods of treating and utilizing reclaimed water; (see potable water, wastewater and solid waste findings and recommendations section);

   - adoption of landscape codes, such as the SFWMD Model Landscape Code, that incorporate xeriscape concepts and low loss irrigation methods; and

- increased on and off-site storage of surface water and a cooperative management system of water management areas as a means to satisfy future water supply needs.

c) Local governments and the South Florida Regional Planning Council should coordinate with the SFWMD as they establish or amend levels of service standards for potable water.

d) A definitive examination of historical water level data should be undertaken in conjunction with computer modeling of the interaction of the groundwater and surface water systems. At a minimum the objectives should include:

- the effect of surface water management systems on groundwater,
- a determination of the elevation at which groundwater and surface water will stabilize, and
- the effect of the determined water level on potable water supply and salt water intrusion.

2) Findings: Water Quality

- The Biscayne Aquifer is extremely permeable and susceptible to water pollution.
- There are several programs at the local, state, and federal levels to protect water resources, but they are in need of additional monitoring, enforcement and coordination.
- Detected groundwater contamination in the Broward County portion of the study area appears to be related to the use of lawn fertilizers and septic tanks. Contaminants detected in the groundwater east of the study area suggest that past or current requirements to control point and non-point sources of pollution were not in place when impacts occurred or may be inadequate.
- While detection of groundwater contaminants in the Dade County portion of the study area has been minimal, detection of contaminants east of the study area suggest that past or current requirements to control point and non-point sources of pollution outside of the Dade County Northwest Wellfield protection area west and northwest of the County's urban development boundary may be inadequate.
- Contamination in the Dade County portion of the study area east of the Turnpike has generally been attributed to industrial activities including solid waste disposal.

- There are high levels of organics, iron, and minerals in the ambient groundwater of the Broward County portion of the study area. To meet state and federal drinking water standards higher levels of treatment will be required than is currently utilized in eastern wellfields.

Recommendations

a) Surface and groundwater quality monitoring programs should be developed to address gaps in the existing (1990) database to determine causes of contamination. More effective methods for identifying sources of detected contaminants should be developed.

b) Broward County EQCB, Dade County DERM, FDER and the SFWMD should increase monitoring and enforcement of water resource protection programs.

c) Broward County EQCB, Dade County DERM, FDER and the SFWMD should investigate and take corrective actions to reduce the causes of point and non-point pollution in the study area and in other areas where pollution may potentially impact the study area.

d) Local governments in the study area should establish land use controls and other programs to eliminate the causes of point and non-point pollution.

e) Potable water service providers in the Broward County portion of the study area should protect eastern wellfields to the greatest extent possible. If western wellfields are developed, service providers should plan for the high cost of future water treatment facilities and technologies, (see potable water, wastewater and solid waste findings and recommendations section).

f) Local governments and the SFWMD should establish a cooperative management system to ensure adequate centralized water treatment and distribution facilities are available concurrent with development (see potable water, wastewater and solid waste findings and recommendations section).

3) Findings: **Water Resource and Wellfield Protection**

- Broward County is in the process of choosing a site for a regional wellfield, part of which is within the boundaries of the study area.

- The Northwest Wellfield is the last source of high quality drinking water at a regional scale in north Dade County. Approximately 792,000 persons in north Dade County receive their drinking water from this source.

- Wellfields that are alternate sources of potable water for north Dade County either have industrial contamination present in the groundwater or have experienced salt water intrusion.

- Due to the general flow of groundwater in the study area, the presence of conveyance canals and the interconnection of ground and surface water, and the siting and operation of facilities that use or generate hazardous materials upstream of public and private water wells in the study area may cause pollution of the downstream water wells.

- Hazardous materials are currently transported through the Dade County Northwest Wellfield area. It is generally not desirable from a public safety standpoint to re-route the transportation of these materials to more heavily used and populated corridors outside of wellfield protection areas. The accidental release of a hazardous substance from a vehicle on a roadway traversing the study area is likely to cause significant degradation to water quality where drainage is via a direct positive outfall into a canal.

Recommendations

a) In order to protect the resources of the Northwest Wellfield area, the Urban Development Boundary between NW 12th to NW 154 Streets in Dade County should become a permanent boundary.

b) All new and planned facilities that use, generate or store hazardous materials in the study area should be designed, constructed and monitored to ensure that runoff or discharges from such facilities will not pollute surface or groundwater resources or downstream potable water wells. All local governments should establish programs to identify and phase out high risk generators, whose runoff or discharges threaten downstream potable water wells.

c) To reduce the exposure of ground and surface water resources, especially within wellfield cones of influence, wellfield protection programs and roadway stormwater management requirements should include methods for immediate containment of accidental spills.

4) Findings: **Airport Planning**

- There are two proposed airports within the study area: the Broward County general aviation facility and the northwest Dade County air carrier airport.

- The proposed northwest Dade County airport is near Dade County's Northwest Wellfield. Several locations within the study area are being considered for the proposed Broward County general aviation facility. The Broward County Aviation Department has proposed a site in the northwest corner of the study area near the Weston DRI.

- Airports require large fueling facilities and other operations that may adversely impact water quality in the event of an accident. They also attract ancillary development that handles hazardous materials. Dade

County DERM and Broward County EQCB have documented contamination in and around several airports in Dade and Broward Counties.

- An accident at an airport could contaminate the ground and surface water.

Recommendations

a) Airports and ancillary facilities should be subject to extraordinary design, construction and monitoring criteria to prevent pollution of ground and surface water supplies. Design considerations should include the ability to detect, contain, and rapidly clean-up any contamination.

b) Emergency response contingency plans that will ensure financial responsibility for the clean-up and restoration or mitigation should be a specific condition of receiving an operations permit for any airport related facility from Broward County EQCB or Dade County DERM. Such assurance could take the form of a facility operator posting bonds which would cover clean-up costs.

5) Finding: **Impacts Outside the Study Area**

- Lowering water table elevations in the study area can adversely affect eastern wellfields by accelerating salt water intrusion and migration of other pollutants. SFWMD criteria does not allow this to occur.

Recommendation

Prior to allowing any modifications to existing groundwater control elevations in the study area the SFWMD should evaluate the impacts of:

a) the effect on water quality within and potential impacts outside the study area;

b) the effect on salt water intrusion into eastern wells; and

c) the effect on the Region's water supply.

6) Findings: **Stormwater Runoff**

- Required "best management practices" for stormwater management systems are technology based and not performance based. In other words, their effectiveness is assumed based on the technology used and not performance.

- While studies have shown that the use of stormwater management systems can decrease surface water quality impacts, the impacts of stormwater runoff on groundwater quality have not been adequately evaluated.

Recommendations

a) Secondary drainage providers should implement long term monitoring and maintenance programs for stormwater systems to assure that all systems comply with state or county water quality standards prior to discharging into the SFWMD's primary canal system.

b) Future stormwater research efforts should examine how effectively stormwater management systems prevent contaminants from entering ground and surface waters.

7) Findings: **Nursery and Agricultural Operations**

- In the study area there is widespread occurrence of improperly constructed wells, abandoned wells, and unpermitted irrigation wells at plant nurseries. Such wells may act as conduits for direct introduction of surface contaminants into groundwater.

- Wells often supply water for "fertigation" (systems where fertilizer is dispersed through irrigation pipes). Such systems often lack proper equipment to prevent chemicals from flowing back into the supply well.

- Nursery and agricultural operations involve the extensive use of fertilizers and pesticides. Very often, they are not properly contained and may contaminate ground and surface waters.

Recommendations

a) Comprehensive studies to determine the extent to which plant nurseries impact groundwater quality should be initiated by Dade County DERM and Broward County EQCB. Particular emphasis should be placed on evaluating the effects of agrochemical applications, irrigation, stormwater and the use of pumps which prevent back flow.

b) Increased enforcement for nursery operations should be provided by Dade County DERM, Broward County EQCB, SFWMD and FDER.

c) All irrigation wells at nursery and agricultural operations should be identified and evaluated. A water quality survey of these wells and an evaluation of groundwater contamination should be conducted by Broward County EQCB and Dade County DERM.

8) Findings: **On-Site Disposal Systems**

There are little data to support conclusive findings regarding on-site disposal systems (OSDS). The following findings are the result of the limited data and the expert opinion of professionals working in the field.

- Without significant site modifications, the study area is not naturally conducive to the use of OSDS due to low land elevations, high groundwater water levels and adverse soil conditions.

- Detection of nitrate-nitrogen contamination in excess of Broward County and state groundwater standards in a residential area and on a farm in the Broward portion of the study area appear to be related to the use of lawn fertilizers and septic tanks.

- Past assessments of the impact of septic tanks on groundwater quality in Broward County have found that some residents in the study area do not perform adequate maintenance of their OSDS.

- Improper installation, maintenance and use of OSDS will often lead to ground and surface water contamination.

- Within the study area, there are areas planned for industrial use on local government future land use maps. In many cases the areas are not sewered and county regulations preclude the use of septic tanks for industrial uses.

Recommendations

a) Within the study area any existing or new user of OSDS in the Broward County and within the Dade County urban development boundary should be required to hook up to a centralized wastewater collection system when available.

b) At a minimum, local governments should ensure that centralized wastewater collection and treatment facilities are available concurrent with development.

c) Local governments should increase enforcement of existing state, county and or local policy that requires hook-up to a centralized system when it is available.

d) For the study area, no new OSDS should be permitted except for low density (1 du/5 acres) residential uses outside of the urban development boundary in Dade County and in Broward County that do not include ancillary farming uses which generate wastewater.

e) Educational programs should be developed to inform users about the proper maintenance of septic tanks and the discarding of toxic chemicals in the home.

f) Future groundwater quality monitoring in the study area should be designed to determine the extent of contamination by nitrate-nitrogen entering the groundwater via OSDS.

g) Areas within the Dade County urban development boundary and the entire Broward portion of the study area that are designated as industrial on future land use maps should be sewered prior to development as industrial facilities.

9) Findings: **Private Wells**

- Improper installation, maintenance and closure of private potable water systems often lead to contamination of the potable water supply.

- There is no graphic illustration of the distribution or density of permitted private wells and permitted OSDS use in Broward County. This inhibits the ability of the county to consider the potential impacts of land use proposals on the potable water supply from private wells.

Recommendations

a) If community and private wells are permitted in the study area, inspections and enforcement of criteria should continue to be carried out by the appropriate agencies, such as Broward County EQCB, Dade County DERM, local HRS and FDER.

b) A survey of water quality from private drinking water wells should be conducted by the local HRS in coordination with Broward County EQCB, Dade County DERM, and FDER, principally focusing on older developments in the study area that are using septic tanks.

c) Educational programs should be developed on the proper maintenance of residential potable water wells and treatment systems. This would include special precautions to be taken by the owner with regard to use of pesticides and fertilizers on the property.

d) The existing distribution and density of private and community wells and OSDS in the study area should be mapped and distributed to all of the effected local governments by the local department of the Florida Health and Rehabilitative Services, the regulating agency. The location of these wells, OSDSs and cones of influence should be considered in land use planning to ensure proper siting of land uses near these areas.

10) Finding: **Illegal Dumping**

- Illegal dumping creates surface and groundwater contamination.

- Illegal dumping of solid waste and toxic substances along roadways, on vacant lands and in canals in the study area is likely a function of the inconvenience and expense associated with legal means of disposal.

Recommendations

a) Within the study area, local governments should provide solid waste collection service to all properties within the Dade County urban development boundary and in Broward County.

b) Local governments should provide conveniently located transfer stations for trash, household hazardous waste, white goods (refrigerators and appliances), and other bulky items.

B. Wetlands

1. Habitat Analysis

a. Historical conditions

Historically, the study area was part of the Everglades system. The principal vegetation associations of the area were fresh water marshes and wet prairies. Sawgrass was the dominant plant in marsh communities, occurring in pure stands or mixed with a variety of grasses. Within sawgrass communities, and occasionally occurring in pure stands, were cattails, maidencane, giant arrowhead and pickerel weed. Shrubs commonly present were buttonbush, willow and wax myrtle. Bladderwort, white water lily, floating heart and figwort were found in more open water areas. Wet prairies were relatively low-stature communities termed flats. Beakrush, Spike rush and maidencane dominated wet prairie habitats. Hydroperiods (ground and surface water levels over time) in the region ranged from seasonal to complete inundation. More complete description of historical Everglades fresh water marsh communities can be found in Davis (1943), Harshberger (1914) and Loveless (1959).

Inundated areas of the Everglades provide habitat for a diverse aquatic fauna. Upland communities provide habitat for many terrestrial species, some of which (white-tailed deer for example) are surprisingly adapted for wet areas (George, 1988). A selection of typical fish and wildlife species of fresh water marshes is shown in Table 13. Historical abundances of fish and wildlife in the Everglades are generally unknown, but because of habitat loss it is safe to assume that most species have declined in number (a few species particularly well adapted for human presence, such as raccoons, may have increased). This point is best illustrated by the decline in wading birds, which are certainly the most visible if not popular wildlife group. Even here, the best population estimates are admittedly crude (Robertson and Kushlan, 1974), but there is little dispute that population levels were once well over one million birds and are now well under one hundred thousand. Marshes on the edge of the central Everglades sloughs (such as those that historically occurred in the study site) were an essential foraging habitat for nesting wading birds.

TABLE 13

REPRESENTATIVE FISH AND WILDLIFE SPECIES FOUND IN SOUTH FLORIDA FRESH WATER MARSHES

Birds

Great Blue Heron
Little Blue Heron
Great Egret
Snowy Egret
Tricolor Heron
Wood Stork
White Ibis
King Rail
Common Gallinule
Mottled Duck
Everglades Kite
Marsh Hawk
Red-Shouldered Hawk
Belted Kingfisher
Red-Winged Blackbird
Common Grackle
Boat-Tailed Grackle
Yellowthroat
Osprey
Greenback Heron
American Bittern
Least Bittern
Sandhill Crane
Clapper Rail
Sora Rail
Common Moorehen
Purple Gallinule
American Coot
Blue Winged Teal

Fish

Dollar Sunfish
Spotted Sunfish
Golden Shiner
Flagfish
Bluefin Killifish
Brown Bullhead
Least Killifish
Mosquito fish
Sailfin Molly
Bowfin
Eastern Chubsucker
Warmouth
Bluegill
Largemouth Bass
Florida Spotted Gar

Mammals

Opossum
Round-Tailed Muskrat
Marsh Rabbit
Rice Rat
Raccoon
Mink
River Otter
White-Tailed Deer
Bobcat

Reptiles

American Alligator
Mud Turtle
Red-Bellied Turtle
Softshell Turtle
Carolina Anole
Cottonmouth
Green Water Snake
Banded Water Snake
Brown Water Snake
Southern Ribbon Snake
Garter Snake
Striped Swamp Snake
Musk Turtle
Chicken Turtle
Snapping Turtle
Green Anole
Green Water Snake

Amphibians

Dwarf Siren
Greater Siren
Peninsula Newt
Green Tree Frog
Squirrel Tree Frog
Florida Chorus Frog
Florida Cricket Frog
Little Grass Frog
Pig Frog
Southern Leopard Frog
Southhern Toad
Oak Toad

Invertebrates

Apple Snail
Crayfish
Fresh Water Prawn
Aquatic Insects

b. Present conditions

Extensive draining, dredging, and filling for urban and agricultural development in and adjacent to the study area has led to significant changes in fish and wildlife resources. Invasive exotic plants, Melaleuca, and Brazilian Pepper, have become established in the study area. These exotic species, which can readily out-compete native vegetation in areas of altered hydrology, form dense stands in portions of the study area. As a result of the impact of shortened hydroperiods on wetland portions of the study area have taken on characteristics of upland habitats. Hence, the general trend in this area has been a loss of habitat for wetland species, with an increase in habitat for upland species, many of which have been displaced as a result of development on the Atlantic Coastal Ridge.

The study area has been systematically observed by staff from Dade County DERM, Broward County Office of Planning, Broward County EQCB, U. S. Environmental Protection Agency, U. S. Army Corps of Engineers, U. S. Fish and Wildlife Service and other qualified field biologists. By synthesizing observations, it is apparent that similar wetland habitats occur in both counties. DERM has identified and partially evaluated fish and wildlife habitats in the Dade County portion of the study area. The distribution and quantity of these habitats is unknown in Broward County.

The various vegetation communities identified can be grouped as follows (adopted from McMahon, 1988):

Short hydroperiod prairie - Characterized by a one to three month hydroperiod, and dominated by grasses and similar species. Muhly grass, Sawgrass and Beardgrass are significant components of these habitats.

Short hydroperiod prairie with Melaleuca - Melaleuca occurs from scattered to dominant within this prairie community.

Short hydroperiod prairie with shrubs - Some areas have a significant presence of shrubs other than exotic species. Wax myrtle and Coastal Plain willow are common.

Sawgrass marsh - Dense sawgrass community with a longer (six to nine month) hydroperiod. Giant arrowhead is also common.

Sawgrass marsh with Melaleuca - Melaleuca occurs from scattered to dominant in the dense sawgrass communities.

Wet prairie - Long hydroperiod (six to 12 month) predominantly grassy community. Sawgrass, Spike rush and beakrush are common. Bladderwort and figwort occur in more open areas.

Wet prairie with Melaleuca - Melaleuca occurs from scattered to dominant in wet prairie communities.

Dense Melaleuca stands - Dense stands of Melaleuca are found throughout the study area, and are the most common forested habitat.

Tree island/Willow head - These two types of forested communities have many of the same species. Common species include Red bay, Coastal Plain willow, Wax myrtle and the exotic, Brazilian pepper.

Forested disturbed areas - This community type occurs along canal berms and roadsides, and is dominated by exotic species, especially Melaleuca, Australian Pine and Brazilian Pepper.

Open disturbed areas - This community is found along roadsides, old fields and scraped areas. Herbaceous, weedy species predominate, but no single species is dominant.

Excavated disturbed areas - This community type consists of canals, ditches and ponds that contain water year round. Spike rush, maidencane and cattails are common in littoral zones.

Fish and wildlife populations in available habitats in the study area have not been quantified, but can be described qualitatively. The remaining longer hydroperiod wetlands that have not yet been invaded by exotic plants support a typical Everglades wetlands fauna. Shorter hydroperiod wetlands have fewer populations of wetland species, but increased populations of more terrestrial species, such as foxes and small mammals. These short hydroperiod wetlands also are important, if not essential, foraging habitat for wading birds when water levels are higher in wetter areas. Some species of amphibians (e.g., Squirrel tree frog and Oak toad) are completely dependant on short period wetlands for breeding habitat. Amphibians like these are an important food source for higher vertebrates, and are the major route for the important ecosystem function of energy transfer from aquatic to terrestrial environments (Moler and Franz, 1987). Short period wetlands are the habitats most threatened with complete elimination in South Florida.

The perspective that the presence of exotic plant species eliminates all of the value of a wetland as fish and wildlife habitat is somewhat erroneous. The impacts of exotic invasion on wetland wildlife depends on the degree of infestation and on the quality of surrounding areas. Even extensive monocultures can support some levels of wildlife activity (Mazzotti et al., 1978). More importantly scattered exotic trees, such as Melaleuca may actually add habitat diversity to a grassy, wetland community. For example endangered snail kites use Melaleuca trees for perches on a frequency greater than that expected by chance (Bennetts, personal communication, 1990). This explanation should not be interpreted as a testimonial for exotic species, but rather an acknowledgement that not all of the effects of exotics are bad and that the worst effects occur in extensive areas of heavy infestation. In the long term, a few scattered trees certainly bodes ill for the future of an area.

In a study completed by Dade County DERM, the values of a short hydroperiod wetland invaded by Melaleuca have been shown. The Bird Drive Everglades Basin, located immediately south of the study site and similar in habitat to the study area, was evaluated by an application of the U. S. Fish and Wildlife Service Habitat Evaluation Procedure (HEP) and periodic wildlife surveys. Both methods demonstrated that the Bird Drive Basin had considerable value as wildlife habitat (Richter, 1988; Dade County DERM, 1989).

The study area is important for its diversity of fish and wildlife and also for its potential for utilization by threatened and endangered species (Table 14). Some of these species are know to inhabit the area, but how many, where they are, and how they use the area is not known.

The proximity of wetland habitats within the study area to existing foraging and nesting sites for wading birds (especially wood storks) and Snail kites (Bennetts et al., 1988) in adjacent Water Conservation Areas makes it essential to maintain or even enhance the capacity of remaining wetlands to support these endangered species. Even short hydroperiod wetlands are important, because they allow wading bird foraging, and possibly initiation of nesting, while water conditions are too high in longer hydroperiod wetlands.

Significant but unquantified fish and wildlife resources exist in the Southwest Broward/Northwest Dade Subregion. Although typical wetland species have declined due primarily to habitat loss, other populations may have increased as a result of the mosaic of upland, wetland and open water sites currently available in the study area. Hence although wetland productivity has declined, regional biodiversity has probably increased. Short period hydroperiod wetlands and upland habitats historically found on or near the Atlantic Coastal Ridge now occur in western Dade and Broward Counties. The ability of these counties to sustain the historical fish and wildlife fauna will be inextricably intertwined with protection and management of resources in the study area. Quantification of the resources in the study area can provide an understanding which may help to slow the decline of the habitat.

2. Definition and Jurisdiction

The wetland resources in the study area are varied in quality and quantity. Within the study area, there are four primary agencies responsible for wetlands permitting and management:

- U.S. Army Corps of Engineers;
- Florida Department of Environmental Regulation; and
- South Florida Water Management District;
- County (Dade County DERM and Broward County EQCB).

Each of these agencies has its own wetlands definition, jurisdictional area and permitting criteria. A permit from one agency does not guarantee a permit from another. Each agency's criteria are discussed in this section.

TABLE 14

FISH AND WILDLIFE SPECIES LISTED FOR PROTECTION BY THE U.S. FISH AND WILDLIFE SERVICE (FWS) AND THE FLORIDA GAME AND FRESH WATER FISH COMMISSION (GFC) THAT, BASED ON HABITAT PREFERENCES AND HISTORIC RANGE, COULD BE IN THE SOUTHWEST BROWARD/NORTHWEST DADE SUBREGION

Species	FWS	GFC	Comments
Everglades Mink	UR2	T	1
Round-Tailed Muskrat	UR2		1
Wood Stork	E	E	2
Snail Kite	E	E	2
Southeaster American Kestrel	UR2	T	2
Florida Sandhill Crane		T	1
Osprey		SSC	2
Little Blue Heron		SSC	2
Snowy Egret		SSC	2
Limpkin		SSC	2
Eastern Indigo Snake	T	T	1
Red Rat Snake		SSC	2
American Alligator	T/SA	SSC	2

E = Endangered; T = Threatened; T/SA = Threatened by similarity of Appearance; UR2 = Under review by FWS, but lacking sufficient information for determination; SSC = Species of special concern
1 = Occurrence questionable; 2 = Known to occur.

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) is the primary agency at the federal level responsible for wetlands regulation. The USACE is responsible for regulating activities in waters of the United States, including wetlands. The definition of wetlands used by the USACE is based on vegetation and soil types and conditions in an area as the following definition indicates:

The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adopted for life in saturated soil conditions" (33 CFR, part 328.3(b)).

Florida Department of Environmental Regulation

The extent of the Florida Department of Environmental Regulation (DER) jurisdiction over dredge and fill activities conducted in, or over surface waters of the state are generally found in Rule 17-312.030, F.A.C. Some exemptions appear in Sections 403.813, 403.913, 403.927, F.S., and Rule 17-312.050, F.A.C. The landward extent of surface waters of the state is determined in accordance with Rules 17-3.022 and 17-4.022, F.A.C. and Sections 403.817, 403.8171 and 403.913, F.S. In determining the landward extent of waters of the state, plant and soil indicators are utilized.

South Florida Water Management District

Wetlands that are not connected to waters of the state are considered isolated wetlands and fall under the jurisdiction of the South Florida Water Management District (SFWMD), pursuant to the Isolated Wetlands Rule (Appendix 7 of the *Basis for Review for Surface Water Management Permit Applications*). The criteria of the rule pertain to wetlands which are not under DER jurisdiction. The definition of wetlands used in the rule is similar to that used by the USACE in that it depends on vegetation and soil type and conditions for wetland determination.

Dade County

Dade County's wetlands jurisdiction in the study area is derived from Chapter 24 of the Dade County Code. Section 24-58 gives Dade County Department of Environmental Resources Management (DERM) the authority to regulate work in freshwater wetlands. The definition of freshwater wetlands is contained in Section 24-3(79)(a) and is based on vegetation and/or hydrology. Vegetatively, "freshwater wetlands shall mean those lands where the dominant plant community is composed of any of the following primary wetland plant species or where an association of any of the following primary and secondary wetland plant species constitutes the dominant plant community." A plant list is contained in the code. The hydrological criteria include "those lands which are subject to soil saturation conditions (i.e., groundwater levels no lower than one foot below surface elevations) for a minimum of thirty (30) consecutive days per year based on an average of data for a minimum ten-year period." Section 24-3(79)(b) exempts certain areas from wetlands jurisdiction including excavations that are not contiguous to wetlands, stormwater management systems and grandfathered agricultural development. The majority of

the study area west of the Homestead Extension of the Florida Turnpike which remains as undeveloped wetlands will be jurisdictional pursuant to Dade County Code, as will be other more limited wetlands that may exist east of the Turnpike.

Broward County

In Broward County, the Environmental Quality Control Board (EQCB) has been given regulatory authority for wetland resources. Wetlands are defined as "areas that are inundated by water with sufficient frequency to support, and normally do support, an assemblage of organisms that is adapted to saturated or seasonally saturated soil conditions for growth and reproduction including, but not necessarily limited to swamps, marshes, bogs, sloughs, potholes, wet meadow, river flood plains, mud flats, and wet prairies" (Chapter 27-11.029 of the Code of Regulations of the EQCB).

In order to delineate those areas described above, the EQCB currently uses the methodologies described in Rule 17-3.022, F.A.C., (DER Criteria) with some modifications, and the plant indicator species list in that same section. Unlike DER, EQCB has jurisdiction in isolated wetlands (those not connected to waters of the state). As a result, the EQCB regulates wetlands of all sizes and types that meet the regulatory definition and fall within the boundaries delineated using the methodologies described above.

EQCB applies two formulas, using species listed in Rule 17-3.002, F.A.C., (DER Criteria), to determine dominance of wetland vegetation. Those formulas are simplified here:

The boundary of the landward extent of waters is the area (in the selected stratum) where either:

1. submerged vegetation + transitional vegetation > 50 percent of all plant species;
   and submerged vegetation > 10 percent of all plant species; and
   submerged vegetation > upland species

or

2. transitional vegetation > 80 percent of all plant species, and;
   submerged vegetation < 10 percent of all plant species; and
   upland vegetation < 10 percent of all plant species; and
   substantial, competent evidence using indicators such as hydrology and soils, indicates that area is subject to regular and periodic inundation.

In areas where a visual determination of the wetland line cannot be made, other methods may be used. These are:

1. Belt transects to establish relative basal area percentage - In areas where a canopy is used as the indicator.

2. Belt transects to establish relative density percentage - In areas where a subcanopy is used as the indicator.

3. Line transects to establish percentages of individuals or cover - In areas where ground cover is used as the indicator.

The percentages generated from these methods are then substituted for areal extent in the formulas above.

3. Permitting Criteria

U.S. Army Corps of Engineers

It has been estimated by regulatory field office personnel that over 75 percent of the study area falls under USACE jurisdiction. Most of the areas west of I-75 and the HEFT in the study area which have not been filled or developed would require a USACE permit (Schneppel, USACE, personal communication, 1989). The Corps jurisdictional wetlands would require a permit unless they fall under the conditions of a nationwide permit. These are wetlands which would, in general, be less than 10 acres in size, are isolated, and do not serve as habitat for endangered or threatened species. The USACE issues permits only for the deposition of fill or dredged material in wetlands. Removal of material from wetlands above mean high water does not require a USACE permit.

The USACE has entered into a Memorandum of Agreement (MOA) with the U.S. Fish and Wildlife Service (USFWS), the Environmental Protection Agency (EPA) and the National Marine Fisheries Service (NMFS) regarding the review of permit applications for dredge and fill activities. The MOA states that the USACE will coordinate with these agencies during application review and consider their concerns when making a decision on a permit application.

Florida Department of Environmental Regulation

The DER criteria for the permitting of activities in wetlands can be found in Section 403.91, F.S. Permit issuance or denial is discussed under Section 403.918, F.S. Under Subsection 403.918(1), F.S., the applicant must provide reasonable assurance that water quality standards will not be violated; while Subsection 403.918(2), F.S., contains the public interest test (i.e., a determination that a project is not contrary to public interest, or is clearly in the public interest, or if an activity is proposed for Outstanding Florida Waters). In this manner, DER determines whether the project adversely affects public health, safety, or welfare, the property of others, the conservation of fish and wildlife (including endangered or threatened species, or their habitats), fishing or recreational values or marine productivity, and significant historical and archaeological resources. DER also considers the temporary or permanent nature of the project, and current condition and relative value of functions being performed by areas affected by the proposed activity. If the applicant cannot meet the criteria for issuance, the department may consider mitigation of the adverse impacts.

South Florida Water Management District

Unlike DER and USACE criteria, the Isolated Wetlands Rule distinguishes between disturbed and non-disturbed wetlands; disturbed wetlands being those which have been "altered by drainage, dredge and fill, or invasive exotic plants so that the hydrologic and biological functions are significantly diminished". Under this definition, the majority of the wetlands in the study area are often exempt from SFWMD isolated wetlands permitting. The Isolated Wetlands Rule also only applies to those areas greater than 0.5 acre. If a project will impact an isolated wetland greater than 0.5 acre, regardless of surface water management permitting criteria, the applicant would need to obtain a permit or exemption from the SFWMD.

Dade County

Dade County's permitting criteria are codified in Section 24-58.3(A) of the Dade County Code and require evaluation of "the potential adverse environmental impact and cumulative adverse environmental impact of the proposed work, including but not limited to the effect upon hydrology, water quality, water supply, wellfields, aquifer recharge, aesthetics, public health, historic values, air quality, marine and wildlife habitats, archaeological values, marine and freshwater soils suitable for habitat, floral and faunal values, rare, threatened and endangered species, natural flood damage protection, wetland values, land use classification, recreation, and any other environmental values, affecting the public interest." The *Dade County Freshwater Wetlands Permit Guidelines Manual* provides some additional guidance, although permitting decisions are ultimately made on a site by site basis. DERM is currently in the early phases of a study to develop a basin-wide plan for wetland resources and stormwater management in the North Trail Basin which is in the southern portion of the study area.

Broward County

The criteria that EQCB currently employs in determining whether a project should be licensed or not is found in Section 27-11.051 of the Code of Regulations of the EQCB which states:

"No dredge and fill license shall be issued in the absence of an affirmative demonstration that:

a. The project will not cause degradation of the water beyond those water quality standards as established by EQCB Ch. 27 and Rule 17-3, F.A.C. for the category of water affected by the proposed project;

b. The project will not materially or substantially interfere with recreational use of waters of the propagation of fish or wildlife or their habitats;

c. That any fill material used shall be free of garbage, rubbish, refuse, materials capable of being decomposed, or other contaminants;

d. That the project will not cause turbidity exceeding 29 Nephelometric Turbidity Units (NTUs) above ambient, or pre-construction readings, outside of a mixing zone which will be established by the EQCB;

e. That when considering all aspects of the project, including economically feasible alternatives, pollution control features, and mitigation, the potential for project related environmental impact has been acceptably minimized."

4. Mitigation Criteria

U.S. Army Corps of Engineers

In February 1990, the USACE entered into a Memorandum of Agreement (MOA) with the EPA which articulates "the policy and procedures to be used in the determination of the type and level of mitigation necessary to demonstrate compliance" with the Clean Water Act. The MOA expresses the intent of the USACE and EPA to "restore and maintain the integrity of the physical and biological integrity of the nation's waters, including wetlands". The MOA addresses the following mitigation policies:

a. mitigation shall mean avoiding impacts, minimizing impacts, rectifying impacts over time and compensating for impacts;

b. the USACE will strive to achieve a goal of no overall net loss of wetland values and functions, realizing that no net loss may not be achieved in each and every permit action;

c. the determination of what level of mitigation is appropriate is based on the values and functions of the impacted wetland;

d. the preferred methods of mitigation are as follows, in most preferred to least preferred:

   1) avoidance;
   2) minimization of impacts; and
   3) compensatory mitigation, preferably on site, in kind, and adjacent to the impacted area; mitigation banking may be acceptable for specific projects;

Monitoring is required for mitigation areas to determine compliance and whether the purposes of the mitigation is actually being achieved.

Florida Department of Environmental Regulation

With regard to the DER's criteria for granting or denying permits, Section 403.918(2)(b) F.S. calls for additional criteria to be utilized when an applicant is unable to otherwise meet the criteria for permit issuance. In this instance, the department will consider measures to mitigate the adverse impacts of dredging and filling in waters of the state. The criteria for evaluating mitigation proposals is detailed in Rule 17-12-3, F.A.C.

In each case, the DER must first examine project modifications that reduce or eliminate the adverse environmental impacts of the project. Once these negative aspects are identified, a mitigation proposal may be developed to offset the expected adverse impacts so that the project is not contrary to the public interest. In the case of projects adjacent to designated Outstanding Florida Waters, the project must be shown to be clearly in the public interest. A mitigation proposal is required to include a description of the mitigation area, description of the referenced waters, description of the proximal habitat, a monitoring plan, estimate of the cost of mitigation, and show sufficient legal interest.

Mitigation proposals are evaluated on a case by case basis. The department must determine the probability that the proposed mitigation plan will offset the cumulative adverse impacts of the dredging and filling (i.e. the likelihood that the mitigation will be successful). Reclamation activities may be viewed as mitigation with respect to mining activities. Mitigation is best addressed through protection, enhancement or creation of the same type of waters as those being affected by the proposed project. Other types of mitigation may be considered, when the waters have been significantly altered by human activity or other factors.

For mitigation involving the creation of waters of the state, DER utilizes a guideline of two acres created for each acre adversely impacted by a proposed dredge and fill activity. This ratio may vary depending on the following factors:

a. likelihood of success;
b. distance from the project site;
c. elapse of time before restoration of impacted functions within the water body;
d. special designation or classification of the affected water body;
e. current condition of the area to be affected;
f. uniqueness of the waters;
g. the presence or absence of exotic or nuisance plant species; and
h. whether the proposed project eliminates waters or changes waters from one type to another.

Ratios for "created mitigation" generally range from less than 1:1 (one acre created for each acre lost) up to 5:1.

Because the success rate in plantings has been emphasized, the department will consider enhancement as mitigation. For enhancement proposals, DER will evaluate the degree to which the wetlands are stressed, type and cause of stress, maintenance requirements, and likelihood of success. "Enhancement" mitigation ratios usually range from 4:1 to 20:1.

"Conveyance of property" is another method of mitigation. The lowest quality conveyance would be considered at a ratio of 100:1, while the highest quality conveyance would not be granted a ratio lower than 10:1.

Also, the department examines what means have been provided to protect a mitigation area, to remove exotic or nuisance plant species, to locate a mitigation area on or off-site, to identify the use and location of donor sites for plant and/or soil material, and to provide evidence of the financial resources necessary to conduct mitigation activities.

Determination of success for mitigation projects is generally determined by comparing the mitigation to a referenced water. The criteria used to judge a project's success includes whether applicable state water quality standards are met, whether hydrological requirements are met, whether specific permit requirements are met, and whether the created or enhanced water can be used for its designated purpose.

Dade County

Pursuant to Section 24-58.4 of the Dade County Code, mitigation is available as an option for projects which are acceptable under the above mentioned evaluation factors and are permittable under all applicable laws but which result in adverse environmental impact. Mitigation is to be limited to unavoidable impacts. The following procedures have been identified and prioritized for evaluating mitigation proposals:

a. Avoiding the impact altogether by not taking a certain action or parts of an action;

b. Minimizing impacts by limiting the degree or magnitude of the action or its implementation;

c. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

d. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;

e. Compensating for the impact by replacing or providing substitute resources or environments.

Different procedures have been used in attempts to evaluate mitigation needs including the USFWS Habitat Evaluation Procedures and various decision matrices. In general however, mitigation needs are based on best professional judgement of staff biologists.

Broward County

Before mitigation is reviewed for acceptability, several things must happen in the licensing process. First, there must be a demonstration of a reasonable need for destruction or alteration of wetlands. Then, there must be a demonstration that no economically feasible alternative exists and lastly there must be a demonstration that the impacts have been minimized before mitigation is reviewed.

Once these steps have been taken, mitigation offered for remaining impacts is reviewed and accepted or denied based on the following general guidelines:

a. Replacement wetlands should be of similar type as the impacted wetlands;

b. Replacement wetlands should be in the vicinity of the impacted wetlands;

c. There must be reasonable assurances that the design and type of replacement wetlands will have a high degree of success;

d. Functions being provided by the proposed impacted wetlands must also be provided by the replacement wetlands;

e. In determining an appropriate ratio for created wetlands a base of 2:1 is used, however depending upon the degree of success, rate of growth to maturity, quality and type of impacted wetlands, etc., either a higher or lower figure may be used. In enhanced wetland mitigation proposals, a base of 4:1 is used again, however, with various factors as above either increasing or decreasing the ratio;

f. The applicant must demonstrate a commitment to ensure the successful reestablishment of wetlands within the mitigation area. This would include factors such as removal of exotic and nuisance plant species, monitoring of ground or surface water elevations, replacement of dead or diseased plants (80 percent survival rate), and redesign of the mitigation area where unanticipated factors precipitate failure of the site or a portion thereof.

5. Enforcement and Compliance

U.S. Army Corps of Engineers

Enforcement of the federal wetlands regulations is carried out by the district and regulatory field offices of the U S. Army Corps of Engineers as described in Section 404 of the Clean Water Act. In a worst case, the EPA would take enforcement action; in most cases, the USACE does.

There are two types of enforcement actions. The first is for illegal (non-permitted) activity. In these instances, warning letters are issued and a cease and desist order is issued for the property. The violator must then apply for an after-the-fact permit. No further work can continue until the USACE decides whether to issue a permit. The second type of enforcement action is if an applicant is in violation of the conditions of a permit. In this instance, a stop work order is issued and the violator must come in compliance with the conditions of the permit.

Florida Department of Environmental Regulation

The department's policies on compliance are based on internal policies which are based upon available staff. DER is given authority to conduct enforcement activities in Section 403.061, F.S., (Department powers and duties), Section 403.087, F.S., (Permits: general issuance, denial, revocation, prohibition, and penalty), Section 403.121, F.S., (Enforcement: procedures and remedies), Section 403.141, F.S., (Civil liability), and Section 403.161, F.S. (Prohibitions, violations, penalty and intent). Enforcement priorities in the Southeast District Office of which the study area is in part are geared towards:

1. compliance with an issued permit;
2. construction before permit issuance; and,
3. unpermitted dredge and fill activities.

After-the-fact permitting is viewed as a response to a violation. The department's final action will be dependent upon the severity of the adverse impact on waters of the state.

Dade County

Enforcement actions can be initiated via several different pathways. Potential violations may be observed directly in the field by wetlands permitting staff, compliance inspectors, other department staff or concerned citizens. Aerial surveillance via helicopter overflights and review of the county's annual aerial photographs are also used. If staff actually observe the action, they attempt to have it halted based on discussion with the person on site. In addition, some staff have been authorized to issue tickets in the field. Once an illegal action has been halted, it is time to initiate a resolution of the violations which could include restoration or after-the-fact permitting. At this point the code enforcement section generally becomes involved in making sure that the proper information is gathered and procedures followed so that if a satisfactory resolution cannot be negotiated at the staff level more formal enforcement can be undertaken. If departmental efforts to reach a satisfactory resolution are not successful the matter is referred to the county attorney's office for adjudication. The county has a high rate of success in its wetlands enforcement program.

Compliance efforts in the study area are not highly structured in the sense that regular inspections are scheduled and logged. Staff inspections of permitted projects are made when in the vicinity. If discrepancies with the permits are noted, a further investigation is undertaken. In addition, where mitigation is involved, monitoring reports are generally required to provide additional information on the project status.

After-the-fact permitting is generally a result of the enforcement process wherein the violation is resolved at the staff level. There is a penalty involved in that "permits...shall provide twice as much mitigation as would have been required if the...permit was obtained prior to the commencement of construction." (Section 24-58.4, Dade County Code). In addition double permit fees are required for an after-the-fact permit.

Broward County

The EQCB operates with an enforcement section which may issue Warning Letters or Notices of Violations for non-compliance with its code of regulations. It has an administrative hearing process in which a duly appointed hearing officer presides. Fines up to a maximum of $10,000 per day per offense may be imposed for violations of the code.

In cases of non-compliance with dredge/fill license conditions or regulations, attempts are arduously made to resolve the issues prior to taking enforcement action. Only after negotiations fail to resolve the issues, are enforcement actions considered through coordination with the enforcement section. The main goal, in any case, is to restore or ensure the viability of the resource.

Within the last year, the Dredge and Fill Section has established a computerized data base and implemented periodic field inspections to assist in tracking the progress and success of all mitigation projects. This tracking system coupled with periodic field-compliance inspections ensures compliance with the license requirements and success of the mitigation. It is anticipated that this system will provide an extremely high degree of compliance with licensed projects.

In cases where activities have begun without the appropriate licenses, a Notice-of-Violation is issued. The enforcement action must be resolved prior to the review of a license application. If the application would have been denied based upon the nature and extent of the activity, attempts at restoration of the site or nearby sites are pursued. If the activity would have been licensed, appropriate fines and costs are assessed and an application requested for remaining portions of the project.

6. Invasive Exotic Plants

The Melaleuca, native to Australia, was introduced to Florida as part of the effort to drain the Everglades. The plant has a high rate of transpiration and removes large amounts of water from the soil. Melaleuca is considered to be an ecologically undesirable species. Over time, it replaces native vegetation communities with dense, monotypic stands that are considered to afford poor habitat. Melaleuca is tolerant of a wide range of habitats and conditions . It is cold and fire tolerant and develops in both aquatic and terrestrial communities.

Studies have shown that stress (fire, mechanical or chemical) to an individual plant may be particularly conducive to Melaleuca invasion. Anything that causes a 25 percent or greater drop in the moisture content of the plant will result in the release of seeds. Fire, for example, not only causes a massive seed release, but also clears the site of competitors and consumes litter that may prevent germinating seed from reaching soil. Fire also causes a nutrient release within the soil thereby aiding seedling establishment.

Melaleuca constantly produces a large number of small, wind-borne seeds that maintain their viability for several years. Seeds can germinate under water but they cannot tolerate extended periods (5-6 months) of submergence. Seedlings also cannot tolerate long periods of inundation. Yet once mature, the plant can survive flooded conditions indefinitely. During periods of drought Melaleuca root elongation can keep pace with the drop in water table, thereby giving it an advantage over competitors.

Melaleuca invasion is a growing problem in western Dade and Broward counties, especially in WCAs 2B, 3A, and 3B, portions of the East Everglades, and much of the undeveloped land east of the WCAs. In 1977, a study using an aerial survey technique determined that 33 percent of the area in WCA 2 and 3 contained

Melaleuca. Although no follow-up study has been performed in these areas, it can be assumed that the Melaleuca has spread considerably since the rate of spread and the growth of individual plants are astonishingly rapid (Hofstetter, 1976).

Large stands of Melaleuca found in the East Everglades along Krome Avenue are expanding into surrounding disturbed wetlands. In addition, large stands have established themselves in Broward County along U.S. 27 and areas east. There is concern that without adequate control, Melaleuca will continue to invade much of South Florida's wetlands, replacing native wetland flora and adversely altering native wildlife habitats.

Studies of the effects of an area's hydrology on the establishment of Melaleuca have shown that higher groundwater can limit but not curtail expansion. The increased water flow into areas east of U.S. 27 resulting from additional storage of water in the WCAs has not contributed significantly to the recovery of the wetlands. Experts indicate that a 100 percent hydroperiod is required to limit the expansion of Melaleuca.

South Florida wetlands systems are undergoing stress from the invasive exotic Melaleuca and although some areas are stressed more than others, the invasion is serious. The mere preservation of existing wetlands in their present condition will not stop the invasion and therefore preservation may not be the most appropriate means by which to guarantee long-term wetland viability in either value or function.

Dade County has implemented an exotic species control program aimed at controlling Melaleuca infestation adjacent to Everglades National Park. It is a mitigation program in which developers who are impacting wetland resources may, with County approval, mitigate by contributing to the program. The SFWMD has drafted a proposal for control of Melaleuca district-wide. This will be implemented through the Everglades Surface Water Improvement and Management (SWIM) Plan and involves both research and eradication of the species.

Another invasive exotic species prevalent in the study area is Brazilian pepper (*Schinus terebinthifolius*). The red berries produced in the late fall and winter have lead to the common name of Florida holly. It has been used as a landscaping plant; however, it quickly invades disturbed land and becomes the dominant plant, outcompeting all other vegetation. Brazilian pepper forms such dense stands that it blocks out the light so no other plants can grow (Lassater, 1974). While it may not increase evapotranspiration like Melaleuca, it does take over an area, especially if the areas has been disturbed. That is why thick stands of it are found along roads and dredged canals. Eradication of Brazilian pepper is also very difficult. New plants will grow from stumps of cut trees and unless the root system is removed the plant will grow back over time.

7. Methodology for Protecting Fish and Wildlife Resources

The incorporation of fish and wildlife considerations into growth management planning is becoming both more common and more important (Mason and Iker, 1982; Kautz, 1984; Westman, 1986; Roberts and Roberts, 1986) but has been limited by lack of information, and lack of a suitable scientific method for quantifying

existing regional fish and wildlife resources and the probable impacts to them from alternative methods of project development. Several papers have discussed criteria and methods for evaluating regional fish and wildlife resources (Adamus and Clough, 1978; Klopatek et al., 1981; Margules and Usher, 1981; Kautz, 1984). All have emphasized the importance of quantitative approaches to assess fish and wildlife resources. New multivariate habitat modeling methods, based on various land and water uses and natural vegetation types, show great potential for furthering our ability to predict the distribution and abundance of fish and wildlife at regional levels (Clawson et al., 1984; Klopatek and Kithchings, 1985). An important principle is that effort expended on data collection and analysis should be commensurate with the perceived impact of the proposed action. In general greater effort should be expended on projects that are expensive, cover large areas, impose serious environmental risks, and may be controversial. All of these factors are important in the Southwest Broward/Northwest Dade Subregional Study.

a. Scientific framework

Figure 11 presents a scientific framework for planning studies of regional fish and wildlife resources. A clear statement of goals is necessary to focus research, and can increase the chance of protecting components of the environment identified as valuable (National Research Council, 1986).

The scoping process identifies important ecosystem components, significant issues and major potential environmental effects, and guides the design of ecological studies. The scoping process can also be used to do a subjective assessment of regional fish and wildlife resources. One of the most important and difficult tasks in the design of environmental research is to decide when, for how long, and over what area effects might occur and what aspects of ecosystem structure and function will be affected. The next steps (inventory through monitoring) in the process are the heart of fish and wildlife habitat evaluation systems.

Figure 12 is a conceptual approach to integrating fish and wildlife evaluation systems with both site design and regional planning. The proposed methodology includes an inventory of existing fish and wildlife habitat conditions, an analysis of existing and proposed land and water uses, a prediction and assessment of impacts, a decision and action phase, and monitoring.

b. Inventory of existing fish and wildlife habitat conditions

The first step in an inventory process is to identify, map and evaluate available wildlife habitat types (Leedy et al., 1978; Jones, 1986). Habitat types can be identified, in part, from good vegetation maps. The relative value of the available habitat types should be determined. Exceptionally sensitive unique or rare habitats, as well as habitats for species of special concern (especially threatened and endangered species) should be protected. The relative value of the remaining habitats should also be evaluated. The diversity, distribution and abundance of fish and wildlife species in the available habitats should be determined. To a certain extent this can be done by reviewing the available literature, but this is not a substitute for field surveys. Wildlife surveys are

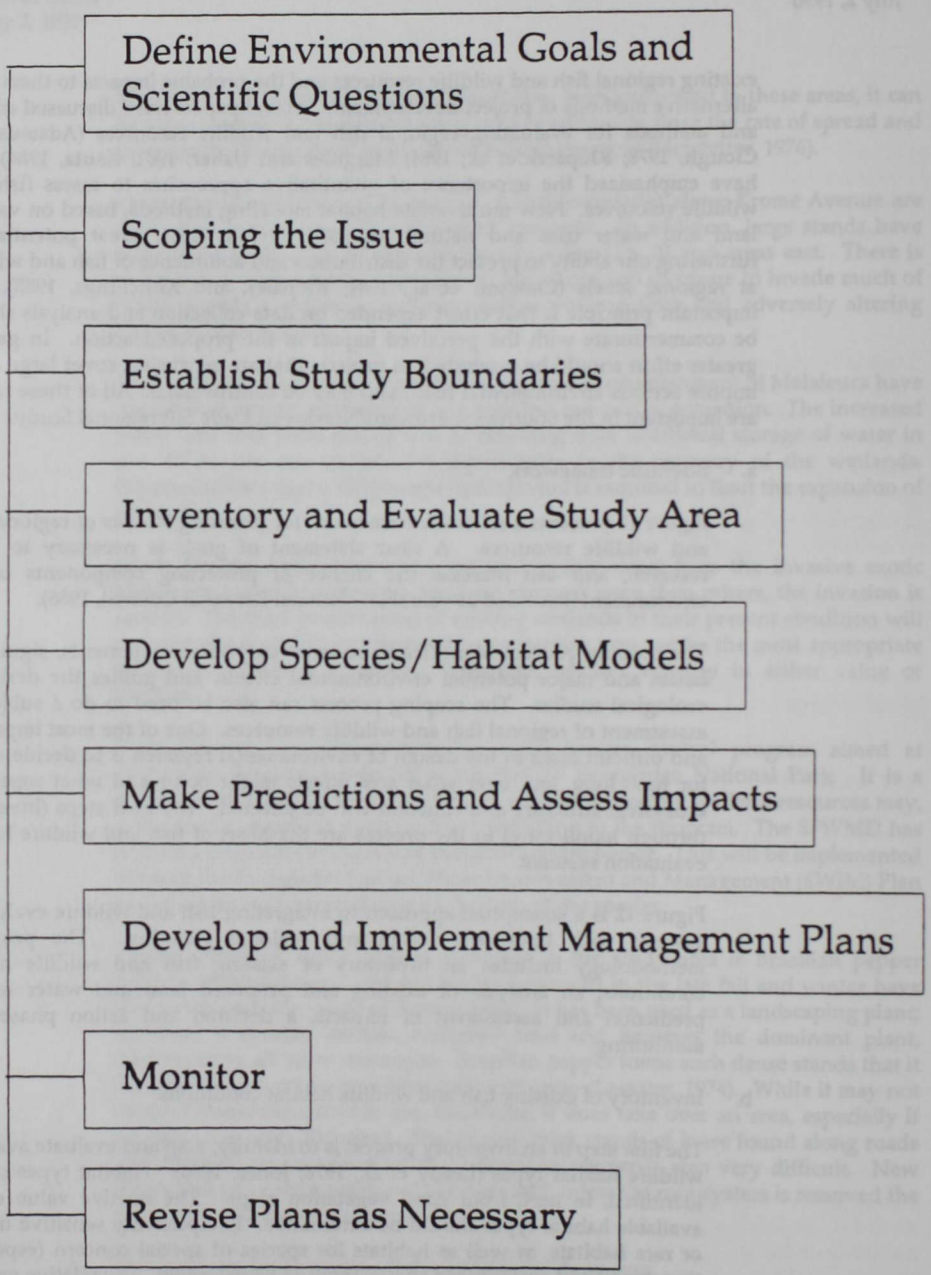


Figure 11. Scientific framework for integrating fish and wild life concerns into growth management plans.

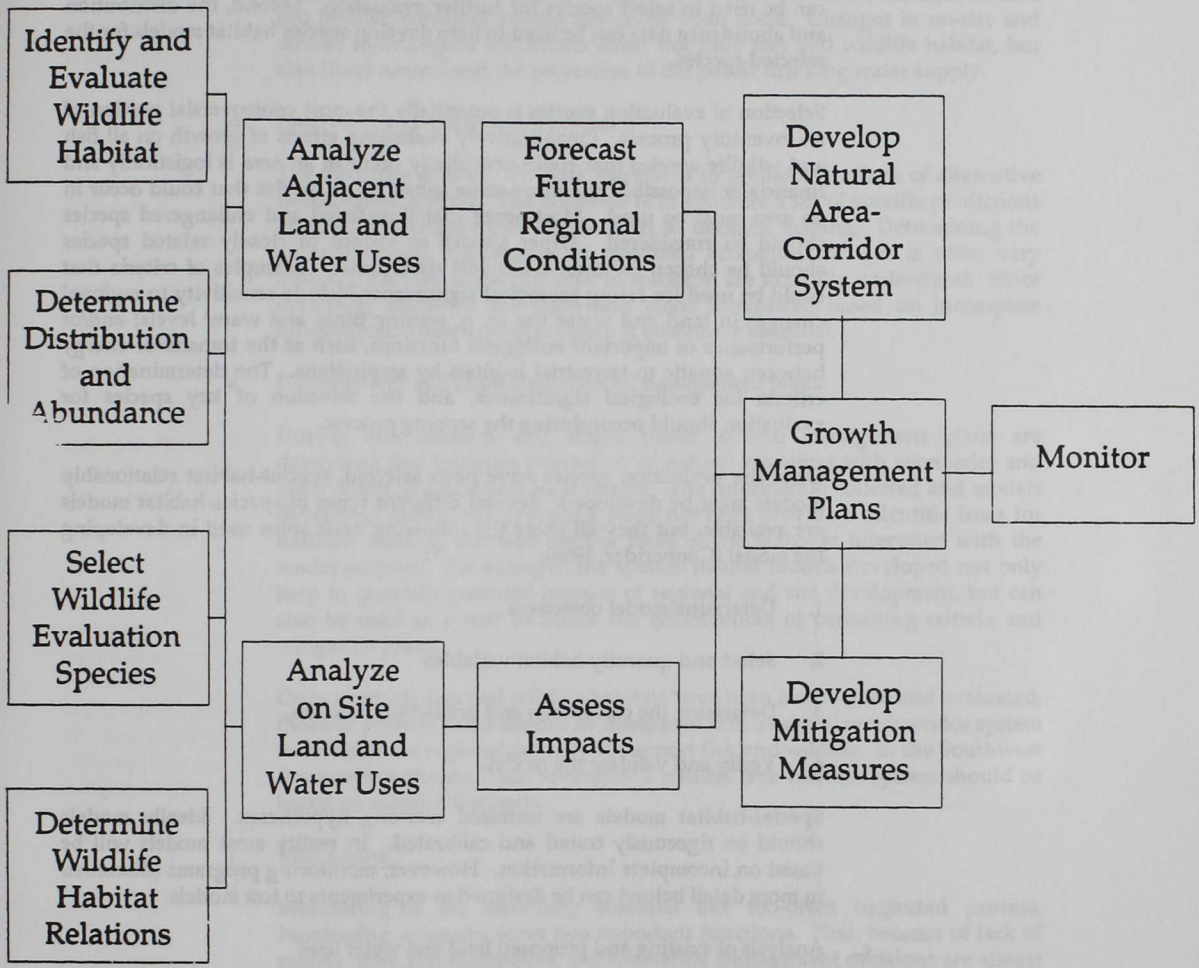


Figure 12. Integrating Fish and Wildlife Habitat Evaluation with Site Design and Regional Planning.

important for two reasons. First, the species list developed from the inventory can be used to select species for further evaluation. Second, the distribution and abundance data can be used to help develop species habitat models for the selected species.

Selection of evaluation species is potentially the most controversial portion of an inventory process. Quantitatively evaluating effects of growth on all fish and wildlife species that could potentially occur in an area is logistically and financially impossible, therefore some subset of all species that could occur in an area must be used. Most agree that threatened and endangered species should be considered. Other species or groups of closely related species should be chosen for their ecological significance. Examples of criteria that could be used for rating ecological significance include sensitivity to regional changes in land and water use (e. g. wading birds and water levels) and/or performance of important ecological functions, such as the transfer of energy between aquatic to terrestrial habitats by amphibians. The determination of criteria for ecological significance, and the selection of key species for evaluation should occur during the scoping process.

Once the evaluation species have been selected, species-habitat relationship models must be developed. Several different types of species-habitat models are available, but they all share the following basic steps used in developing the model (Cooperider, 1986):

1. Determine model objectives

2. Select and quantify habitat variables

3. Determine the correlation and prediction function

4. Verify and validate the model.

Species-habitat models are untested working hypotheses. Ideally models should be rigorously tested and calibrated. In reality most models will be based on incomplete information. However, monitoring programs (discussed in more detail below) can be designed as experiments to test models.

c. Analysis of existing and proposed land and water uses

Planning for wildlife must take into consideration adjacent and on-site land and water uses. Large, permanent, open space areas immediately adjacent to the planning area should be connected by corridors to large open space areas preserved within the planning area (Leedy et al. 1978). This connectivity increases the value of fish and wildlife habitat available throughout the region. It is important to remember that some isolated areas (for example, seasonal wetlands) are valuable and may have unique values.

Analysis of site design for proposed land uses can be used to assess environmental impacts and to mitigate environmental losses. Mitigation sites can become corridors linking preserved open areas. Changes in on-site and off-site hydrological conditions affect not only fish and wildlife habitat, but also flood control and the protection of the public drinking water supply.

d. Prediction and assessment of impacts

The next step is to use the data assembled to predict the effects of alternative management actions. The objective is to generate a set of specific predictions of ecological change that can be used in decision making. Determining the magnitude and significance of predicted ecological changes is often very difficult, because the ecosystems in question are not fully understood. Since invariably decisions are made and plans formulated based on incomplete information, a monitoring program is absolutely essential.

e. Development and implementation of management plans

During this decision and action phase growth management plans are developed that integrate protection of natural resources with economics and other social, political and legal factors. The information collected and models developed during the preceding steps not only provide a scientific basis for decision making, but also become tools of the manager interested with the model outputs. For example, the species habitat models developed not only help to quantify potential impacts of regional and site development, but can also be used as a tool to assess the effectiveness of permitting criteria and mitigation plans.

Once available fish and wildlife habitats have been inventoried and evaluated, those of greatest value should be integrated into a natural area/corridor system to enhance the regional capacity to support fish and wildlife. In the Southwest Broward/Northwest Dade Subregion a natural area-corridor system should be based on existing wetlands.

f. Monitoring

Monitoring is an absolutely essential but too-often neglected process. Monitoring programs serve two important functions. First, because of lack of money, time and techniques, environmental management decisions are almost always based on incomplete information. Through monitoring, it is possible to empirically test the predictions of impacts to fish and wildlife resources. If management plans are not meeting the desired objectives within tolerable limits then it is possible to modify management plans (Holling, 1978). Second, monitoring also increases our knowledge of how ecosystems work and respond to man's interference. Thus, monitoring also refines our predictive tools, which in turn improves our ability to make future management decisions.

8. Preliminary Wetland Analysis Methodology

Preliminary information regarding wetland conditions in the study area has been compiled and is presented in Figures 13 and 14. This includes general ground cover and hydrology. The following describes how each were determined.

General Ground Cover

The general ground cover in the study area was determined using a land cover classification system established by the SFWMD. Dade County Planning Department has mapped the ground cover in that portion of the study area under a contract with the SFWMD. This was done through interpretation of 1988 aerial photography and ground truthing. Broward County EQCB has done the same for the Broward County portion of the study area using 1989 aerial photographs. General vegetation types indicate if an area is able to support wetland plant species.

Soils

The hydric soil delineation was determined from interpretation of the Soil Conservation Service soils maps. Hydric soils are those that retain water, allowing an area to support wetland vegetation if the proper hydrology exists. The majority of the study area exhibits hydric soils.

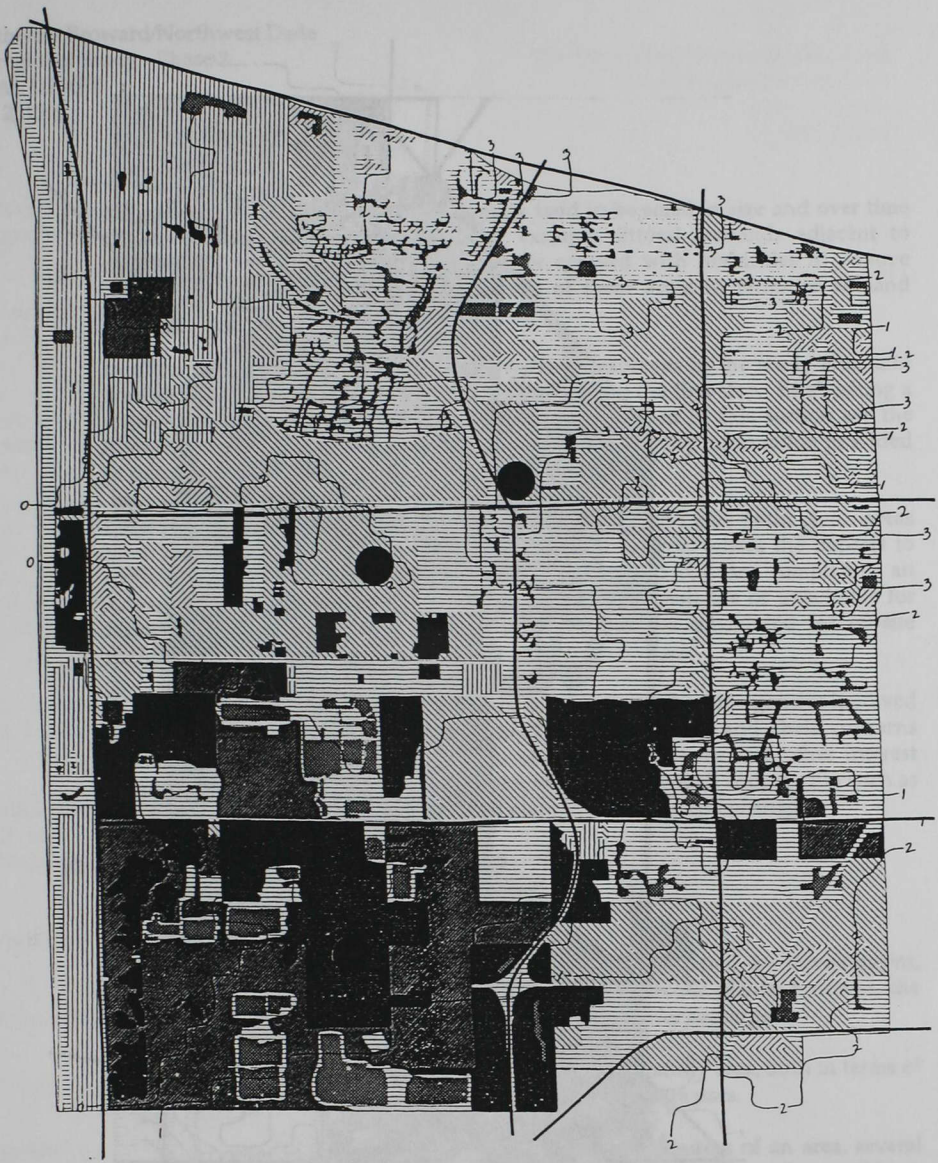
Hydrology

The typical depth to the water table (in feet) was calculated for the study area by the USGS. This was done using land elevation data and water level data from the 1984 wet season (October) and 1985 dry season (May). These dates are representative of the wet and dry seasons, respectively, in the study area and the data was readily available. The difference between the land elevation and the water level is the depth to the water table. This was done using a geographic information system. The water level over the entire study area was interpolated from the available limited data. For Broward County, USGS data from four wells and the canals was used. In Dade County, the data from the Northwest Wellfield was used. Figures 13 and 14 were compiled using the wet season water table elevations to show the wetter period. With more extensive data, a more accurate evaluation of the hydrology in the study area can be made.

The information in Figures 13 and 14 is a first step in understanding the wetlands of the study area. For example, those areas exhibiting a high water table and general freshwater wetland ground cover could be examined more closely in terms of their value for habitat and groundwater recharge. Figures 13 and 14 can help in identifying those areas which could potentially be used for mitigation banking or incorporation into other types of wetland resource management plans.

9. Basin-wide Wetlands Permitting and Mitigation Alternatives

Traditionally, wetlands planning has been carried out through the permitting process. This leads to piece-meal resource preservation and mitigation. While wetland impacts to a site may be small, the cumulative impacts of such actions need to be considered.



South Florida Regional Planning Council

Broward County General Existing Land Cover and Estimated Depth to Water Table-Wet Season (October 1984)

MELALEUCA IMPACTED
FRESHWATER WETLANDS
WATER
DEVELOPED
UPLAND VEGETATED-GRASSLAND
UPLAND VEGETATED-FORESTED
MELALEUCA DOMINATED
MONITORING WELLS

–2– depth to water table (feet)

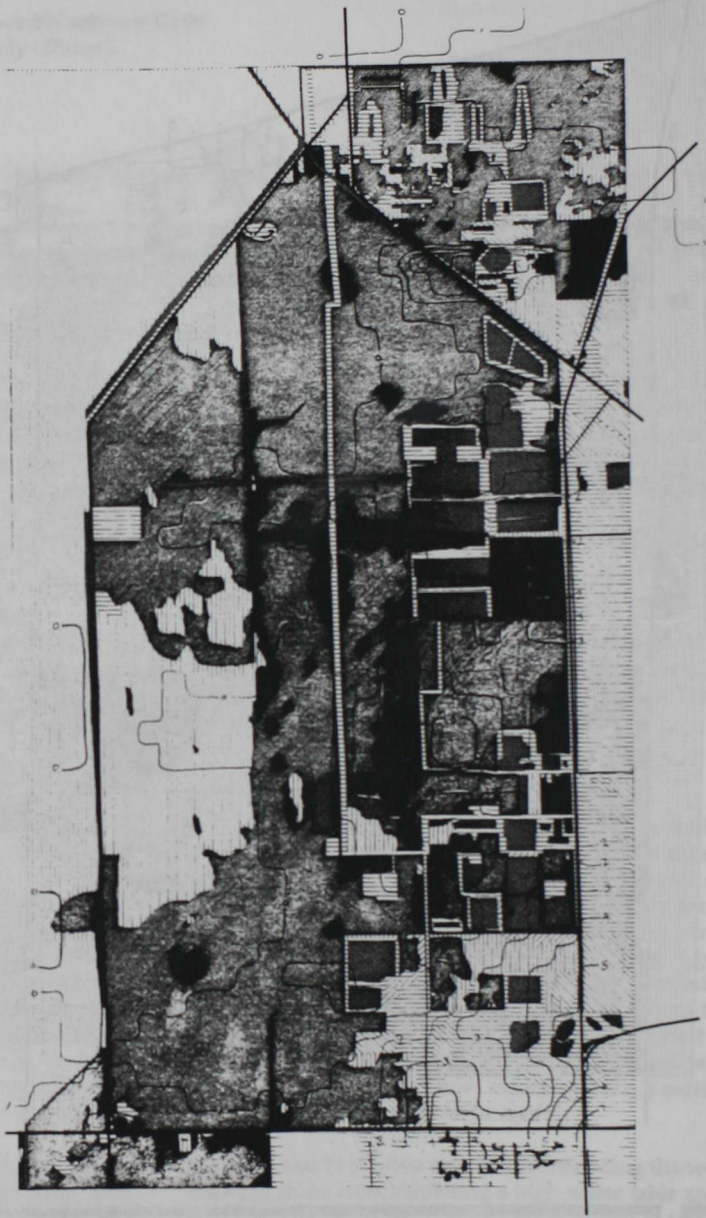
Source: U.S. Geologic Survey, Broward County Environmental Quality Control Board

FIGURE 13

N

1 Mile

June 1990



South Florida Regional Planning Council

Dade County General Existing Land Cover and Estimated Depth to Water Table-Wet Season (October 1984)

MELALEUCA IMPACTED
DEVELOPED
UPLAND VEGETATED-FORESTED
FRESHWATER WETLANDS
UPLAND VEGETATED-GRASSLAND
MELALEUCA DOMINATED
WATER

–2– depth to water table (feet)

Source: U.S. Geologic Survey, Dade County Planning Department

FIGURE 14

N

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Mitigation for site specific wetland impacts tend to be small in size and over time are effected by the development. For example, littoral wetlands adjacent to residential areas are often mowed down or sprayed with herbicides to remove "obnoxious plants." This limits the benefit of these areas in terms of wetland habitat.

In order to better plan for and manage wetland resources in the study area, and South Florida, a basin wide or regional plan would be the first step. Establishing a wetlands goal through programs such as those described in this section are the basis for effectively managing the resources. The preliminary information provided in this report can be the beginning of the process.

Dade County has begun a similar process through its Bird Drive Basin plan. Areas have been identified for mitigation "banks" as well as areas where the impacts to wetlands can be mitigated off-site. The EPA and USACE are completing an Advance Identification study which designates areas as suitable or unsuitable for filling. Those areas designated as unsuitable could be considered for off-site mitigation areas.

In order to implement a regional wetlands management plan, all agencies involved in wetland planning and regulation need to be involved and their concerns addressed. In addition, representatives of the private sector and other interest groups need to be included in plan development. It is through cooperation such as this that a regional approach to wetlands planning can be accomplished.

10. Findings and Recommendations

1) Findings: **Wetlands Evaluation**

- The wetlands of the study area have been impacted by development, drainage, wellfield withdrawals, and invasive exotic plants; however, the area still is valuable for wildlife habitat and aquifer recharge.

- A better understanding of wetland value in the study area, both in terms of biology and hydrology, is needed to plan for future uses.

- In order to adequately evaluate the wetland resources of an area, several factors must be considered, including vegetation, soil conditions, hydrology, and fish and wildlife resources.

- There is a lack of comprehensive data for water levels within the study area. The hydrologic conditions of the study area have been estimated using modeling based on the limited available water level data.

Recommendations

a) An appropriate scientific methodology similar to the one presented in Part 7 of this section should be used for further evaluation of the habitat value in the study area and development of a regional habitat plan. Pertinent elements include defining goals, establishing issues,

establishing study boundaries, evaluating the study area, developing species and habitat models, assessing impacts, developing management plans, and monitoring.

b) The information regarding wetlands resources presented in this report should be considered as a basis for preliminary evaluations of existing wetland resources.

c) A program to more fully understand the hydrology of the study area should be developed. Existing conditions need to be determined and future impacts anticipated in order to fully assess the wetland characteristics of the study area.

2) Findings: **Wetlands Permitting and Management**

- Wetland protection and management is accomplished primarily through the permitting process. This leads to site-specific consideration of the resource instead of regional or basin-wide consideration.

- Mitigation for projects which impact wetlands tend to be isolated and provide benefits different than those associated with large wetland areas or pre-development conditions.

- Basin-wide and regional wetland planning efforts have been initiated in the study area, including the direction given in the Dade County Comprehensive Development Master Plan and the Advance Identification study currently being completed by the EPA and USACE.

- Effective resource management must be based on thorough identification of the resource.

- Wetlands management includes identifying areas for preservation and mitigation banking.

Recommendation

a) Those agencies responsible for wetlands regulation and management within the study area should manage wetland resources on a regional scale in cooperation with one another. An approach such as the one outlined in Recommendation 1(a) above should be used.

b) Regional land banking for mitigation and wetlands management is encouraged.

3) Findings: **Jurisdictional Issues**

- Wetland regulation and permitting in the study area are carried out by various agencies at different levels. Different standards and criteria make this a difficult process to administer and with which to comply.

- Most of the study area may be under the jurisdiction of one or more wetland permitting agency.

Recommendation

Coordination between the agencies involved in wetland definition, jurisdiction and mitigation requirements should be furthered through interagency agreements based on regional planning. Concurrent agency review of permitting activities in wetlands is strongly recommended.

4) Findings: **Invasive Exotic Plants**

- Invasion of exotic plants, particularly Melaleuca, threatens wetland resources within the study area. Over time such species outcompete native wetland vegetation and form a monoculture that provides little of the habitat value typically associated with wetlands.

- Other invasive exotic species often found in disturbed wetlands, such as Australian pine and Brazilian pepper, are becoming more prevalent.

Recommendations

a) Coordinated efforts to eradicate invasive exotic plant species should be implemented. Inter-agency programs, such as the SFWMD Melaleuca Control Program, should be used to coordinate and implement eradication efforts.

b) Programs should be developed to address the eradication of other exotic invasive species, such as Brazilian pepper and Australian pine.

5) Finding: **Other Wetland Impacts**

- Impacts to wetlands occur not only through dredging and filling, but through more indirect means as well. For example, lowering the water table for drainage and potable water withdrawal also adversely impact adjacent wetlands.

Recommendation

Activities such as land use amendments and permits for dredge and fill should be reviewed for secondary impacts to wetlands in addition to direct impacts.

IV. INFRASTRUCTURE

A. Surface Water Management

1. Introduction

Because of the relatively small distance between the land surface and the water table, the study area is subject to flooding. The land elevations average five feet above sea level in this part of the region. The average wet season water elevation varies from three to five feet above mean sea level and is highest in the western part of the study area close to the Water Conservation Areas (WCAs) where water is stored several feet higher. Because of flooding, an extensive drainage infrastructure system has been put in place. This involves the South Florida Water Management District's primary drainage system, the secondary drainage systems of the drainage districts (in Broward County) and Dade County DERM, and the tertiary systems specific to a project.

2. Primary Drainage System

Figure 15 illustrates the primary drainage system in the study area.

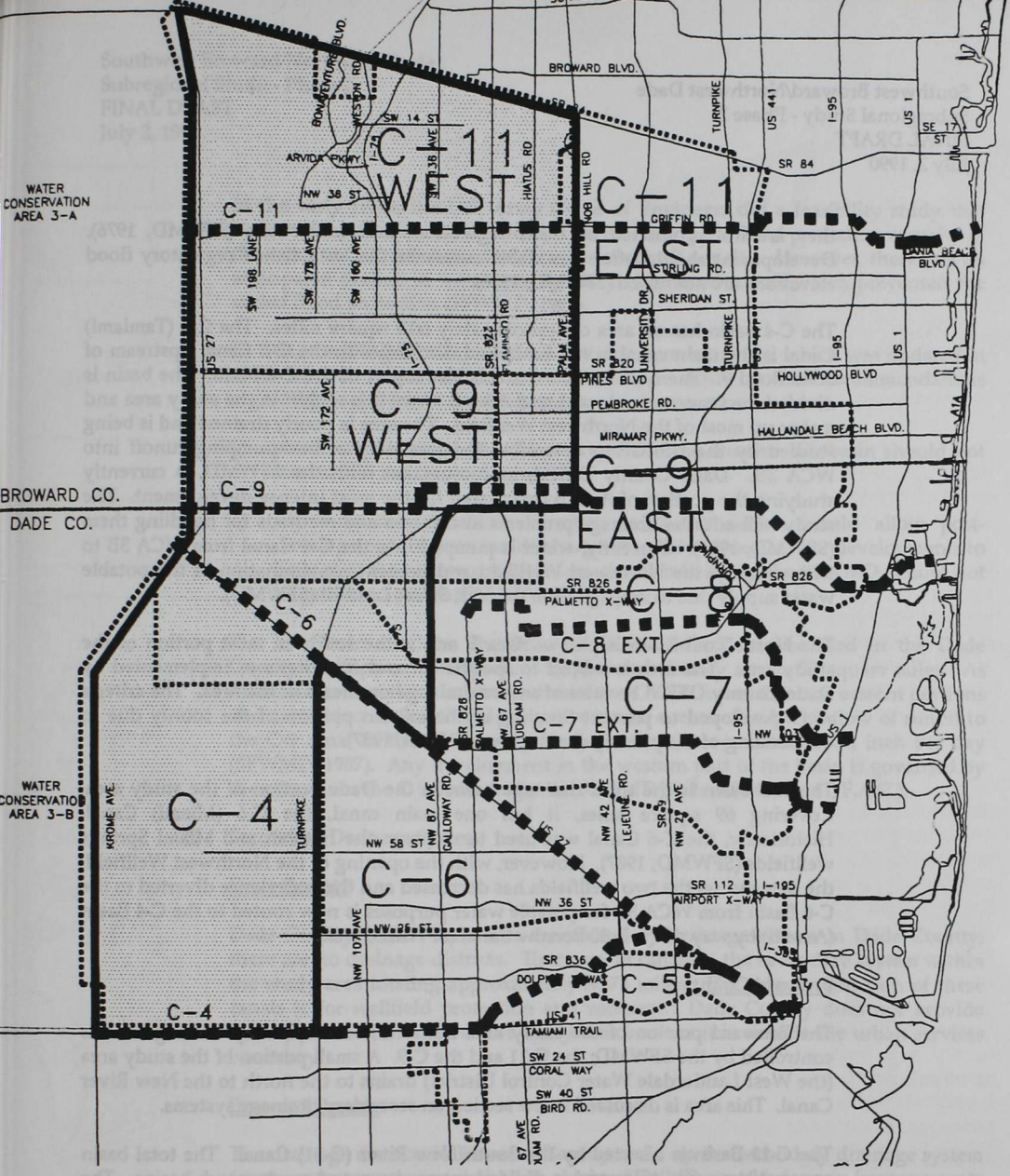
Dade County

The Dade County portion of the study area is divided into basins by SFWMD canals and levees. There are three major drainage basins in the Dade portion of the study area: C-9, C-4 and C-6.

The C-9 Basin straddles the Broward-Dade border and is divided by the C-9 (Snake Creek) Canal. It covers 98 square miles; 39 square miles are in Dade County and 59 square miles are in Broward County. It is divided into eastern (45 square miles) and western (53 square miles) sub-basins. The majority of the western basin is within the study area. Excess water from the canal is discharged to Dumfoundling Bay through the S-29 structure. There is no backpumping into the WCAs from this basin (SFWMD, 1987).

The eastern half of the C-9 Canal was designed to handle virtually unlimited inflows from the eastern portion of the basin. However, the western sub-basin is very prone to flooding because of low ground surface elevations relative to the eastern sub-basin. Major storms can reverse flow from east to west because of rapid runoff in the east. Allowable pumped inflow to the C-9 Canal in the western sub-basin is limited to 0.75 inch of runoff per day (SFWMD, 1987).

In 1976, the SFWMD completed a water management study for the western C-9 sub-basin. The study aided in the promulgation of special rules the SFWMD uses for evaluating development in the basin (Rule 40E-41, Part I, F.A.C.). The recommendations of the report included limiting discharge to the system to 0.75 inch per day and recommending land uses that have low flood damage potential such as agricultural, recreational, industrial, and commercial activities, provided



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Primary Drainage Basins

Study Area
Drainage Basin Boundaries
C-4 Primary Basin Name
Primary Canals

Source: South Florida Water Management District

FIGURE 15

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they are not prohibited by other regulations and restrictions (SFWMD, 1976). Development should offer reasonable assurance that established regulatory flood elevations are not raised (SFWMD, 1976).

The C-4 basin has an area of approximately 60.9 square miles. The C-4 (Tamiami) Canal is the main canal in the basin and discharges to the C-6 Canal upstream of State Road 9. The L-30 Borrow Canal is also a part of the C-4 basin. The basin is divided into two areas: Area A and Area B. Area B is within in the study area and makes up most of the Northwest Wellfield. The area is poorly drained and is being studied by the USACE to determine the feasibility of backpumping runoff into WCA 3B. Dade County DERM, in conjunction with the SFWMD, is currently studying the portion of Area B designated for the most intense development. The study will address drainage problems in the area and methods for handling them (SFWMD, 1989). Currently, water is pumped into the C-4 Canal from WCA 3B to help recharge the Northwest Wellfield and prevent contamination of the potable water supply due to seepage from the 58th Street Landfill (SFWMD).

The North Trail Basin is part of Area B and is the southern most portion of the study area. The area is subject to specific cut and fill criteria as implemented by Dade County DERM because of severe drainage problems in the area. The criteria were developed to prevent flooding of the eastern portion of the county due to overloading of the primary canal system (DERM, 1987).

The C-6 Basin is the third drainage basin in the Dade portion of the study area. Covering 69 square miles, it has one main canal, the C-6 (Miami) Canal. Historically, the C-6 Canal was used to recharge the Hialeah and Miami Springs wellfields (SFWMD, 1987). However, with the opening of the Northwest Wellfield, the demand on the two wellfields has decreased and the water once diverted to the C-6 Basin from WCA 3B for potable water purposes is now routed to the C-4 Basin (Area B) by way of the L-30 Borrow Canal (SFWMD, 1987).

Broward County

The Broward portion of the study area lies within two primary drainage basins controlled by the SFWMD; the C-11 and the C-9. A small portion of the study area (the West Lauderdale Water Control District) drains to the north to the New River Canal. This area is discussed in the section on secondary drainage systems.

The C-11 Basin is bisected by the South New River (C-11) Canal. The total basin covers 104 square miles and is divided into eastern and western sub-basins. The system was designed to provide flood protection and receive up to 1.25 inches of runoff per day (SFWMD, 1987). Excess water in the eastern basin is discharged to the east to the South Fork of the New River by way of the S-13 control structure. Excess water in the western sub-basin is pumped from the C-11 Canal to Water Conservation Area (WCA) 3A through the S-9 structure. If S-13 is not pumping at full capacity, additional discharges of excess water from the western sub-basin can be made to the eastern basin. In times of low natural flow, water can be supplied from the western sub-basin to the eastern sub-basin to maintain optimum stages in the eastern reaches of the basin and prevent saltwater intrusion (SFWMD, 1987).

In the early 1970s, the U.S. Army Corps of Engineers did a feasibility study that indicated a positive cost benefit ratio for increasing the flood protection capacity in the western C-11 sub-basin to 2.5 inches of runoff per day. However, there was an anticipated decline in water quality due to increased runoff which prevented the added flood protection (SFWMD, 1987).

In 1981, the SFWMD completed a water management study, which was updated in 1989, of the western C-11 sub-basin which made several recommendations regarding flood protection. There are two main recommendations:

1) stormwater removal rates from projects in the western sub-basin should not exceed 1.25 inches per day; and

2) fill encroachment above elevation +3.0 feet which would allow post-development 100-year "no-discharge" flood elevations in new developments to be higher than those computed for that sub-basin by the SFWMD should not be permitted (SFWMD, 1987).

The C-9 Basin straddles the Broward-Dade line and is discussed in the Dade County description. The portion in Broward County covers 59 square miles. As discussed earlier, the western reaches of the C-9 are lower than the eastern portions and are subject to flooding during severe rain events. Pumped inflow of runoff to the C-9 canal in the western area is limited to three-quarters of an inch per day (SFWMD, 1987). Any development in the western part of the basin is governed by the criteria for the C-9 Basin set by the SFWMD (Rule 40E-41, Part I, F.A.C.).

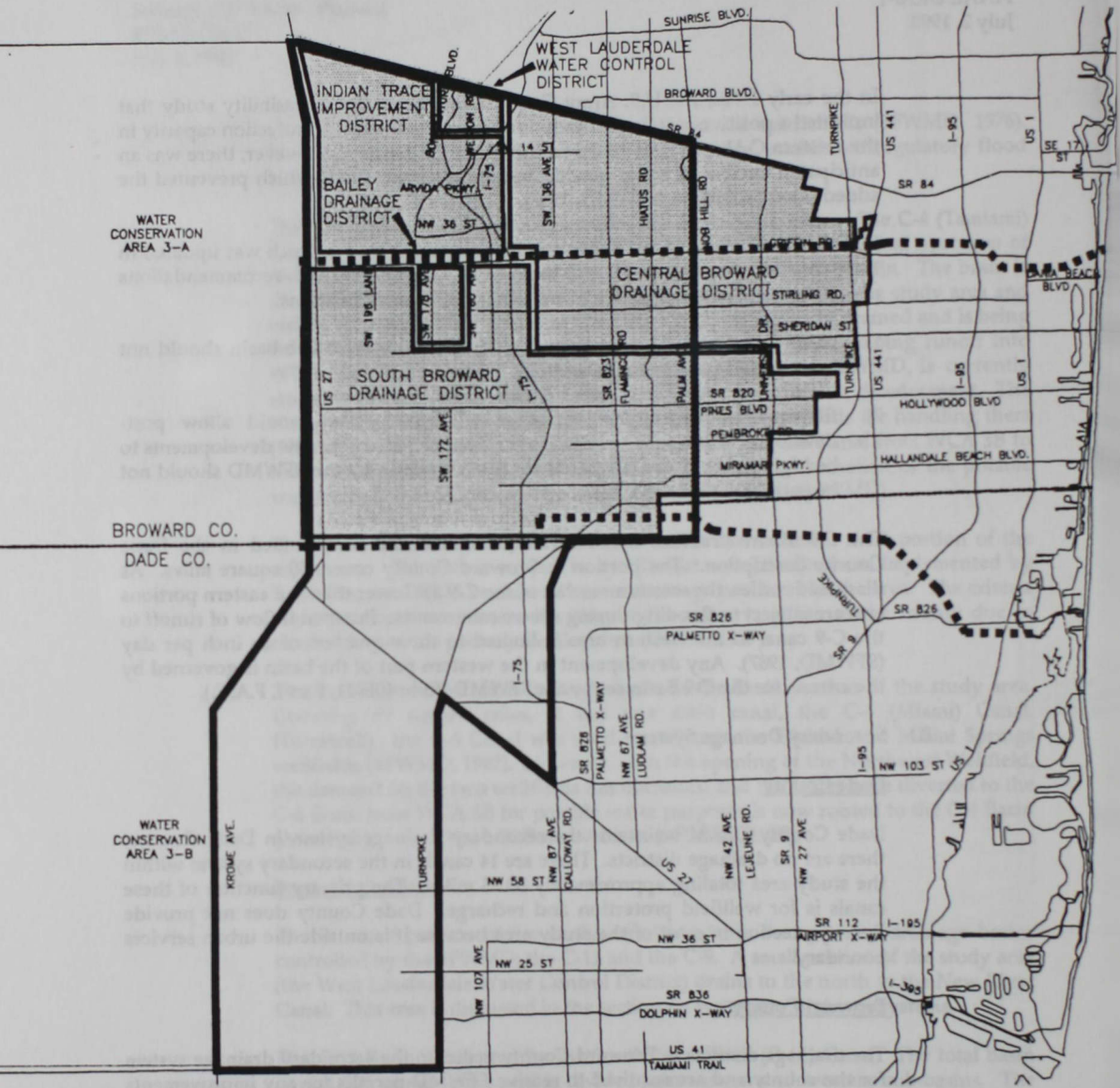
3. Secondary Drainage System

Dade County

Dade County DERM maintains the secondary drainage system in Dade County; there are no drainage districts. There are 14 canals in the secondary system within the study area totaling approximately 30.75 miles. The primary function of these canals is for wellfield protection and recharge. Dade County does not provide flood protection in most of the study area because it is outside the urban services boundary.

Broward County

The drainage districts in Broward County make up the secondary drainage system for the county and are required to receive SFWMD permits for any improvements requiring discharge to a SFWMD canal. They are outlined in Figure 16. Within the individual basins, the drainage districts require permitting for drainage projects. In some of the drainage districts, some of the large projects which tie into the secondary drainage system deed their project lakes over to the drainage districts to be included in the secondary system for maintenance purposes. Maintenance includes weed control and maintenance of water flow. There are five independent taxing drainage districts within the Broward portion of the study area, South Broward Drainage District, Bailey Drainage District, Indian Trace Improvement District, West Lauderdale Water Control District, and Central Broward Drainage



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Drainage Districts

- Study Area Boundary
- Primary Canals
- Levee with Borrow Canal
- Drainage Districts

Source: Broward County Water Resources Management Division.

FIGURE 16

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District. With the exception of the West Lauderdale Water Control District and a small area of the Central Broward Drainage District, portions or all of these basins discharge to the C-11 or C-9 canals of the SFWMD system.

South Broward Drainage District

The South Broward Drainage District (SBDD) (formerly known as the Hollywood Reclamation District) covers approximately 45,174 acres (70.5 square miles) of southwest Broward County. It is an independent taxing district overseen by a five member Board of Supervisors.

The northern portion of the SBDD, west of Flamingo Road (except for CB Smith Park), is designed to discharge to the C-11 canal; the remaining portion drains to the C-9 Canal. The SBDD currently maintains nine principal north-south canals, five extending from State Road 820 (Hollywood/Pines Boulevard) to the C-9 Canal; four extending from the north boundary of the district to the C-9 canal; two of which (Flamingo Road and the borrow ditch along U.S. 27) extend from the C-11 Canal to the C-9 Canal. Several east-west canals exist east of Flamingo Road. There are 10 secondary pump stations discharging the University Drive Canal which are scheduled to be eliminated, converting these canals to gravity flow. The University Drive Canal is controlled by a pump station. Four major pump stations within the SBDD serve the area east of SBDD Canal No. 5 (just west of I-75). Approximately 90 major structures, including bridges and culverts, exist in the district; the majority of these are east of I-75.

The SBDD is divided into 12 separate drainage basins referred to as unit districts. Each unit district or combination of unit districts has or will have its own pump station, except for the basins north of Pines Boulevard and west of 172nd Avenue and the two basins west of U.S. 27. Canals within the unit districts are used to convey surface water by gravity to the pump stations or the primary canals through direct connections. The minimum design water elevation (control elevation) varies from 2.5 to 3.0 feet NGVD for systems controlled by the four pump stations which discharge to the C-9 Canal. For those drainage basins which are not controlled by a pump station, the district is proposing a control elevation for its future pump stations between 3.5 and 4.0 feet NGVD. However, this is undergoing permit review by the SFWMD. The existing and future pump stations and control structures are designed to keep the water level within a minimum and maximum designated elevation. The existing four pump stations will continue to have a maximum discharge capacity at their permitted rate. Future pump station capacities and allowable control structure discharge will be based on maximum allowable flows to the C-9 and C-11 Canals.

Planned future surface water management facility construction within the SBDD includes new canals, pump stations, and control structures to be phased over a period of years. The phasing of new facilities is presently under review and will be included as part of the facilities report being prepared for the SBDD. The majority of the new work is proposed for west of I-75; however, there are no anticipated improvements for the Everglades buffer strip west of U.S. 27.

Central Broward Drainage District

The Central Broward Drainage District (CBDD) is located north of the SBDD and covers approximately 27,000 acres (42 square miles). For voting purposes, the area is broken up into six zones with one commissioner representing each zone. It is a gravity controlled drainage system. All but 800 acres (1.25 square miles) within the district drains into the C-11 Canal; the remaining area (the Shenandoah development) drains north into the North New River Canal which lies on the north side of S.R. 84.

The control elevation west of 100th Avenue is maintained at approximately +4.0 feet, NGVD. The area east of 100th Avenue has a control elevation of approximately +3.0 feet, NGVD (Bell, CBDD, personal communication, 1989). The water level in the canals responds to the level of the C-11 Canal, which is controlled by the SFWMD. The facilities in the CBDD include approximately 80 canals, the majority of which run north and south and are centered on or near section lines and half section lines.

Indian Trace Community Development District

The Indian Trace Community Development District covers 9,913.9 acres (15.5 square miles) in west central Broward County (Gee and Jenson, 1988). It encompasses most of the Weston and Tishman-Speyer Developments of Regional Impact and is divided into 2 main basins and 16 sectors. Seven of these sectors have not been developed yet and do not have complete water management systems. The control elevation for the district is approximately +4.0 feet, NGVD which is maintained by a series of pumps. These pumps begin operation when the level in the lakes reaches +4.5 feet, NGVD, and stop when the level is brought back down to +4.0 feet, NGVD. The district discharges into the C-11 Canal maintained by the SFWMD at three points (Gee and Jenson, 1988).

West Lauderdale Water Control District

The West Lauderdale Water Control District (WLWCD) comprises 1,237.99 acres (1.9 square miles) adjacent to the south side of State Road 84 in west Broward County. Surrounded by the CBDD on the east side, and the ITCDD on the west and south, the WLWCD primarily serves the Bonaventure development. The district drains into the North New River Canal, which is controlled by the SFWMD, by way of two pumping facilities. The water levels in the canals are maintained at approximately +5.0 feet, NGVD (Gee and Jenson, 1969). Water flows from the site through the project lakes for the Bonaventure development (Gee and Jenson, 1969)

Bailey Drainage District

The Bailey Drainage District (BDD) is surrounded on three sides by the SBDD and is bordered by the ITCDD on the north. It covers approximately 1,440 acres (2.25 square miles). The BDD has 12 canals and two pump stations (which are not currently in operation) which discharge to the New River (C-11) Canal. The SBDD is currently investigating the feasibility of incorporating the BDD into the SBDD system.

4. Planning Efforts for Surface Water Management

In 1989, the Florida Legislature passed House Bill 599, commonly known as the Special Districts Bill (Sections 189.415 and 189.4155, F.S. specifically address the inventory of existing infrastructure and plans for future infrastructure) which requires all special taxing districts in the state to promote coordination between the districts and local governments and to develop facilities management plans which are consistent with local government comprehensive plans developed in accordance with Chapter 163, F.S. These plans must include an inventory of facilities and their capacities as well as identify future needs. The financing for future expansions must also be identified. These plans are to be submitted by March 1991. The independent drainage districts have begun compiling this information and it will be available for use in surface water management analysis by March 1991.

The SFWMD is also developing basin management plans for the primary drainage basins in the district. The anticipated completion date is March 1991. In addition, the SFWMD has ongoing surface water management and water use planning activities such as water use management plans and their involvement in the comprehensive plan review process.

5. Methodologies for Evaluating Drainage Capacity

a. Modeling approach

The development of a precise predictive methodology for flood plain management can be a lengthy and complex process. An analysis by Broward County Water Resources Management Division, based on previous studies of a similar nature done in other areas of Florida and the United States, indicates that a computer simulation of the area would be required. Such a simulation requires the establishment of a hydrologic model to estimate the amount of rainfall which ponds and runs off from the area as a function of storm events and land use. The runoff is either handled by the on-site surface water management system and the flood protection network of canals or causes local flooding.

The capability of the flood protection network is ascertained by a hydraulic model which takes inputs from the hydrologic model. Both models require considerable data relating to physical characteristics of the area, amount of development and a delineation of the network of ditches and canals that are in place to handle the runoff.

This approach is a sound and comprehensive method of long range water management; however, it is long term and beyond the scope of this study. Several models could be considered and various combinations of hydrologic and hydraulic models used. The following is a list of the various models available and the combinations that have been used in several Florida basin studies:

HYDROLOGIC AND HYDRAULIC MODELS

1. SWMM - Runoff Block (TR-20) used with dBase III Prerun (hydrologic)
2. HEC 2 - Hydraulic
3. BRASS MODEL - Canal and sub area flood stages (hydrologic)
4. USDA - Soil Cons Service Computer Program TR-20 (hydrologic)
5. NOAA - National Weather Service DWOPER (hydraulic)
6. HSPF - Hydrologic simulation P - FORTRAN - Runoff (hydrologic)
7. UNET - New hydraulic model used with TR-20 runoff hydrologic inputs
8. MBR - Multi Basin Routing - 2D Routing Model (hydrologic) developed by SFWMD

FLORIDA BASIN STUDIES

1. Rocky Creek Tampa area - SWMM hydrologic and HEC 2 hydraulic
2. Hillsboro Canal Basin in Broward - TR-20 and DWOPER
3. C-11 Basin in Broward - BRASS and DWOPER

There are problems associated with the use of the above listed models. Some concerns are as follows:

(a) Calibrating data is meager.

(b) The terrain in the study are is flat and there is little slope to create hydraulic gradients to cause the water to flow to the discharge points at the primary canals.

(c) Models used to date have difficulty coping with structures and flow reversal.

There is a new model, UNET, which is purported to be able to cope with the low slopes, structures, and flow reversals - similar to the conditions in South Florida. The SFWMD is considering further development of the UNET model using data from the study area.

Development of the longer more involved approach would require the data listed below:

1. soils and percolation;
2. vegetation/wetlands/habitats

3. ground levels, topography

4. water levels

5. typical rainfall pattern, climate

6. water quality

7. canals, ditches, water bodies, streams

8. flood problem areas

9. basin studies

10. geology of the Biscayne Aquifer

The potential use of this approach and the development of the UNET model should be kept in mind for future refinements of the Phase 2 Study and for extension of drainage capacity analysis to other parts of the study area.

b. Application of existing information

An effective method of evaluating surface water management needs can be applied without the need for developing models. This approach uses engineering judgment in localized areas based on available data to develop guidelines for decision making.

Stage storage and flood routing calculations are made using the computer programs available from the South Florida Water Management District and described in the SFWMD Basis of Review III.

Significant assumptions made for this technical approach, using the SFWMD runoff models, are:

(a) The infrastructure shown in basin plans will be put in place in time to provide adequate drainage to the development it serves.

(b) Secondary infrastructure will be adequately designed and installed so that stormwater will, without impediment or delay, reach the pumps that discharge it to the primary canals. Therefore, all calculations of discharge from a basin assume maximum allowable discharge rate to the canals as set forth by SFWMD.

(c) There will be no increased flood elevation of stormwater in areas distant from discharge points to drive waters to flow to secondary drainage canals and discharge pumps.

(Note: Because the Broward County portion of the study area is subject to more development pressure, the area was looked at in more detail and used in the examples. The majority of the Dade portion of the study area is outside the

county urban service boundary and does not receive flood protection from the county. However, this methodology can be applied throughout the study area.)

The Broward County portion of the study areas was divided into six study sub-areas (subsections) whose boundaries closely approximate the drainage basins in the area for which water management plans have been developed and for which drainage basin permits have been applied for or received from the SFWMD by the cognizant independent water control district. The subsections are as follows:

SW 1 - South West Subsection No. 1 - Far southwest corner of study area from Snake Creek Canal north to Pines Boulevard. From U.S. 27 east to 172 Avenue. In South Broward Drainage District, Western C-9 Basin.

MW 2 - Mid West Subsection No. 2 - Far west area between Pines Boulevard and Griffin Road. From U.S. 27 east to 172 Avenue. In South Broward Drainage District, Western C-11 Basin, with northwest corner of subsection of Bailey Drainage District.

NW 3 - North West Subsection No. 3 - Far west area between Griffin Road and North New River Canal on State Road 84. From U.S. 27 to Weston Road. In Indian Trace Community Development District, Western C-11 Basin, with northwest corner of West Lauderdale Drainage District.

SE 4 - South East Subsection No. 4 - Eastern area between Snake Creek Canal and Pines Boulevard. From 172 Avenue east to Palm Avenue. In South Broward Drainage District, C-9 Basin.

ME 5 - Mid East Subsection No. 5 - Eastern area between Pines Boulevard and Sheridan Street from 172nd Avenue east to Palm Avenue, and extending north to Griffin Road between 172 and Volunteer Road. In South Broward Drainage District, C-11 Basin.

NE 6 - North East Subsection No. 6 - Eastern area between Sheridan Street and State Road 84 from Weston Road and Volunteer Road east to Nob Hill Road. In Central Broward Drainage District, C-11 Basin.

In each subsection there is a mix of developed and undeveloped area. The developed areas usually have already had extensive analysis in Development of Regional Impact (DRI) documents or in SFWMD drainage permits. In most cases, the surface water management designs for these areas and the drainage analyses show that the development will meet all codified regulatory/engineering criteria. For the analyses of this study, the land use configurations and water management areas of developed portions have been backed out of each subsection. Analysis has then proceeded for the remaining undeveloped areas. This has been confirmed to be a correct procedure since any individual development uses all of its water management area to satisfy its drainage requirements and other development within the basin must provide its own water management areas.

In order to do the stage storage and flood routing calculations, certain technical parameters were defined for each subsection:

(a) A composite site configuration was formulated based on the land use in the basin permit which in turn is based on the March 1989 Broward County Land Use Plan. To determine the effect of increased density, such as might be obtained if proposed land use amendments are approved, a more dense land use configuration was formulated.

This configuration was based on proposed land use amendments submitted to the county in early 1989. Each of the two land use configurations is used in the calculations.

(b) An acreage amount is required for water management area. The amount of water management area was varied from 16 to 50 percent to observe its effect on meeting criteria.

(c) A value for wet season water level - or control elevation - is required. Since there is considerable discussion ensuing between regulators and developers as to what is the proper value to use, a range of values was used to determine its effects. Ultimately, there needs to be a consensus on the control elevation, since it may have a bearing on water supply, salt water intrusion, wetlands and septic tanks as well as on drainage capacity.

(d) The design storm determines the amount of rainfall. At least four storm event magnitudes have been used in determining ability to meet engineering/regulatory criteria and provide a public convenience level of service. At some future date, if time permits, historical rainfall sequences and amounts may be used in place of design rainfalls to calculate public convenience of level of service.

(e) Natural and developed land elevations are a factor in the calculations. For the south-west area there does not exist a consensus on the true natural land elevations. For the calculations, the land elevations certified by the design engineers to be in existence were used, and the developed land elevations specified in the basin permits were also used.

c. Discussion of results

The drainage capacity methodology has to date been applied to two subsections: SW1 and MW2.

SW1 Subsection

The SW1 subsection is characterized by low land elevation and high water table. Under such conditions a rainfall event will quickly raise the water level above ground level. Developed land elevation is therefore raised using fill to keep non-water management areas as dry as possible.

For the SW1 Subsection all calculations completed to date used the Proposed Future Amended Land Use Configuration.

For all cases the 100-year 3-day minimum floor standard can be met. If the Wet Season Water Level (WSWL) is 4.5 feet mean sea level (m.s.l.), then a 25 percent water management area is barely enough to meet the SFWMD 25-year 3-day standard which is related to non-encroachment of storm water runoff onto neighboring property. While the Broward County water level maps show the WSWL to be 4.5 feet, this value is currently in contention. Basin permits and developer calculations are using WSWL values of 4.0 feet m.s.l. and 3.5 feet m.s.l.

MW2 Subsection

To date, the site configuration examined has been based on the basin permit application to SFWMD which is based on the Broward County Land Use Plan of March, 1989. Stage Storage calculations indicate that minimum floor and road (engineering/regulatory) standards are achieved. Note that allowable discharge rate into the C-11 Canal is 1.25 inches per day for this area compared to 0.75 inch per day for the C-9 Canal in the farthest southwest section. The higher allowable discharge rate also makes it easier for the area to meet the public convenience level of service. The 10-year 3-day level of service set forth in the Comprehensive Plan is achievable - at least for the land use site configuration used in the basin permit application.

6. Level of Service

Level of service (LOS) for flood protection is a relatively new concept. Flood protection applies to life and property from loss as a result of flooding. The concept of flood protection levels of service is most meaningful when considered in the context of land uses. Water quality is an inherent component of flood protection because the first flush of storm water runoff generally contains contaminants which may pollute the receiving water bodies if it is discharged untreated. Figure 17 summarizes the level of service standards for drainage in effect in the study area.

The South Florida Water Management District has proposed draft LOS standards for consideration. The intent is to provide a common language to communicate relative risk and protection expectations throughout the district. Figure 18 is a summary of the proposed LOS standards, with C being the recommended minimum LOS. This standard is generally consistent with the district's surface water management criteria for new projects. They also include a standard for emergency service, evacuation routes and arterial and collector roads.

a. Impact of level of service standard

Because of the variety of levels of service adopted for the study area, it is difficult to determine an area wide impact.

Within Dade County, the majority of the study area is outside the urban services boundary and the county does not provide flood protection.

Adopted Levels of Service for Study Area

Municipality/County	Level of Service
Dade County	For urban areas, protection from the degree of flooding that would result for one day from a 10 year storm or one week from a five year storm, whichever is higher. For the study area, the general policy is that all runoff must be retained on site.
Broward County	LOS dependent on use of property as follows: •roads: flood protection from a ten year storm •buildings: flood protection from a 100 year storm Off site discharge not to exceed inflow limits of the SFWMD recieving canal or the local conveyance system - whichever is less Within southwest Broward County, future development shall be designed to remove stormwater from non-water management areas within 72 hours of the end of the 10 year design rainfall.
Cooper City	design storm - 25 year/1 day storm must be retained on site.
Davie	For areas west of 100th Avenue - 3/4th of an inch per day maximum allowable discharge; For areas east of 100th Avenue - 1 1/2 inches per day maximum allowable discharge.
Sunrise	Design storm - flood protection according to the following: •subdivision streets - 3 year storm •major roadways - 10 year frequency •cross culverts - 25 year frequency •floor pads - 100 year frequency No discharge to the primary canal system in exceedence of the SFWMD system will be allowed.
Pembroke Pines	LOS dependent on use of property as follows: •roads: flood protection from a ten year storm •buildings: flood protection from a 100 year storm Off site discharge not to exceed inflow limits of the SFWMD recieving canal or the local conveyance system - whichever is less
Miramar	LOS dependent on use of property as follows: •roads: flood protection from a ten year storm •buildings: flood protection from a 100 year storm Off site discharge not to exceed inflow limits of the SFWMD recieving canal or the local conveyance system - whichever is less

Source: Local Government Comprehensive Plans

Figure 18

SFWMD Proposed Levels of Service for Surface Water Management

	Reference	Level of Service				
		A	B	C	D	E
I.	**Building floor elevation**					
	A. Emergency shelters/service	> 100 yr. storm 0 discharge	> 100 yr. storm 0 discharge	> 100 yr. storm 0 discharge	100 yr. storm 0 discharge	< 100 yr. storm retained
	B. Habitable	> 100 yr. storm 0 discharge	100 yr. storm 0 discharge	100 yr. storm 0 discharge	100 yr. storm with allowable discharge	< 100 yr. storm retained
	C. Employment/service	> 100 yr. storm 0 discharge	10 yr. storm 0 discharge	100 yr. storm 0 discharge	100 yr. storm with allowable discharge	<100 yr. storm retained
II.	**Roads (edge of pavement)**					
	A. Evacuation Routes	> 100 yr. storm 0 discharge	> 100 yr. storm 0 discharge	> 100 yr. storm 0 discharge	100 yr. storm 0 discharge	< 100 yr. storm retained
	B. Emergency service	> 100 yr. storm 0 discharge	> 100 yr. storm 0 discharge	> 100 yr. storm 0 discharge	100 yr. storm 0 discharge	< 100 yr. storm retained
	C. Arterials	> 100 0 discharge	100 yr. storm with allowable discharge	100 yr. storm with allowable discharge	10 yr. storm with allowable discharge	< 10 yr. storm retained
	D. Collectors	> 100 yr. storm 0 discharge	25 yr. storm with allowable discharge	25 yr. storm with allowable discharge	5 yr. storm with allowable discharge	< 5 yr. storm retained
	E. Neighborhood	> 100 0 discharge	25 yr. storm with allowable discharge	5 yr. storm with allowable discharge	3 yr. storm with allowable discharge	< 3 yr. storm retained
III.	**Sites (assumes 80% of property is dry at all times)**					
	A. Urban (> 1 du/acre)	> 100 yr. storm 0 discharge W.Q. > 100%*	25 yr. storm with allowable discharge W.Q. > 100%*	5 yr. storm with allowable discharge W.Q. = 100%*	3 yr. storm with allowable discharge W.Q. ≥ 50%*	< 3 yr. storm retained W.Q. < 50%*
	B. Rural (≤ 1 du/acre)	> 100 yr. storm 0 discharge W.Q. > 100%*	25 yr. storm with allowable discharge W.Q. > 100%*	3 yr. storm with allowable discharge W.Q. = 100%*	< 3 yr. storm retained W.Q. ≥ 50%*	< 3 yr. storm retained W.Q. < 50%*

* Water quality is in percent of SFWMD criteria (2.5 times percent impervious area retained and treated but not to be less than one inch)

NOTES

1. The level of service is applicable to new building permit issuance and existing sites/buildings.
2. Flood protection is based on the combination of conveyance and storage capability plus site or facility elevation.
3. Rainfall event frequencies are 3 day for 100 and 25 year storms, and 1 day for lesser events.
4. Flood durations are unspecified.
5. Employment and service buildings are utilized by 5 or more people per day.

The SFWMD criteria is Level C. Areas with Levels D and E would require modifications, particularly Level E.

Source: SFWMD, 1989.

Therefore, all development must retain runoff on site. In Broward County, the local governments have established a level of service standard.

The level of service currently established in the Broward County Comprehensive Plan for unincorporated Broward County specifies that "... future development shall be designed to remove stormwater from non-water management areas, including but not limited to yards, within 72 hours of the end of the ten-year design rainfall." This level of service is difficult to achieve in some parts of the study area. A typical flood routing calculation for land within this area indicates the following:

(a) Site natural land elevation: 4.2 feet mean sea level (m.s.l.)

(b) Developed site average elevation: 6.0 feet m.s.l.

(c) Large percent of site at 5.5 feet or lower.

(d) Applying standard engineering methodology, it can be determined that during a 10-year 3-day storm, water will rise to 5.5 feet in 59 hours, to 6.0 feet in 66 hours, and peak at 6.06 feet in 72 hours.

(e) Waters, with pumped drainage, will recede to 6.0 feet at 84 hours after storm begins, to 5.5 feet after 167 hours, and back to 4.5 feet after 305 hours.

The Broward County Comprehensive Plan LOS requires dry non-water management areas 144 hours after a 10-year 3-day storm has begun. The flood routing results above indicate that average land elevation will meet the criteria, but the back yard at elevations between 5.5 and 4.2 feet will remain wet for over 300 hours.

7. Backpumping in the Study Area

There is one canal in the study area, the C-11, which has a pump (S-9) for discharging water from the canal to WCA 3A. This is for flood protection. There has been discussion of retrofitting the C-9 canal to be able to backpump. The water pumped into WCA 3A must meet the water quality standards established by the SFWMD and DER. Concerns over backpumping include increasing nutrient-related changes to the WCAs and Everglades National Park (SFWMD, 1989). Currently, the water from the S-9 structure meets existing standards (SFWMD, 1989), however, as the C-11 basin experiences increased development, there is a potential for degradation of the water quality. The theory is that as long as best management practices for stormwater management systems are installed and maintained, the water quality of the canal will be maintained.

8. Right of Way Issues

In Dade County, the primary purpose of the secondary drainage system is to provide recharge for the Northwest Wellfield. The county does not provide flood protection in the majority if their portion of the study area. Right-of-way issues are more of a concern in the Broward County portion of the study area.

Historically the plans of reclamation for the secondary drainage providers in the study area have provided for construction of drainage canals on the north-south section line or half section lines. These canals can be constructed so that they are connected to a SFWMD canal by either a control structure or a pump station which maintains a minimum permitted water elevation. As authority for its right to construct the secondary drainage system, each of the drainage districts is given the power to establish, construct, operate and maintain a drainage system within its areas of jurisdiction. In addition, the Florida legislature provides that the districts or Dade County may use reservations and dedications to public use for drainage purposes.

Since the initial drainage canals were constructed in Broward County, a conflict has developed among the proposed Broward County Trafficways Program, the local cities proposed roadway plans and the drainage districts' canal plans. Often canals and roadways are to be built in the same location. The South Broward Drainage District is in the process of determining the exact status of the reservations granted it by various agencies, both past and present.

9. Findings and Recommendations

1) Findings: **Level of Service**

- Due to the low land elevation, high water table, lack of conveyance, and limits on allowable discharge to some of the primary canals, there is special concern regarding surface water management infrastructure in certain portions of the study area.

- Several differing level of service standards for surface water management for the study area exist.

- Areas where there is a low level of service for surface water management (flood prone areas) serve as important aquifer recharge areas.

Recommendations

a) The proposed surface water management levels of service standards developed by the South Florida Water Management District (Figure 18) should be used as guidelines for the adoption of appropriate level of service standards for local governments. LOS C should be considered as the minimum standard for new development.

b) Developed areas where LOS is D or E should be reviewed to determine feasibility of improving the level of service.

c) The value of an area for aquifer recharge should be considered when establishing a level of service for surface water management.

2) Findings: **Availability of Infrastructure Concurrent with Need**

- In portions of the study area, development approvals do not require secondary surface water management infrastructure planned or in place.

- Single family homes which are not part of a planned development are often exempt from the surface water management permitting process; therefore, their cumulative impacts are difficult to monitor. In addition, the costs associated with development of a surface water management analysis for a small single lot can be expensive.

- Upon completion of the facilities analysis required by sections 189.415 and 189.4155, F.S., the information will be available for use in reviewing proposed land use changes.

Recommendations

a) Prior to final plat approval, secondary surface water management infrastructure required to meet the adopted level of service standard should be in place or scheduled to be in place prior to construction. Proposed surface water management infrastructure includes those facilities which are planned by secondary drainage providers and conceptual site specific surface water management plans.

b) A surface water management plan for basins within secondary drainage districts should be in place prior to any development approval.

c) If a basin surface water management plan is undergoing review for change, land use amendments that would affect the drainage capacity of the basin should be deferred until the surface water management capacity of the area is verified by the applicant.

d) Surface water management permit issuers should develop methodologies to allow single lot owners to develop surface water management plans in a cost-effective manner. This can include development of a surface water management manual and procedures which allow small single lots to be reviewed in the context of a basin plan.

3) Findings: **Water Management Areas**

- Within the study area, there are many individually owned lots which will need to provide their own surface water management.

- Since many individually owned lots are not connected to secondary drainage infrastructure, large portions of property would need to be designated for surface water management. Common surface water management areas in a given sub-basin can help reduce the need for individual water storage for individually owned lots.

Recommendation

Common water management areas should be planned by secondary drainage providers to hold runoff from individual lots in an area. These areas should be identified and their use required as a condition for the issuance of a building permit.

4) Findings: **Secondary Drainage Provider Review**

- Secondary drainage providers can contribute valuable and necessary information in the land use amendment process.
- For some portions of the study area, secondary drainage is not in place.

Recommendation

To assure adequate secondary drainage capacity is available or scheduled to be available upon need, secondary drainage providers should be included in the review of land use amendments.

5) Findings: **Surface Water Management Modeling**

- In order to fully evaluate the dynamics of the surface water management needs of the study area, a hydrologic model needs to be developed. This can be accomplished by modifying existing models adapted to the specifications of the study area.
- Independent drainage districts are required to do facility capacity analysis as required by sections 189.415 and 189.4155, F.S.

Recommendations

a) Consideration should be given to implementing a technical modeling approach for surface water management planning similar to the proposal in Section 5(a) on page 95 of the Surface Water Management section of this report and expanding existing modeling efforts.

b) Coordination between agencies currently undertaking modeling efforts should be expanded.

6) Finding: **Interaction of Systems**

- Within the study area, several factors can be affected by water quantity, primarily wetland habitat, aquifer recharge and water supply. The volume of water removed from an area can adversely impact these resources.

Recommendation

Decisions regarding surface water management and flood control in the study area should be coordinated with the appropriate agencies and consider effects on water supply and wetland habitat.

7) Findings: **Information for Application Review**

- Preliminary information regarding the surface water management needs of a site is needed for evaluating the impacts of the land use amendment.

- Since detailed information regarding surface water management is required at the platting or permitting stage, minimal information is required at the land use plan amendment stage.

- The drainage districts in the study are required to complete facility analysis by March 1991.

Recommendations

a) For proposed land use amendments, sufficient information should be submitted indicating that the levels of service will be achieved. This information should be prepared by a licensed engineer and reviewed by the appropriate agency staff. The following is a minimum of the information which should be received:

- current land use;
- proposed land use;
- wet season water level*;
- design storm;
- natural* and proposed land elevation;
- acreage for proposed water management area;
- proposed minimum first floor elevation;
- 100 year flood elevation
- time for water to recede to natural land elevation**

* Provide source of information
** Submit stage storage and runoff calculations for the design storm for the site

b) Information regarding surface water management from the drainage districts through the activities of Sections 189.415 and 189.4155, F.S., should be incorporated into the land use amendment review process by October 1991.

B. Transportation

1. Introduction

The transportation discussion contains six sections, including land use, highway system, mass transit system, airport facilities, air quality and transportation control methods, and concurrency management methods.

The land use section examines the compatibility of the adopted future land use plans of Broward County, Dade County, and the cities within the Broward portion of the study area, with the physical environment of the study area. It also evaluates the coordination of land use projections across county lines. In general, the current and future land use designations within the study area are compatible.

The highway system section analyzes the compatibility of the future planned network across the county line. Existing network and programmed improvements are described. The Broward County Year 2010 Plan envisions an integrated roadway network for the Broward portion of the study area. For the study area in Dade County, almost all is outside of the county's urban development boundary for the year 2010; therefore, no major improvements are planned in the Dade County Year 2010 Plan. If development occurs as indicated in the Future Land Use Plans of Broward and Dade counties, the (Old) Flamingo Road will fall below the acceptable level of service standard in the year 2010.

The mass transit system provides an overview and analysis of the existing and proposed transit services in Broward and Dade counties, especially in the study area. Only a small section of the study area in Broward County is currently served by mass transit. The Dade portion is designated largely as open land and there is no anticipated transit service. The Broward portion is projecting urban type growth patterns, consequently transit service expansion is also projected to include approximately 85 percent of the study area. The major generators are primarily developments of regional impact in Broward County.

The airport facilities section discusses the current status and development issues related to the proposed South Broward General Aviation Airport and the proposed Northwest Dade Air Carrier Airport. The final location has not been decided for either airport. Several studies have been conducted and more are anticipated for the South Broward General Aviation Airport in the near future. For the proposed Northwest Dade Airport, in February 1990, the Dade County Board of County Commissioners authorized a feasibility study over the next two years to determine if it would be possible to build and operate an air carrier airport there.

The air quality and transportation control methods section explored the air quality condition based on field monitoring results and computer modeling. It also suggests transportation control measures to be used. Dade and Broward Counties currently are not meeting the federal air standard. Additional growth in the subregion can only add to this problem if adequate measures are not taken. Since motor vehicles cumulatively contribute as much as 75 percent of all the man-made

pollution in metropolitan areas, the most effective means available would be the joint implementation of Transportation Control Measures (TCMs) by both counties. Education programs promoting alternatives to automobile travel should be encouraged.

The concurrency management methods section discusses level of service (LOS) standards and concurrency management system adopted by the local governments within the study area. The LOS standards for the study area vary between the two counties. Both Broward and Dade counties have adopted and currently implement a concurrency management program. In Broward County, platting is a county function, therefore, concurrency management is more centralized and easier to effect. The details of each county's concurrency management systems are described. Due to differences in LOS standards and concurrency management program implementation procedures, concurrency conclusions can be very different across jurisdictional lines.

2. Land Use and Transportation

Land use is a determinant of the transportation system, therefore, accurate land use data is an essential component of transportation analysis, forecasting and planning. Land use in terms of the number of dwelling units (DUs) by type equates to the number of home-based trips generated work, shopping, social/recreation and other purposes. Acres of commercial use are translated into shopping trips, square feet of office space and acreage of industrial use are translated into work and business trips assigned to the arterial street and highway network. Crossing jurisdictional boundaries, these become External/Internal (E/I) or External/External (E/E) trips in the respective transportation models which are the basis for transportation plans.

Significant urban development is proposed in Broward County including concentrations of industrial and commercial development at interchanges of surface arterial streets with I-75, and new residential development at urban densities (greater than 1 DU/ac.) nearly to U.S. 27 primarily along the Pines Boulevard (SR-820) corridor.

Approved DRIs and Florida Quality Developments alone in Broward County will add over 47,000 DUs (9,485 acres) at an average density of just under five DUs/acre, the threshold of the low-medium density range. The lowest density is 3.07 DUs/acre (Silver Lakes FQD) the highest, 22.5 in the Pembroke Lakes Regional Center DRI. Overall, in addition to residential uses, 2,104 acres of industrial, 827 acres of shopping and general commercial, and 7.4 million square feet (307 acres) of office uses will be added in Miramar, Pembroke Pines, Davie, unincorporated Broward County including Weston. The vehicular trips produced by these developments are included in the Broward County Transportation Model. Their impact was considered in Dade. There are no DRIs or FQDs in the Dade County portion of the study area.

The impact of the existing and future land uses on the highway network and transit uses will be discussed under the highway network and mass transit sections.

3. Highway System

a. Existing highway network

The existing highway functional classification within the study area is shown on Figure 19. With the exception of the Flamingo Road from Hollywood Boulevard to Sheridan Street, the existing highway system is operating at acceptable levels of service.

Within the existing highway system, I-75 is the major north-south corridor. In Dade County, I-75 connects to the Palmetto Expressway which provides access to employment centers in Hialeah, west Dade, the Miami International Airport area, and Downtown Miami. To the north, I-75 connects to the Sawgrass Expressway which provides access to northern Broward County as well as southern Palm Beach County. It also connects to I-595 which provides access to Port Everglades, Fort Lauderdale/Hollywood International Airport and Downtown Fort Lauderdale via I-95. In Dade County, the Homestead Extension of the Florida Turnpike serves as the major north-south corridor and provides a connection between west Dade and south Broward. The arterial system within the study area is well connected east of I-75. However, it is poorly connected west of I-75 and HEFT.

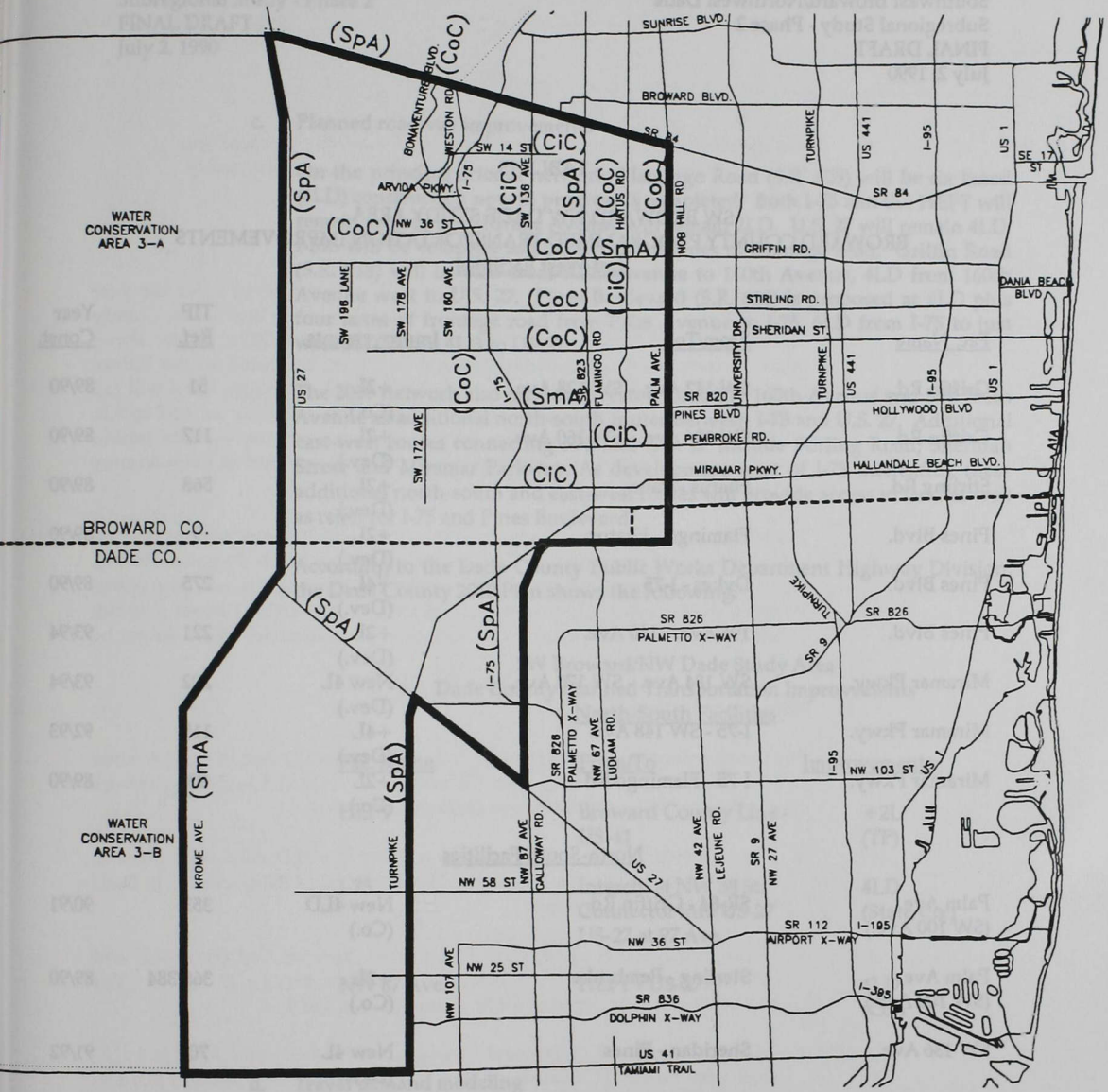
The east-west routes that serve the area west of I-75 and the HEFT include Griffin Road and Pines Boulevard in Broward County, and Okeechobee Road, NW 58th Street and the Tamiami Trail in Dade County.

Significant improvements completed recently included the completion of I-595, six-lane widening of Flamingo Road from Hollywood Boulevard to Pembroke Road, and the construction of the new Flamingo Road from Pembroke Road to Red Road.

b. Programmed roadway improvements

The Broward County Transportation Improvement Program (TIP) includes state, county, city, or developer-funded improvements to major facilities in the study area (Table 15). Among those, Palm Avenue is to be improved to a four-lane road extending from I-595 to Pembroke Road except for a three laned section between Griffin Road and Stirling Road. These improvements will significantly facilitate north-south travel in western Broward County. Major improvements to the east-west network include the four-lane widening of Pines Boulevard from SW 160th Avenue to SW 196th Avenue, the four-lane widening of Sheridan Street from Palm Avenue to Flamingo Road, the four-lane widening of Griffin Road from 160th Avenue to 180th Avenue and from 142nd Avenue to 148th Avenue.

In Dade County, the programmed improvements consist of the two new interchanges on the Homestead Extension of Florida's Turnpike at NW 41st Street and NW 106th Street. Further detail is provided in the Broward and Dade County TIPs.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Existing Roadway Functional Classification

- Study Area Boundary
- SpA State Principal Arterial
- SmA State Minor Arterial
- CoC County Collector
- CiC City Collector

Source: Florida Department of Transportation

FIGURE 19

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June 1989

TABLE 15

SW BROWARD/NW DADE STUDY AREA
BROWARD COUNTY PROGRAMMED TRANSPORTATION IMPROVEMENTS
East-West Facilities

Fac. Name	From/To	Improvements	TIP Ref.	Year Const.
Griffin Rd.	SW 142 Ave. - SW 128 Ave.	+2L (Co.)	51	89/90
Griffin Rd.	SW 184 Ave. - SW 160 Ave.	+2L (Dev.)	117	89/90
Stirling Rd.	Hiatus - Palm	+2L (Dev.)	568	89/90
Pines Blvd.	Flamingo - Hiatus	+2L (Dev.)	9	89/90
Pines Blvd.	Dykes - I-75	+4L (Dev.)	275	89/90
Pines Blvd.	196 Ave. - 160 Ave.	+2L (Dev.)	221	93/94
Miramar Pkwy.	SW 184 Ave. - SW 172 Ave.	New 4L (Dev.)	202	93/94
Miramar Pkwy.	I-75 - SW 148 Ave.	+4L (Dev.)	115	92/93
Miramar Pkwy.	I-75 - Flamingo Rd.	+2L (Co.)	93	89/90
	North-South Facilities			
Palm Ave. (SW 100 Ave.)	SR-84 - Griffin Rd.	New 4LD (Co.)	353	90/91
Palm Ave. (SW 100 Ave.)	Sterling - Pembroke	+2L (Co.)	368/384	89/90
SW 136 Ave.	Sheridan - Pines	New 4L (Dev.)	70	91/92
SW 160 Ave. (Weston Rd.) (Dykes Rd.)	Sheridan - Pines	New 4LD (Dev.)	284	92/93
SW 172 Ave.	Sheridan - Pines	New 2L (Dev.)	209	92/93
SW 184 Ave.	Pines - Miramar	New 2L (Dev.)	203	93/94

c. Planned roadway improvements

On the principal arterial network, Flamingo Road (S.R. 823) will be six laned (6LD) construction now in progress is completed. Both I-75 and the HEFT will remain as they are. Krome Avenue will remain 2LD. U.S. 27 will remain 4LD. I-595 will be complete as 6LD with four lanes of frontage road. Griffin Road (S.R. 818) will be 6LD from Palm Avenue to 160th Avenue, 4LD from 160th Avenue west to U.S. 27. Pines Boulevard (S.R. 820) is proposed as 6LD plus four lanes of frontage road from Palm Avenue to I-75, 6LD from I-75 to just west of I-75 and 4LD to US-27.

The 2010 network also includes Weston Road/SW 160th Avenue and SW 184th Avenue as additional north-south routes between I-75 and U.S. 27. Additional east-west routes connecting I-75 and U.S. 27 include Stirling Road, Sheridan Street and Miramar Parkway. As development west of I-75 intensifies, these additional north-south and east-west routes will provide access to land as well as relief for I-75 and Pines Boulevard.

According to the Dade County Public Works Department Highway Division, the Dade County 2010 Plan shows the following:

SW Broward/NW Dade Study Area
Dade County Planned Transportation Improvements
North-South Facilities

Fac. Name	From/To	Improvements
HEFT	Broward County Line - US-41	+2L (TP)
I-75	Interch. at NW 38 St. Connector into US-27 US-27 at 97 Ave.	4LD (State/Co.)
NW 87 Ave.	HEFT - US-27	4LD (Co.)

d. Travel demand modeling

In determining future travel demand in Broward County, a computer model is used. The software used in the model is called Florida Standard Urban Transportation Model Structure (FSUTMS). The model was developed by the Florida Department of Transportation to be used statewide. The hardware, input data and manpower to run the model are provided by Broward County Transportation Systems Planning Section. Most long-range modeling activities in Broward County are performed using VAX 11/785 mini computer. One important part of the input data used in the model is the projected number of trips at the County Line. These trips are generated in one county

and terminated in the other (External/Internal trips) or generated and terminated outside Broward County but passing through the county (External/External trips).

e. Impacts of future land use on the 2010 network

The future transportation network (Figure 20) is intended to serve the year 2010 demand based upon the adopted Broward County and Dade County Future Land Use Plans including approved DRIs and FQDs. If the above improvements are built and development occurs as proposed in the Future Land Use Plans of Broward and Dade counties, Old Flamingo Road will fall below standards in 2010 from Pembroke Road south, probably at least to S.R. 826 in Dade County. Other arterial roads will apparently operate within standards. Griffin Road could be reduced to four lanes west of Palm Avenue and still operate within standards.

Money for construction of the improvements discussed above are not now on the horizon in the state's current adopted five year Work Program-1989/94. However, many development orders require the construction of these roads. Without significant additional sources of income, the arterial street network necessary to serve uses proposed on adopted future land use plans cannot be built.

f. Network compatibility

The study area at the Dade/Broward County Line extends east to Palm Avenue and west to U.S. 27. Starting from the east to the west, the highway network connecting the two counties can be outlined as follows:

- Palm Avenue in Broward County at present is a 2LD road with plans to upgrade it to 4LD by the year 2010. The extension of Palm Avenue in Dade County is NW 47th Avenue.

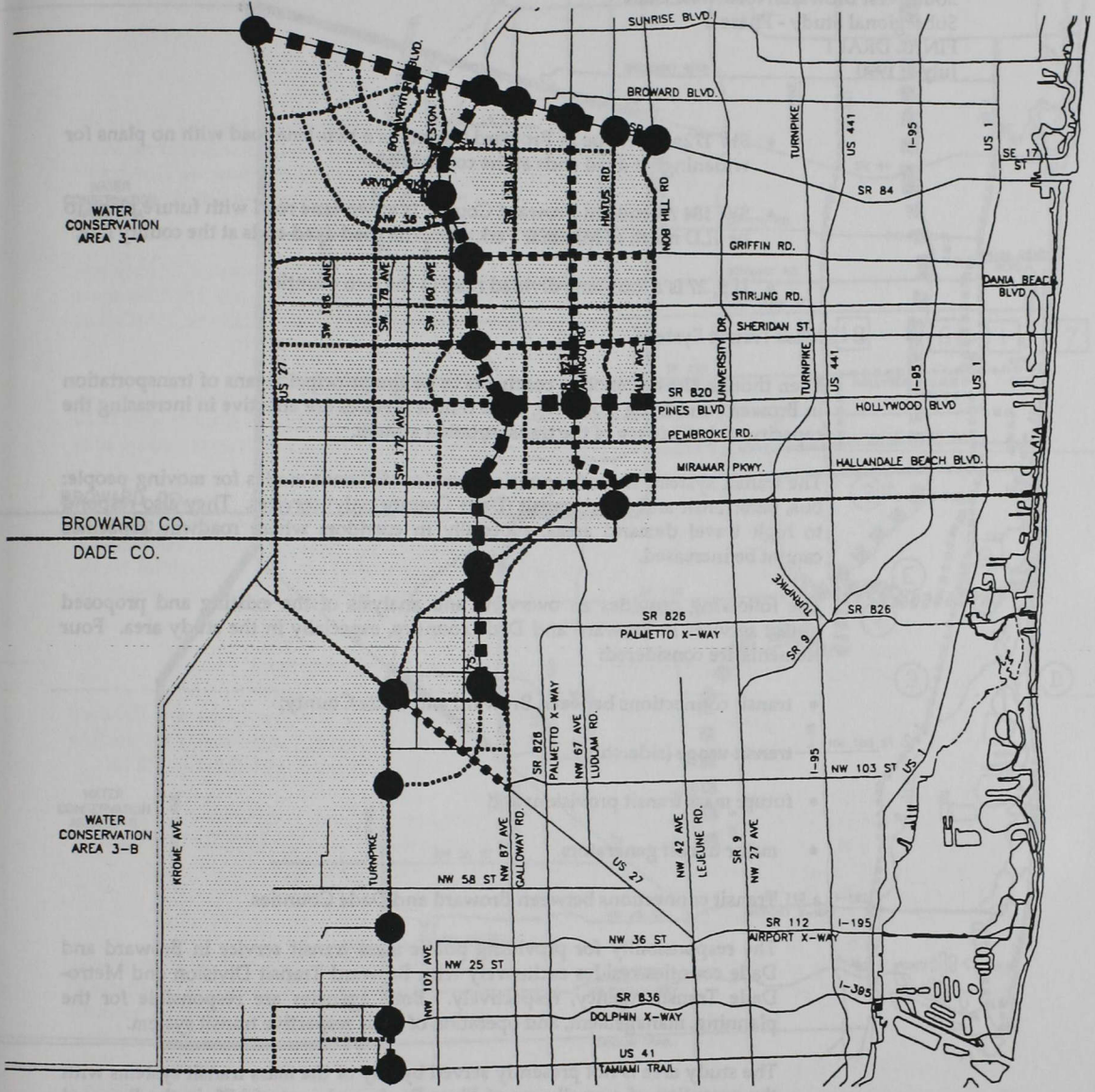
- Hiatus Road, south of Miramar Parkway in Broward County is 6LD and connects to new Flamingo Road with an interchange at HEFT. The extension of Hiatus Road in Dade County is Red Road.

- Old Flamingo Road in Broward County south of Pembroke Road is a 2LD road with no future widening plans. The extension of Flamingo Road in Dade County is NW 67th Avenue. At present, NW 67th Avenue is a two-lane road with plans to widen it to 6LD.

- SW 136th Avenue in Broward County does not reach the county line at the present time.

- I-75 is an eight-lane expressway in both counties.

- SW 160th Avenue in Broward County is a two-lane road. There are future plans to widen 160th Avenue north of Miramar Parkway to 4LD. The road, however, dead ends at the county line.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Planned Future Transportation Network

2 Lane
4 Lane
6 Lane
8 Lane
10 Lane
Interchange or Fly Over
Study Area

Source: South Florida Regional Planning Council

FIGURE 20

N

MILES

0 1 2 3

May 1990

- SW 172nd Avenue in Broward County is a two-lane road with no plans for widening. It dead ends at the county line.

- SW 184 Avenue in Broward County is a two-lane road with future plans to be 4LD north of Miramar Parkway. The road dead ends at the county line.

- U.S. 27 is a four-lane divided road in the two counties.

4. Mass Transit System

Even though the automobile continues to be the principal means of transportation in Broward and Dade Counties, mass transit services are effective in increasing the capacity and efficiency of the transportation system.

The transit systems in both counties combine different modes for moving people: bus, paratransit and rapid transit (Dade County only) services. They also respond to high travel demand areas, especially in corridors where roadway capacities cannot be increased.

The following provides an overview and analysis of the existing and proposed transit services in Broward and Dade counties, especially in the study area. Four elements are considered:

- transit connections between Broward and Dade County;

- transit usage (ridership);

- future mass transit provision; and

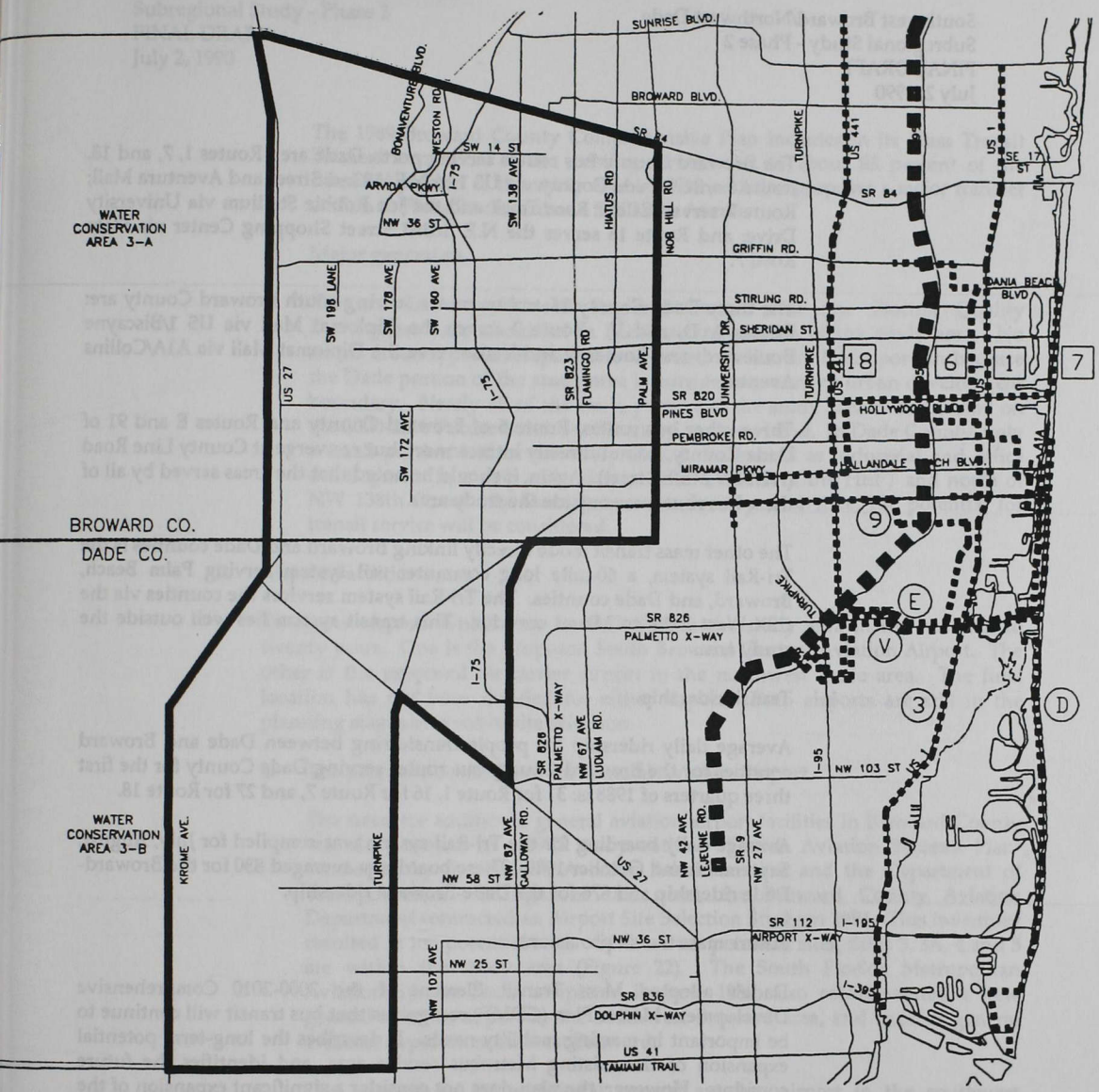
- major transit generators.

a. Transit connections between Broward and Dade Counties

The responsibility for providing public mass transit service in Broward and Dade counties resides exclusively with Broward Transit Division and Metro-Dade Transit Agency, respectively. Both agencies are responsible for the planning, management, and operation of their respective transit system.

The study area is not presently served by any of the mass transit systems with the exception of a small area of Pines Boulevard, east of I-75, in the Broward County portion of the study area. But six bus routes currently connect both counties serving areas east of the study area (Figure 21).

Outside the study area, Broward and Dade counties are connected by two modes of mass transit: a system of bus routes operating on expressway and arterial streets to serve areas of both counties; and the Tri-County Commuter Rail System, better known as Tri-Rail, which serves Palm Beach, Broward and Dade counties (Figure 21). The operation and management of the Tri-Rail System is the responsibility of the Tri-County Commuter Rail Authority. The operation beyond its first three years is still uncertain.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Mass Transit Network

- Study Area Boundary
- Dade County Bus Route
- Broward County Bus Route
- Tri-Rail Commuter System

Source: MetroDade Planning Department

FIGURE 21

N

MILES

0 1 2 3

May 1990

The Broward County bus routes serving north Dade are: Routes 1, 7, and 18. Route 1 enters Dade County via US 1 to N.E. 192nd Street and Aventura Mall; Route 7 serves Calder Race Track and the Joe Robbie Stadium via University Drive; and Route 18 serves the N.E. 163rd Street Shopping Center via State Road 7.

The three Dade County Metrobus routes serving south Broward County are: Routes 3, D, and V. Route 3 serves the Diplomat Mall via US 1/Biscayne Boulevard; and Routes D and V also serve the Diplomat Mall via A1A/Collins Avenue.

Three other bus routes, Route 6 of Broward County and Routes E and 91 of Dade County, do not directly interconnect, but converge at County Line Road (NE/NW 215th Street). Again, it should be noted that the areas served by all of these bus routes are outside the study area.

The other mass transit mode directly linking Broward and Dade counties is the Tri-Rail system, a 60-mile long commuter rail system serving Palm Beach, Broward, and Dade counties. The Tri-Rail system services the counties via the CSX West Palm to Miami corridor. This transit system lies well outside the study area.

b. Transit ridership

Average daily ridership for people transferring between Dade and Broward counties for the Broward County bus routes serving Dade County for the first three quarters of 1988 is: 31 for Route 1, 16 for Route 7, and 27 for Route 18.

Average daily boarding for the Tri-Rail system was compiled for July, August, September, and October 1989. These boardings averaged 830 for the Broward-Dade ridership and 876 for the Dade-Broward ridership.

c. Future mass transit provisions

Dade's adopted Mass Transit Element of the 2000-2010 Comprehensive Development Master Plan (CDMP) recognizes that bus transit will continue to be important in meeting mobility needs. It describes the long-term potential expansion of the existing Metrobus service area, and identifies the future corridors. However, the plan does not consider a significant expansion of the transit system to the Dade portion of the study area with the exception of a small area of Miami Gardens Drive, east of I-75, and Gratigny Drive, northeast of U.S. 27.

Preliminary findings of Dade County's Long Range Transportation Plan Update proposes three new preliminary bus routes, Routes 27x, 29, and 199 for the area east of the study area, but none would serve Broward County directly. In addition, the possibility exists for future service into Broward County via 27th Avenue/University Drive corridor, provided funding sources are available.

The 1989 Broward County Comprehensive Plan includes in its Mass Transit Element expansion of the existing service area to about 85 percent of the Broward portion of the study area by 2010 and also proposes a major transfer station at Pines Boulevard and SW 136th Avenue.

d. Major generators

Thirteen Developments of Regional Impact and one Florida Quality Development are identified in the Broward portion of the study area. No major urban type development is expected within the Dade portion because the Dade portion of the study area is outside the county's urban development boundary. Nearly all of the Dade portion of the study area is designated on the 2000-2010 Future Land Use Plan map as Open Land. In Dade County, only a small portion within the study area is designated as industrial and office development in a strip of land west of I-75, south of the HEFT and north of NW 138th Street. As these generators develop over time, the potential for transit service will be considered.

5. Airport Facilities

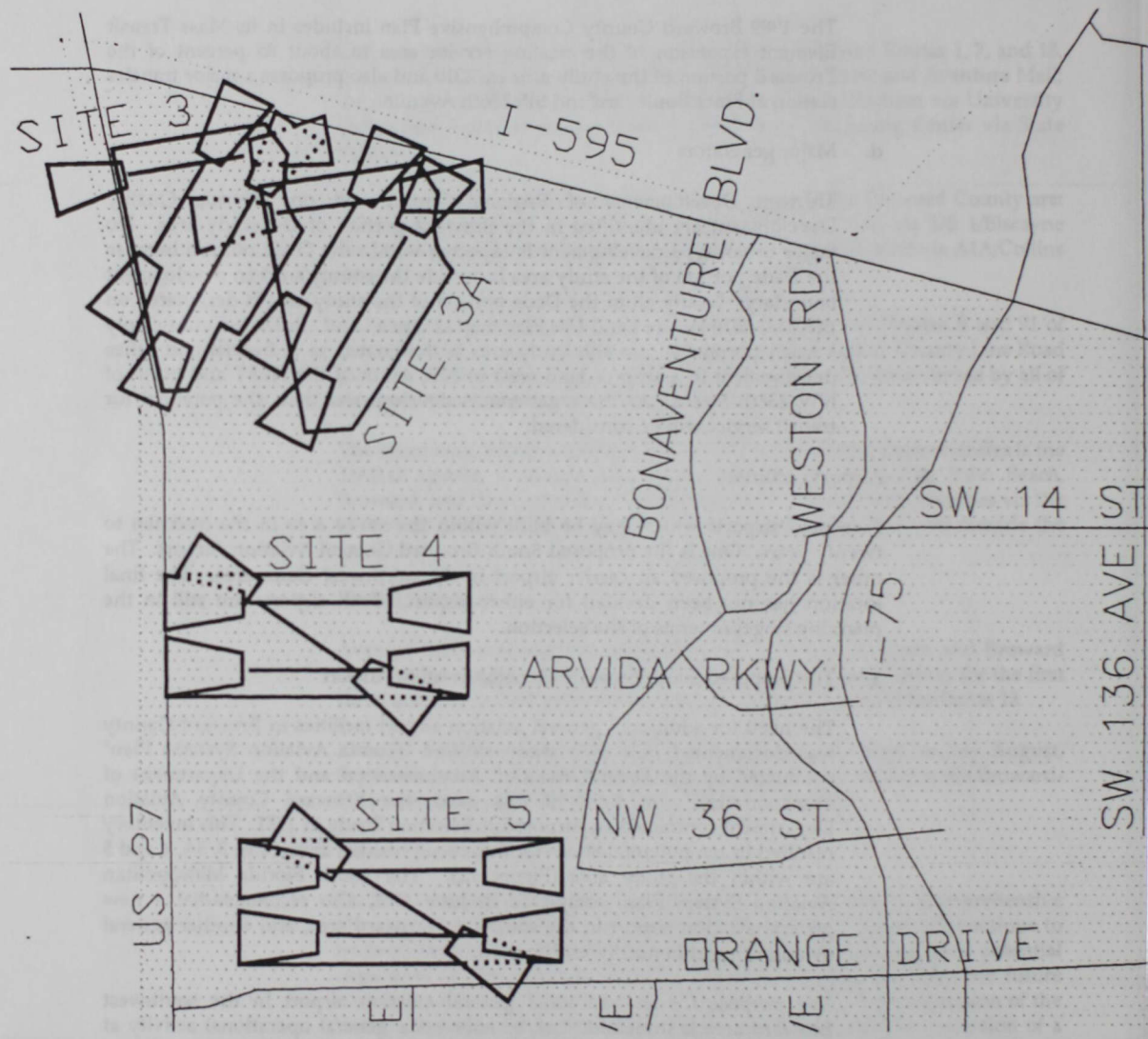
Two new airports which may be built within the study area in the next ten to twenty years. One is the proposed South Broward General Aviation Airport. The other is the proposed air carrier airport in the northwest Dade area. The final location has not been decided for either airport. Both airports are still in the planning stages in terms of site selection.

a. The proposed South Broward General Aviation Airport

The need for additional general aviation airport facilities in Broward County was documented in a 1975 study entitled "Florida Aviation Systems Plan" conducted by the Federal Aviation Administration and the Department of Transportation. In light of this need, the Broward County Aviation Department contracted an Airport Site Selection Study in 1981. This inventory resulted in ten potential sites. Of these ten potential sites, Sites 3, 3A, 4 and 5 are within the study area (Figure 22). The South Florida Metropolitan Aviation System Plan, completed in June 1988, also recommended a new general aviation airport in the southwest Broward area, and another general aviation airport in northwest Broward.

The purpose for an additional general aviation airport in the southwest Broward area is threefold: first, to relieve the general operational activity at Fort Lauderdale/Hollywood International to allow for safe and continued growth of scheduled airline passenger flights; second, to divert excess general aviation demands and student flying from other regional airports such as Fort Lauderdale Executive and North Perry; and third, to relieve air congestion on the existing airports.

Several studies have been conducted and more are anticipated in the near future. An environmental assessment (EA) for the basic transport airport for south Broward County, revised in June 1990, has been submitted to the Federal Aviation Administration (FAA) for approval. If this document is



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Alternative Sites for the Proposed South Broward Airport

Clear zone at the end of a runway

Source: South Florida Regional Planning Council

FIGURE 2

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MILES

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May 1990

approved by the FAA, a finding of no significant impact will be issued. If the EA does not adequately address all of the impacts expected to be created by the proposed airport, an environmental impact statement will be required.

Site 3 has been part of the development plan for the area since the mid-1970s. Both Site 4 and Site 5 are located within the approach path of the Ft. Lauderdale/Hollywood International Airport. Neither Site 4 or 5 will be compatible with the adjacent residential areas. Hence, while recognizing that the final site selection has not been decided, the following section will focus on sites 3 and 3A only.

Under the Broward County Comprehensive Plan (BCCP), an airport facility can only be located within land designated as agriculture, industrial or transportation. Otherwise, a land use amendment will be needed. An airport designation has remained on Site 3 since the adoption of the Broward county Land Use Plan in 1977. The subject property was then proposed for use as a general aviation airport as part of the development order for the Weston DRI. Development of the surrounding area has proceeded with this airport site under consideration to avoid establishing any incompatible uses.

The BCCP General Aviation element has a goal for providing additional general aviation airports. It also has specific policy stating that the plans to develop "Weston" and "Parkland" airports should be pursued to accommodate future demand of developing areas in the western sectors of the county.

Preliminary runway configurations and clear zones are designed to minimize the impact of aviation activities upon existing and planned residences. However, the location of Site 3A may have a greater impact upon this existing residential area than Site 3, particularly with regard to the Bonaventure area.

For Sites 3 and 3A, the Airport Site Evaluation indicated that currently sanitary sewer and potable water are not available. Expansion of the Indian Trace Community Development District will be required.

Other potential impacts from Site 3 or 3A will include at least the following: impacts on water resources, threatened and endangered species, and noise impacts.

b. The proposed Dade County supplemental air carrier airport.

The Southeast Florida Metropolitan Aviation System Plan conducted by the Florida Department of Transportation and concluded in 1988 studied aviation needs in South Florida through the year 2005. This study concluded that additional air carrier airport capacity will be needed to support South Florida's aviation needs by shortly after the turn of the century. The study recommends that a site be identified, purchased, and land banked for that purpose in south Broward County or north Dade County.

The Dade County Aviation System Planning Study, also concluded in 1988, determined that additional air carrier capacity is needed by the year 2005. The study recommends that a site somewhere in northwest Dade county be selected and land banked, to be used for a supplemental air carrier airport when increased volumes of activity warrant the need.

The Dade County Board of County Commissioners established criteria for the proposed site which dictated that it be outside the urban development area described in the Comprehensive Development Master Plan, outside of any designated wetlands, and that it not interfere with any designated well fields.

When considering one other important siting criterion, that of integrating the anticipated air carrier flights into the airspace, only one site in Dade County meets all of these criteria. This site is generally located south of the Dade-Broward County line, west of the HEFT, north of Okeechobee Road and east of U.S. 27.

In February 1990, the Dade County Board of County Commissioners authorized a feasibility study of the proposed site to determine if it would be possible to build and operate an air carrier airport there. These studies, which will be undertaken over the next two years, will evaluate engineering aspects of the site, provide airport layout and operational plans, evaluate ground transportation access needs, and provide an environmental assessment. Consideration for the development of regional impact analysis will also be included.

6. Air Quality and Transportation Control Methods

Dade and Broward Counties currently are not meeting the federal air standard for ozone and are classified as non-attainment areas for this pollutant. Air quality concerns in the region were evaluated to ensure that growth would not increase pollution, especially as it affects local public health and the quality of life.

Staff from Dade Environmental Resource Management, Broward EQCB and DER in West Palm Beach performed an analysis of three parameters; ozone, 24 hour total suspended particulates and carbon monoxide, through actual field monitoring results of air pollutants (Table 16). It was found that during a consecutive nine-year period (1980 to 1988), the region had monitoring results above the federal ozone standard in 1981, 1986 and 1987. The region also recorded monitoring results for the same time period above the 24 hour standard for total suspended particulates in 1981, 1986 and 1987. Computer modeling for projected carbon monoxide concentrations was performed for fifteen different years, beginning with 1985 and ending with 2006 (Table 17). While no exceedences were forecast, the maximum allowable concentration was predicted for 1989, 1991, 1997 and 2002. An air quality trend was established by examining the 17 different roadway intersections that were modeled for carbon monoxide for two or more years. Of these 17 intersections, 15 showed increases in projected carbon monoxide concentrations and two showed declines. In some cases the increases were dramatic, one was almost four times the original concentration, while the two declines were minimal.

TABLE 16

FIELD MONITORING RESULTS

Site	Pollutants	Year 1980	1981	1982	1983	1984	1985	1986	1987	1988
11251 Taft Street	TSP	73	120	92	126	67	54	78	78	64
SR 821/U.S. 27	TSP	114	236	84	130	113	131	139	176	204
Thompson Park/U.S. 2	Ozone	.12	.13	.09	.115	.09	.106	.16	.13	.12
Pembroke Pines	CO1 Hr.	-	-	-	-	-	-	-	-	-

Total Suspended Particulate (TSP) results reported above are for a 24-hour maximum and are measured as micrograms per cubic meter (ug/m^3). The standard, not to be exceeded more than once per year, is 150 ug/m^3.

Ozone results are based upon a daily maximum hourly average and are measured as parts per million (ppm). The standard, not to be exceeded an average of more than once per year over three years, is 0.12.

Carbon monoxide (CO) results are based upon a daily maximum hourly and eight-hour average and are measured as parts per million. The standards, not to be exceeded more than once per year, are 35 ppm for one-hour and 9 ppm for eight hours.

SOURCE: Florida Department of Environmental Regulation, West Palm Beach

TABLE 17

8-HOUR CO CONCENTRATIONS (ppm) PREDICTED BY COMPUTER MODELING

Intersections/Year	85	86	87	89	91	92	93	94	96	97	98	01	02	03	06
Hollywood B/Flamingo R	4.2t	4.1t						4.7t							
Pembroke Meadows B/136 A	2.6p					4.0p				5.9p		5.9p			
Pines B/136 A	3.2p					4.9p				6.1p		5.5p			
Pembroke Meadows B/Sheridan S	2.7p				3.3p				3.6p		4.2p				
Taft S/Flamingo R	3.7p					3.3p				4.2p		4.3p			
Flamingo R/NW 292 S			5.7b		5.6b				5.4b						
NW 57 A/NW 183 S			5.4b		8.6b				8.2b						
NW 67 A/NW 186			5.4b		7.4b				7.0B						
Johnson S/U.S. 27			3.0c							6.6c			6.9c		
Pines B/U.S. 27			4.2c							6.0c			6.4c		
Pines B/SW 184 A			3.3c							7.3c			7.2c		
Pines B/I-75			2.0c							8.0c			7.9c		
Pines B/Flamingo R			6.5c	9.0k		8.1c				8.5c			9.0c		
Hiatus R/Pines B				9.0k											
Johnson S/Flamingo R				8.0k											
Hiatus R/Johnson S				9.0k											
Miramar Parkway/Executive Way						3.8m									
Pines B/Main Drive							4.7s				6.1s			8.0s	
Bonaventure B/Arvida Park										8.0w					7.9w
Bonaventure B/Post R										7.9w					
Bonaventure B/Entrance 1										7.9w					
Bonaventure B/Entrance 2															7.8w
Bonaventure B/Griffin R										7.2w					7.8w
Flamingo R/Griffin R										7.1w					8.0w
Weston R/Griffin R															7.9w

Legend:

R = Road; S= Street; B = Boulevard; W = Way; A= Avenue

b - Bluegrass Lakes DRI
c - Chapel Trails DRI
k - Pembroke Lakes DRI
m - Miramar Park of Commerce DRI
p - Pembroke Meadows DRI
s - Silver Lakes DRI
t - Centrum Complex Source
w - Weston DRI

The range of the increases were from 0.5 to 5.9 parts per million (ppm), whereas the reductions were 0.1 and 0.3 ppm. Based on these findings, it was decided that concerns over air quality were justified and corrective actions should be considered.

The analysis showed that the region has recorded monitoring results above the federal standards for ozone and total suspended particulates three times over the last nine years. A review of computer modeling for carbon monoxide (CO) indicates that four times in the next fifteen years the CO levels are forecasted to be at the maximum allowable concentration.

Since surveys show that motor vehicles may cumulatively contribute as much as 75 percent of all the man-made pollution in metropolitan areas, it is suggested that Dade and Broward counties together address reduction of automobile emissions. The most effective means available would be joint implementation, perhaps through the MPOs, of the TCMs listed in Table 18. These TCMs can be coupled with a good public information campaign designed to encourage support for programs aimed at reducing vehicle miles travelled.

7. Concurrency Management Related to Transportation Facilities

   a. Level of service coordination

      Level of service for transportation systems is one consideration for development within the study area. All jurisdictions within the study area have prepared and adopted major updates of their respective comprehensive plans as mandated by the state growth management legislation. These documents include a traffic circulation element which, by statute, must establish minimum level of service (LOS) standards.

      Establishment of these standards began with the adoption of minimum LOS standards for state roadways by FDOT. The FDOT criteria recognize the difficulties in maintaining high levels (non-congested roadways) of service in urban areas and allow certain roadway categories to operate at LOS "E". On the other hand, LOS standards for small urban or rural areas are generally higher.

      Both Broward and Dade Counties have adopted levels of service standards which apply within the respective unincorporated areas. LOS standards at the municipal level are generally the same or more stringent than the corresponding county LOS standard. The standards established by both counties have been effective in recognizing existing low LOS and constraints. Dade County also recognized different levels of mass transit as a transportation mitigation tool which allows low levels of service on roadways in areas where effective mass transit is available. This is applicable primarily in areas outside of the study area.

TABLE 18

RECOMMENDED TRANSPORTATION CONTROL MEASURES (TCMs)

1. Roadway improvements--synchronized signals, grade separated intersections, one-way pairs, reversible lanes, additional lanes
2. Obtaining right-of-way for future exclusive mass transit corridors
3. New mass transit routes
4. Car and van pooling
5. Posting of mass transit schedules
6. Bus shelters
7. Bus turnout lanes
8. Preferential parking spaces for car and vanpool users
9. Exclusive bus and car pool lanes
10. Bicycle lanes
11. Programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas
12. Programs to limit portions of road surfaces to the use of non-motorized vehicles or pedestrian use, both as to time and place
13. Require that streets be designed for pedestrians and bicycles as well as cars.
14. Fringe and transportation corridor parking facilities serving multiple occupancy vehicle programs or transit service
15. Programs to limit or restrict vehicle use during periods of peak use, through road use charges, tolls, parking surcharges, or vehicle registration programs
16. Establish employee data base for ride sharing matching service
17. Require that development be mixed use, detailed in such a way that pedestrian travel within the development is more convenient and desirable than automobile
18. Transportation management plans for developers for VMT reduction
19. Assess developments, based on square footage and/or vehicle trips generated, for funding TCMs.
20. Limit development around trafficways which are operating at unacceptable level of service standards

SUGGESTED TRANSPORTATION CONTROL MEASURES (TCMs)

1. Staggered hours of work and four-day work week
2. On-site amenities - day care, restaurants, shops
3. Endorsement of the new Automobile Anti-Tampering and Inspection Program
4. Shuttle system including free lunch-time service
5. Require streets to connect with one another such that local trips will not impact collector and arterial streets: no cul-de-sacs
6. Require that streets within a development connect with streets in adjacent developments when it does not interfere with Crime Watch activities
7. Employer-based transportation management plans on reduction of VMT
8. Trip-reduction ordinances
9. Limit parking and on-street parking restrictions including loading/unloading restrictions for trucks
10. Require telecommuting, i.e. work at home, use of teleconferencing, Fax and computer
11. Restrict truck operations to specific periods of the day
12. Programs for conversion of fleet vehicles to cleaner engines or fuels
13. Prohibit all drive thru
14. Encourage tourists commuting during off-peak hours, i.e. early bird dinner specials, attraction discounts
15. Stage II Vapor Recovery
16. Support the continuing operation of the Tri-Rail

The Broward County circulation LOS standards considers existing levels of service (1989). In essence, roadways operating at LOS "D" or better will not be allowed to deteriorate below LOS "D" and long range improvements are planned. The objective would be to achieve LOS "D" with the adopted improvement. In the case where the existing LOS is below "D" and improvements are not planned, the objective is to prevent the LOS from deteriorating too far beyond the existing levels. Building permits in areas

where the existing levels of service are below "D" will continue to be issued until projected traffic volumes reach a maximum of 10 percent below the existing levels.

The Dade County adopted LOS standard is subdivided in two time periods: through 1994 and beginning from 1995. The standards are also sensitive to geographic areas. The intent of the geographic stratification is to promote infill development and discourage urban sprawl. The comprehensive plan defined three basic geographic areas as follows:

- The area outside the urban development boundary (western Dade County),
- The urban infill area (east of the Palmetto Expressway),
- The area between the urban development boundary and the urban infill area.

The short term LOS standard (through 1994) establishes relatively high levels of service outside the urban development boundary level (LOS "C" or "D" depending on the type of roadway) LOS "E", however, is allowed inside the urban development boundary. Additionally, traffic volumes on roadways presently operating below LOS "E" could continue to increase up to 10 percent of existing levels in the area between the urban development boundary and the urban infill area. A 15 percent increase in traffic is permitted on roadways within the urban infill area. LOS "E" and up to 20 percent of certain roadways below LOS "E" are allowed in Special Transportation Areas.

The Dade County long term LOS standard (beginning from 1995) is based both on geographic location and level of mass transit service. In essence, high traffic levels of service are required in the less developed areas with no transit service while low traffic levels of service (as low as 150 percent of the roadway capacity - LOS "E") is allowed in the more dense areas with significant transit service (including Metrorail, Metromover, Commuter Rail or Express Bus).

The adopted levels of service in the Dade municipalities are, for the most part, LOS "D". This standard is compatible with or higher than the LOS standards in the state, regional and county comprehensive plans. The details of the municipal levels of service standards vary widely. Many of them do not recognize the lower levels of service standards allowed in other plans under certain conditions. From that standpoint, there are certain discrepancies which make comprehensive planning somewhat difficult. For instance, in certain cases, acceptable levels of service can be found on one side of the jurisdictional line for a roadway with a certain traffic volume and cross-section. Under the same conditions, on the other side of the jurisdictional line, the resulting LOS may be deemed unacceptable.

b. Concurrency management

Both Broward and Dade counties have adopted and currently implement a concurrency management program. Municipalities, for the most part, lag behind the counties in the implementation of these programs. The lag is more noticeable in Dade County where, in many cases, platting and building permits are approved at the municipal level. In Broward, platting is a county function, therefore, concurrency management is more centralized and easier to effect.

The Broward County Concurrency Management Program is based on the TRIPS model. The county, through the use of the model, keeps track of all approved development and associated traffic. The model is used as a tool to accumulate traffic volumes, therefore providing projections of existing plus approved developments on all principal county roads. Traffic projections, coupled with roadway capacity estimates, establish existing and anticipated levels of service on these roadways.

Broward County has published a map illustrating areas with anticipated deficient roadway levels of service (compact deferral areas). Generally, development is not allowed in compact deferral areas within one-half mile in each direction from the end of a deficient roadway segment as well as one mile in each direction parallel to each deficient roadway link. the program, however, allows for development applicants in those areas to submit an Action Plan designed to mitigate the impact of a proposed development. Action Plans showing complete mitigation of project impacts may be determined to fulfill the concurrency requirement and are used as a basis for issuance of development permits.

Dade County is in the process of establishing a Concurrency Management Information Center. In the meantime, concurrency requirements are being reviewed by the appropriate county departments. Traffic concurrency is the responsibility of the Public Works Department.

Concurrency determinations are performed prior to issuance of any development approval. The determination takes into consideration programmed and planned improvements. The future roadway improvements may be recognized in the concurrency determination depending on the type of development permit and geographic location. For example, rezoning applications will recognize roadway improvements in the long range plan (as late as the year 2010), on the other hand, programmed improvements in areas outside the urban development area must be present concurrently with or before the proposed development.

Dade County has an extensive database of existing traffic counts. Previously approved developments are taken into consideration. Traffic volumes generated by a new project are estimated and added to the roadway network as appropriate. Levels of service with the approved and the proposed development is calculated. Development approvals are issued if the projected LOS is consistent with the comprehensive plan.

Generally speaking, Dade and Broward Counties perform their own concurrency determinations. Municipalities in Broward rely heavily on Broward County for concurrency calculations. Municipalities in Dade, however, must prepare their own concurrency determinations. Often the burden is put on an applicant to provide the necessary concurrency information.

Due to differences in LOS standards and concurrency management program implementation procedures, concurrency conclusions can be very different across jurisdictional lines. In general, concurrency is a jurisdictional issue. Not only does each jurisdiction have potentially different levels of service standards and concurrency programs, but also only one jurisdiction has the legal powers to approve or deny development orders. In other words, even though concurrency conclusions may vary across a boundary line, the adjoining jurisdiction across from a proposed development has no legal authority to approve or disapprove a project in the adjoining jurisdiction.

Jurisdictional barriers are one issue that the growth management legislation does not specifically address. In theory, through the implementation of consistent municipal, county, regional, and state plans discrepancies should not arise. In reality, each local jurisdiction, through its inherent power to adopt local regulations and goals (which are compatible with the desires and resources of its constituency), differences in standards are inevitable. A variety of development approval policies, therefore, has resulted.

8. Findings and Recommendations

1) Findings: **Highway Planning Coordination**

- The future motor vehicle traffic forecasts between the Broward and Dade Counties are compatible except for few instances; however, there is a need to strengthen the dialogue between the county agencies for highway planning.

- Due to the divergent land use policies of the two counties, there are few existing or planned inter-county connections of the roadway network within the study area.

Recommendations

a) The mechanisms for coordination of motor vehicle planning such as traffic count surveys at the Broward/Dade county line should be strengthened.

b) Within the study area, if Dade County's Comprehensive Plan is amended in the future to authorize urban development adjoining Broward County, the need for additional inter-county roadway connection should be addressed.

2) Findings: **Mass Transit Integration**

- Within the study area, there are no connections between the two mass transit systems due to different land use and associated transportation policies of the two counties.

- Outside the study area, the Broward and Dade mass transit systems have few connections.

Recommendations

a) As land use changes within and outside the study area are proposed, coordination between Broward and Dade Counties is needed to address greater connectivity issue between their respective mass transit systems.

b) In order to more fully evaluate the need for greater system connectivity, the South Florida Regional Planning Council, in conjunction with the appropriate agencies, should initiate an inter-county transit study.

3) Findings: **Proposed Airport Facilities**

- The proposed northwest Dade air carrier airport and the south Broward general aviation airport would share common airspace, which will impact the operations and design of the proposed airports.

- NEPA (National Environmental Policy Act) process will require the planning of the proposed airports to be multi-jurisdictional.

- The proposed northwest Dade air carrier airport is in close proximity to the Broward/Dade county line.

Recommendation

All stages of the planning of the proposed airport facilities, including before entering the NEPA process, shall be multi-jurisdictional.

4) Finding: **Air Quality**

- Declining air quality has been associated with increases in automobile transportation activities. Use of transportation control measures (TCMs) can help alleviate this problem.

Recommendation

The TCMs described in Table 18 should be considered as part of the public/private planning and permitting process within Broward and Dade Counties.

5) Findings Level of Service and Concurrency Management

- State growth management law allows each county to adopt and enforce its own level of service standards.

- Transportation level of service standards and concurrency management system are different between Broward and Dade Counties. These differences could impede an effective impact review process.

Recommendations

a) To facilitate a more effective impact review process, the inconsistencies should be resolved through measures such as inter-jurisdictional agreements.

b) A transitional area which blends the different level of service standards and concurrency management systems should be established at the Broward/Dade county line. The South Florida Regional Planning Council should coordinate these efforts.

C. Potable Water, Wastewater and Solid Waste

Growth in the study area will result in the need for local governments to provide water, wastewater and solid waste service. Local governments already have some ability to provide these services, but the existing infrastructure will need to be expanded as further development takes place.

1. Infrastructure Availability

Tables 19 and 20 indicate the existing capacity and expansion plans for potable water and wastewater facilities serving the study area. Most of these facilities also provide service to areas outside the study area, and it was not possible to obtain data which would identify the capacity currently allocated or projected to be allocated specifically to the study area. Therefore the figures should be taken only as a rough approximation of total service capability available to the area.

a. Potable water

Both the South Florida Water Management District (SFWMD) and the Florida Department of Environmental Regulation (FDER) regulate potable water service. The SFWMD issues permits for the withdrawal of raw water from wells, while the FDER issues permits for the treatment plants. Both institutions maintain data bases, which contain information on the permits issued, as well as data gathered from monthly operating reports prepared for each treatment facility.

There are, however, some inconsistencies in the data coming from the two sources, which make it difficult to compare permitted consumptive use capacity with the permitted design capacity of potable water treatment plants and their actual production of potable water.

TABLE 19

SOUTHWEST BROWARD/NORTHWEST DADE SUBREGIONAL STUDY
POTABLE WATER TREATMENT FACILITIES SERVING THE STUDY AREA - 1990

County/Entity	SFWMD Current Allocation (MGD)	FDER Design Capacity (MGD)	Current Maximum Demand (MGD)	Available Capacity (MGD)	Projected Maximum Demand (MGD)	Planned Capacity Expansion MGD)
Dade County:						
WASAD	165.5	225.0	178.0	47.0	263.0	20.0
Broward County:						
Cooper City	3.3	4.9	2.8	2.1	7.5	
Pembroke Pines	5.9	12.0	8.2	3.8		
Miramar	3.4	6.0	3.8	2.2	12.8	
Sunrise	13.6	21.5	14.1	7.4		3.0
S. Broward Utility	0.7	2.0	0.9	1.1	0.2	
Ferncrest Utilities	0.9	1.2	1.1	0.1		
Davie	3.1	7.4	4.1	3.3		
TOTAL	196.4	280.0	213.0	67.0	283.3	23.2

SOURCES: FDER, Drinking Water Program - System Inventory Information (April 5, 1990)
SFWMD, Public Water Supply Database (April 10, 1990).

TABLE 20

SOUTHWEST BROWARD/NORTHWEST DADE SUBREGIONAL STUDY
WASTEWATER TREATMENT FACILITIES SERVING THE STUDY AREA - 1990

County/Entity	Rated Capacity (MGD)	Current Demand (MGD)	Available Capacity (MGD))	Planned Capacity Expansion (MGD)
Dade County:				
North District	90.0	78.3	11.7	40.0
Central District	133.0	127.2	5.8	0.0
Broward County:				
Cooper City	3.5	2.0	1.4	6.5
Cenvill	1.3	0.9	0.4	7.5
Hollywood	38.0	34.7	3.3	46.0
Sunrise	6.0	5.8	0.3	11.0
S. Broward Utility	0.5	0.3	0.2	1.0
Ferncrest Utilities	0.5	0.6	-0.1	
Davie	3.0	1.6	1.40	
TOTAL	275.8	251.4	24.3	112.0

SOURCES: Local Government Comprehensive Plans (1989) and direct collection.

The following definitions are used in the tables:

SFWMD Current Allocation
The amount allocated in the consumptive use permit issued by the South Florida Water Management District. These permits are valid for anywhere from two to ten years.

FDER Design Capacity
The maximum amount of water that a system is permitted by FDER to produce (as measured by a finished water flow meter) on any given day, regardless of how often that peak occurs in a given year. The permitted capacity is equal to or less than the rated capacity.

Current Maximum Demand
The maximum volume of treated potable water actually withdrawn for distribution on any given day.

Available Capacity
FDER design capacity minus current maximum demand. The existence of storage capacity for treated potable water may increase the maximum amount of water actually available for distribution.

Projected Maximum Demand
The volume of water projected to be needed by the population expected to reside within the plant's service area, based on a 2010 planning horizon.

Planned Capacity Expansion
The amount of capacity which is currently planned to be added to the system within the planning horizon.

A total of 19 potable water treatment plants provide service to the study area, two for all of Dade County, under the responsibility of WASAD, and 17 for varying local governments and private entities in Broward County. Of these 17, three do not currently treat water (they are used as repump stations).

Although these plants have a total design capacity of 280 MGD (million gallons a day), they are currently permitted to withdraw only 196 MGD by the SFWMD. Actual use averages between 160 and 180 MGD. It is worth repeating, however, that a significant part of this capacity serves population outside of the study area. This is notably the case in Dade County where the population in the study area is a small portion of the total population served by the Hialeah-Preston plant.

Planned expansions will provide an additional 23 MGD over the planning horizon, according to the local comprehensive plans and data collected from the facility operators.

b. Wastewater

The FDER issues permits for wastewater treatment plants. The following definitions are used in the tables:

Rated Treatment Capacity
The system is assigned a rated capacity based on its most limiting component. Each treatment and disposal unit within a treatment facility is given a rated capacity based on its ability to process hydraulic and organic loadings. This is equal to the capacity permitted by FDER.

Current Demand
The volume of wastewater actually taken in for treatment, expressed as a peak day demand.

Available Capacity
Permitted treatment capacity minus current demand, expressed in peak day terms.

Projected Maximum Demand
The volume of wastewater treatment capacity projected to be needed by the population expected to reside within the plant's service area, based on a 2010 planning horizon.

Planned Capacity Expansion
The amount of capacity which is currently planned to be added to the system within the planning horizon.

The overall capacity of the facilities which service the study area is estimated to be 275 MGD, of which 80 percent is located in Dade County. Once again, the population in the study area represents only a small portion of the total demand served by those facilities. Current demand is estimated to be 251 MGD. Planned capacity expansion will provide an additional 112 MGD within the planning horizon.

c. Solid waste

The FDER regulates the disposal of solid waste in Florida.

Dade County has three primary solid waste disposal sites operated by Metro-Dade Solid Waste Management and one private facility. The North Dade Landfill is closest in proximity to the Dade portion of the study area, located near the Dade-Broward line, south of the HEFT. It has a capacity of 11,500 tons per week and an expected life of eight years. The South Dade Waste Disposal Facility has a capacity of 25,000 tons per week and an expected remaining life of 15 years. The county resource recovery facility, located adjacent to the county's 58th Street landfill, is designed to process approximately 17,692 tons per week into electrical energy. These figures are based on 1988-1989 data and assume disposal alternatives, such as recycling and composting programs. If these programs perform marginally or not at all, landfill capacity will be reduced at a faster rate. The private facility was scheduled to close in 1992; however, the contract agreement with the county has been extended until the landfill has received sufficient quantities of solid

waste to achieve its design contours. This extension occurred as part of Waste Management's agreement to undertake substantial environmental agreement. None of the sites is located in the study area.

Broward County currently operates two major solid waste facilities, the Central Disposal Sanitary Landfill (CDSL) and the Broward County Interim Contingency Landfill (BCIL). The latter facility is located on a 588-acre site within the study area, directly east of US 27 at the proposed extension of Sheridan Street. It is expected to be operational for another 17 years and accommodates primarily trash and unprocessable waste. In addition, the county has an Office of Resource Recovery which is developing a solid waste resource recovery system. The system will include two subregional resource recovery facilities, one next to the CDSL and the other at SR 441 and I-595. These are scheduled to come on line in 1990, with a combined capacity of 3,673 tons per day and generating capacity of 124 megawatts of electrical energy.

Both Dade and Broward have solid waste programs that will meet the needs of the study area. Dade County has a county-wide plan for solid waste collection and disposal which will meet their needs until the year 2005. The plan includes transfer stations and public trash drop off sites to control illegal dumping. Detailed capacity analyses are currently being undertaken and are an ongoing activity of the planning and engineering departments to determine changes in remaining capacity. Broward County has a plan that includes solutions for the disposal of solid waste through the year 2030. However, Broward does not have a countywide collection program. The method of waste collection and the enforcement of prohibitions of illegal dumping are the responsibility of each city or municipality within their jurisdiction.

The FDER has specific requirements regarding the disposal of hazardous waste which are enforced at a county level by Metro-Dade Department of Environmental Resources Management (DERM) and Broward County Environmental Quality Control Board (EQCB). Both counties report that improper disposal is widespread. There is only one permitted hazardous waste transfer station in southeastern Florida, located in Pompano Beach.

The data reviewed on existing and planned capacity for potable water, wastewater and solid waste in the study area was insufficient to determine the capacity available for attending expected development in the study area. This was primarily due to the difficulty of separating expected population growth and capacity estimates for the study area from jurisdiction-wide data for each facility operator. This problem was exacerbated in Broward County due to the large number of public and private operators of facilities.

Solid waste planning typically establishes a long-term horizon, and both Broward and Dade Counties indicate the ability to satisfy the demand for solid waste facilities in the next 20 years.

On the other hand the planning horizon for potable water and wastewater facilities is much shorter. In Broward County, the treatment of projected demand for each facility is not systematic in the different local comprehensive plans. Moreover, because the surplus capacity identified in some of the plants

that service the study area is also available for areas outside the study area, it is not possible to compare projected growth within the study area with the existing plant capacity and planned expansions. In the case of potable water, this evaluation is complicated by the need to analyze both consumptive use capacity and water treatment capacity.

There is a general consensus that physical plant capacity can be expanded to meet the needs of future development in the study area provided that the necessary natural resources are available and capital facilities funding is guaranteed; however, available financing is often a primary factor in landfill expansion. The costs and fiscal resources associated with the acquisition of land, design and construction must be carefully evaluated.

2. Potable Water

a. Water supply

As discussed in the water resources section, the sole source of potable water in South Florida is the Biscayne Aquifer. In its naturally occurring state, water from the Biscayne Aquifer is generally hard and often contains high concentrations of iron, which are primarily attributed to the large natural organic content of the aquifer. This large natural organic content has contributed to the formation of trihalomethanes during the chlorination of public water supplies. Locally, portions of the Biscayne Aquifer have been contaminated by industrial discharges, landfill leachate and fuel spills. East of the study area, wellfields have also become contaminated from nearby saline water (salt water intrusion).

Within the study area, no public water supplies currently draw raw water from the Floridan Aquifer system. In this area the aquifer is confined and artesian. Several adjacent supplies have constructed test wells to investigate the feasibility of this source. The overall water quality from this formation is lesser than from the Biscayne, but it is less vulnerable to contamination because of its overlying, confining formation.

b. Potable water treatment

There are two objectives of water treatment as discussed herein: to make it safe for human consumption and to make it appealing to the consumer, both of which must be provided for reasonable cost. The type of treatment depends on the quality of the source and the quality desired in the finished product.

Private Wells

Because of the low population density within the area, many of the residents in the study area are not served by public water supplies, but have individual wells. Treatment provided for private well supplies runs the spectrum. Many private wells use the water just as it is taken from the ground, while others may provide some treatment. Treatment may include aeration (for removal of taste and odor), package softeners, disinfection and cartridge filters.

Treatment Methods

Ground water supplies are highly mineralized. In this locale this is nearly synonymous with hard water and the type of hardness is defined as bicarbonate hardness. Hardness causes soaps and detergents to perform poorly, reduces fabric life with repeated washing and causes scaling problems on pipes, water heaters and cooking utensils.

The present treatment process incorporates the following unit processes:

- Chemical addition
- Softening
- Filtration
- Disinfection

All public water supplies in the study area employ the lime softening process to remove hardness. Chemicals are added to the raw water as it enters the plant. At this point, lime, the principal agent used in softening, is added. Also an oxidant or activated carbon may be added to combat taste and odor problems. A polymer may also be added to enhance coagulation in the softening process.

In this process chemicals (primarily lime) are added and mixed with the raw water. The chemically rich raw water is fed to a solids contact unit. There are several solids contact units in the area. These units are fundamentally similar in design in that they combine solids contact mixing, flocculation, solids-water separation and continuous removal of sludge in a single package type basin. In these units water enters at the bottom of the units, flows up through a suspended sludge blanket and the softened water is withdrawn.

Filtration follows softening to remove colloidal matter from the softened water. Disinfection is a unit process used to render pathogenic and enteric organisms harmless. Chlorine is the disinfectant of choice. State regulation requires that a residual be maintained in the distribution system. Several utilities now add ammonia to allow the chlorine residual to last longer in the distribution system.

The present softening process used produces large amounts of sludge, a soupy substance which is extremely difficult to dispose of properly. Presently, most utilities are lagooning or land spreading the sludge.

c. Regulations

An increased awareness and public concern about the quality of the water we drink has brought about two major pieces of legislation in the last two decades: the Safe Drinking Water Act (SDWA) of 1974 and the more recent 1986 Amendments. The new rules from this legislation will have profound impacts on the future treatment of public drinking water supplies.

d. Emerging treatment processes

With the advent of the new regulations several new treatment processes and ancillary unit process may emerge. They are:

- Membrane Softening
- Reverse Osmosis
- Aeration
- Absorption
- Ozonation

Membrane softening is a recent modification of the reverse osmosis process used for saline and brackish water desalination. In the membrane softening process, semi-permeable membranes have been specifically formulated to retain calcium, magnesium and other multi-valent ions that comprise water hardness, while allowing suitable water flux at relatively low pressures (90-150 psi). The membranes filter out humic and fulvc acids and other long chained organic molecules, including trihalomethanes, that are by-products of disinfection. Complete retention of bacteria, viruses and protozoans in conjunction with the nearly complete removal of color allows the use of free chlorine at relatively low doses to satisfy disinfection requirements.

Basically, membranes have been used for softening, desalination and, more recently, removal of volatile organic compounds (VOCs), manmade pollutants. The composition of the membrane and the pressure applied to the feed water distinguish the different processes.

Aeration is used as a water treatment method for oxidizing iron and manganese, by adding oxygen to the water, a process referred to as a gas absorption. Conversely, aeration also has been used to release or strip sparingly soluble gases, such as hydrogen sulfide and carbon dioxide, from the water, a process which is referred to as air stripping. The fact that the most frequently occurring organic compounds in ground water are very slightly soluble in water, and thus are volatile, causes aeration to be a feasible alternative for removing these compounds from contaminated ground water supplies.

Adsorption, a technique for removing organic chemical contaminants from drinking water, has received the most attention to date in this country, especially for decontaminating large surface water supply systems. In contrast, the treatment of affected ground water supplies using adsorption techniques has only recently been the subject of pilot and full-scale plant projects. Adsorption techniques which have been considered for removing organics from ground waters are:

- Granular activated carbon (GAC)
- Powdered activated carbon (PAC)

Ozonation is a process using ozone (strong oxidant) that has been heralded as the disinfectant of the future because it does not generate halogenated by products often associated with the use of chlorine. However, a residual cannot be maintained in the distribution system. It now appears that other (secondary) disinfectants will also be required.

3. Wastewater Management

The provision of wastewater treatment and disposal has long been recognized as an important factor in influencing urban growth patterns. With today's increased awareness of environmental quality it has become a major investment of local municipal governments. From past experiences, health hazards associated with high density use of on-site disposal systems, increasing land costs, and the need to protect surface and groundwater quality have been recognized. In many cases, the presence or absence of wastewater systems has meant the financial success or failure of land development activities.

Planning for wastewater management involves three design parameters:

- the ultimate extent of the service area,
- the ultimate service area population, and
- the projected capital service level requirements.

Therefore, it requires decision making by both planners and design engineers. Choice of techniques to be utilized for wastewater treatment lies in the identification of local conditions within an area to the point that alternative investments can be considered. Trade-offs can be made between high first costs with low operating and maintenance costs and low first costs with a relatively high operation and maintenance component.

There are many different types of wastewater treatment systems. They can range from individual septic tanks and drain fields to large regional systems which include gravity collection sewers, lift stations, transmission mains, regional treatment plants and reclaimed wastewater (effluent) disposal facilities. A decision to develop a regional system versus local facilities will depend on the savings in capital (i.e., size of the facility) and the cost of operations (i.e.., transport of waste over greater distances) with septic systems being the most cost effective.

a. Septic systems

The Florida Department of Health and Rehabilitation Services (HRS) regulates septic tanks and drain field installation for systems up to 5,000 gallons per day (gpd) for domestic sewage and 3,000 gpd for food service establishments. The rules which regulate septic tanks are in Chapter 10D-6, F.A.C. County health departments or health units issue individual permits for septic tanks. Additionally, in Dade County DERM regulates all wastewater disposal, including septic tank/drainfield systems. Severe restrictions for the usage of septic tanks are established by section 24-12.1 of the Metropolitan Dade

County Code for the Northwest Wellfield Protection Area, which occupies most of the Dade County portion of the study area. In Broward the EQCB has regulatory responsibility.

Septic tanks are generally used to serve single housing units, although relatively large scale systems have been created. The system consists of the septic tank and the drain field. The tank receives wastewater and provides a period of settling, during which time a significant portion of the suspended solids settle out. The remaining liquids are discharged through underground perforated drainage pipes into the drain field and allowed to percolate into the soil. Micro-organisms and filtration processes remove the solids from the liquids. Septic tanks generally require removal of the settled solids (septage) every two to three years.

A detailed discussion of septic tanks is included in the water resources section of this report.

b. Package treatment plants

Package plants are essentially small treatment systems which have a collection network, treatment plant and disposal system. They can be designed to provide any level of treatment, dependent upon state and local regulations. Capacities can range up to one million gallons per day. They generally serve isolated developments and are usually partially or completely pre-assembled by the manufacturer prior to shipment. Effluent disposal is generally in the form of drain fields, percolation ponds or spray irrigation. Most of the package plants in existence today are privately owned and operated. The average small package plant has an operator on-site for only one-half hour per day, five days per week and a weekend visit. There are no package treatment plants in the study area at this time.

Package plants and regional systems are governed by the Federal Water Pollution Control Act (PL 92-500), as well as local regulations. The goal of this act is the restoration and maintenance of the chemical, physical and biological integrity of the nation's waters. The Environmental Protection Agency is responsible for implementing the act. The Florida Department of Regulation (FDER) is responsible for ensuring that the state implements the federal legislation. FDER regulates wastewater facilities under Chapter 17-600, F.A.C. These rules apply to facilities which treat flows exceeding 5,000 gallons per day for domestic establishments, 3,000 gallons per day for food service establishments, and where sewage contains industrial, toxic or hazardous chemical wastes.

Dade County DERM enforces these requirements on behalf of FDER through an interagency agreement for all package plants in Dade County. Package treatment plants cannot be administratively approved in Dade County. They can only be approved through a variance granted by the Environmental Quality Control Board (EQCB), in a process which requires a public hearing.

c. Regional facilities

Regional facilities are large-scale sanitary sewage systems which generally provide service to densely populated areas. These facilities are comprised of three components which perform the basic functions of collection, treatment and disposal of domestic sewage and industrial waste.

A collection system is composed of a network of gravity sewer pipes and pressure sewer mains which collect sewage from individual sources and convey it to a central location for treatment. In South Florida, these systems generally contain lift stations which raise the sewage flow to higher elevations. Lift stations discharge into force mains, other lift stations, other gravity sewer systems or into a treatment plant.

The treatment plant functions to remove solid and organic materials from the sewage. Primary treatment refers to the removal of between 30 percent to 35 percent of the organic materials and up to 50 percent of the solids which can be accomplished with screens and settling tanks. Secondary treatment refers to the removal of between 80 and 90 percent of total organic material and suspended solids. This level of treatment generally requires multiple steps involving at least one biological process and one or more processes for removal of suspended solids. Tertiary or advanced treatment provides processes to remove synthetic organic compounds and inorganic chemicals.

Treated water produced by the wastewater treatment system is known as effluent and is disposed of through ocean outfalls or deep injection wells into the boulder zone. Beneficial reuse of wastewater may be permitted subject to state and local regulations and requirements. It should be noted that effluent reuse is not permitted within the Northwest Wellfield Protection Area due to water quality considerations. Effluent is not discharged into the region's canals. The effluent is generally disinfected by chlorination. The solid by-product or residual is known as sludge. Sludge is usually subjected to one or more additional processes to remove pathogens, stabilize and dewater. Common disposal methods include burial in solid waste landfills, land application as a soil conditioner for agricultural purposes or incineration.

d. An Evaluation of wastewater treatment systems

Septic Systems

Septic systems are the least expensive method of treatment, but they provide the least amount of treatment. Problems arise generally due to periodically high water tables, poor drainage, lack of space, improper installation, hydraulic overloading from washing machines and lack of maintenance. Also, the use of non-biodegradable products and chemicals which destroy bacteria may result in septic system failures.

There are no federal, state or local rules to require the proper maintenance of these systems or disinfection of the effluent. In a 1986 U.S. Geological Service study, effluent in sand substrate was detected more than 20 feet below the septic tank outlet, but diluted to near background within 50 feet down

gradient from the tank, while effluent in a limestone substrate was detected to depths greater than 25 feet and was diluted, but still detectable at distances 40 feet down gradient from the tank.

Much of Florida's soil is unsuitable for septic tanks. However, in some areas it is thought that septic systems may provide significant amounts of groundwater recharge. A 1985 report by the University of Florida's Institute of Food and Agricultural Sciences stated that 1.3 million families (27 percent of the existing housing units) in Florida were served by on-site sewage disposal systems, while introducing an estimated 170 million gallons of effluent per day into the subsurface environment.

Package Treatment Plants

Package treatment plants are a step up from septic tanks, in that they provide tertiary treatment for the wastewater, which lessens the chance of groundwater contamination. Initial cost and management of the plant is relatively low compared with the cost and management of regional facilities. Because they are generally utilized to serve isolated communities, it provides for the decentralization of large amounts of effluent, which in turn, provides for more wide-spread opportunities for the use of reclaimed water. Problems occur within package plants generally as a result of poor maintenance practices and failure of percolation ponds due to poor soils and high water tables. Private ownership of most of these plants has contributed to many of these maintenance problems. Several counties now are taking a stand to either purchase these facilities, or phase them out by requiring hook-up to existing regional systems.

Regional Systems

Regional systems are a necessity for densely populated areas. Because they are capable of treating large quantities of sewage, there is less chance of ground and surface water contamination in the areas they serve. Initial cost and management of these systems is high. Problems generally arise at regional facilities due to poor maintenance practices and occasionally from the introduction of toxic substances from outside sources (i.e., illegal dumping or stormwater runoff).

Many of these systems are very old and still may have connections to existing stormwater systems, which may over-load the plant during periods of heavy rainfall. Other problems are associated with final disposal of the effluent and sludge. Disposal of effluent to surface water bodies (including fresh, brackish and oceanic waters) does contribute to the pollution of these natural resources, particularly when the effluent is toxic; and it discourages the use of reclaimed water. The use of deep well injection systems results in a permanent loss of large volumes of water from the system, discourages water reuse and has a high initial cost. On the positive side, deep well injection systems have lower operating costs than other methods of disposal, require minimal amounts of land, and require only a secondary level of treatment of the effluent. Sludge

disposal may create problems due to the presence of bacteria and viruses, as a result of inadequate treatment, and from the accumulation of heavy metals and high levels of nutrients.

Low pressure sewer systems have lower construction cost per lineal foot than regional gravity systems. Problems arise with the serviceability of the on-site components, electrical failures (power outages and groundwater seepage), and the accumulation of hazardous and potentially smelly gases under the pressurization unit wetwell cover. STEP systems do have additional storage capacity in the pump wetwell which is useful during prolonged power outages. The operation and maintenance of the pressure sewer systems must be the responsibility of a central management entity. Homeowners cannot be relied upon to take a responsible role in the management of these systems. Periodic inspections must be made of the pressurization unit, pressure sewer valve and the septic tank residual accumulation. Specialized training is required for overall maintenance and operation of these systems.

Today, most regulatory agencies encourage the regionalization of wastewater treatment systems because they provide the best known effluent and sludge management techniques, which, in turn, provide for better protection of our drinking water sources. In addition, they provide a more reliable source for the production of reclaimed water, which will be very important in our efforts to conserve water in South Florida.

e. Wastewater effluent reuse

The challenges South Florida faces with the diminishing supply of quality groundwater and the ever-increasing demands of a growing population are well documented. One water conservation and management method that will play an ever-increasing role in Florida's future is the reuse of wastewater effluent for non-potable purposes. As a typical community uses 50 percent of its potable water supply for irrigation purposes, the potential benefits of a reuse program are significant. (Wastewater effluent reuse is commonly referred to as reuse, reclaimed, recycled, or gray water).

Florida, through its State Water Policy, Chapter 17.40, F.A.C., is very supportive of wastewater reuse, referring to it as a beneficial replacement for the use of higher quality water. Under this policy, the state and the water management districts are required to "promote water conservation and reuse as an integral part of water management programs, rules and plans and encourage the use of water of the lowest acceptable quality for the purpose intended."

Federal, state and local regulatory agencies have stringent treatment standards on wastewater facilities which govern the quality of the effluent which they discharge to surface waters, deep wells or the ocean. With additional treatment, effluent previously disposed can be reused for irrigation and other uses which do not require potable water, such as cooling for industrial plants and flushing of toilets. For a typical secondary wastewater treatment plant, the additional treatment required for reuse includes filtration and high-level disinfection typically utilizing chlorine.

The FDER, through Rule 17-610, F.A.C., regulates the reuse of wastewater effluent for irrigation purposes where there may be public access such as golf courses, parks and residential properties. Effluent reuse must contain less than five milligrams per liter of total suspended solids prior to high-level disinfection. High-level disinfection must accomplish at least 75 percent of all fecal coliform observations made on a daily basis during a month to be below detectable limits. No sample shall exceed 25 fecal coliform per 100 milliliters. Effluent reuse which meets these standards is considered extremely safe, as there have been no documented health problems in Florida.

Reuse Programs in the State

Nearly 20 million gallons per day (MGD) of reclaimed water was used for irrigation purposes by over 5,000 customers in St. Petersburg in 1987. By the year 2000, it is estimated the St. Petersburg reclaimed water system will have the potential to serve approximately 17,000 customers and irrigate almost 9,000 acres.

The City of Naples is currently using six MGD of reclaimed water for irrigation at local golf courses. The city is currently negotiating with other golf courses to expand the program.

In the Loxahatchee River Environmental Control District (ENCON), a reclaimed water system has been developed to help recharge groundwater. The system currently reclaims 4.3 MGD by irrigation of eight golf courses and has contracts for 6.2 MGD with a waiting list for this resource.

The City of Altamonte Springs is currently developing a reclaimed water program which involves the installation of an extensive reclaimed water distribution system. By means of this system, reused water will be delivered throughout the city for irrigation of residential, public and commercial properties, citrus groves, farm trees, crops, golf courses and other recreational facilities. It is ultimately the intent of the city to install dual water systems in homes, commercial buildings and factories, where, in addition to irrigation, the reclaimed water will be used for toilets, fire protection sprinkler systems, cooling water and processed water, and is projected to be fully operational by 1993.

Local Reuse Programs

In August 1989, the City of Pompano Beach placed in operation its 2.5 MGD reuse plant which withdraws effluent from Broward County's North Regional Wastewater Treatment Plant (NRWWTP) for further treatment prior to irrigation of the city's two public golf courses. The NRWWTP currently utilizes 1.25 MGD for site irrigation and process purposes and is currently planning expansion of its reuse system to increase capacity to approximately 10 MGD by 1991. Users of the reclaimed water include the county's North Resource Recovery Plant for cooling purposes and potentially expanding irrigation of local parks and golf courses.

The Miami-Dade Water and Sewer Authority Department (WASAD) is planning to install a one MGD reuse system at their North District Wastewater Treatment Plant. Florida International University is expected to use 70,000 gallons per day for irrigation. It is estimated that WASAD currently reuses approximately nine MGD at its three regional treatment plants for irrigation, maintenance and other non-potable uses. However, reuse of effluent is prohibited in Dade County within the Northwest Wellfield Protection Area due to water quality considerations.

Economic Considerations for Wastewater Reuse

It is significantly less expensive to withdraw water from local surface or underground supplies than from a wastewater reuse facility. However, the incentive for developing and implementing wastewater reuse programs involves more than economic considerations.

A local example is the situation faced by the City of Pompano Beach. Continued irrigation of golf courses by pumping groundwater at approximately five cents per thousand gallons was clearly the most cost-effective option. However, this practice was not viable because of saltwater intrusion which led the SFWMD to refuse to renew their water consumptive use permit. In other words, the city was forced into an effluent reuse program because suitable water for irrigation was unavailable.

Similar situations have already been addressed by St. Petersburg, Naples and Altamonte Springs, and certainly more will be faced with this challenge.

It is clear that further utilization and expansion of wastewater effluent reuse programs will be a vital component of the state's efforts to manage its water resources. Public and private interests must give due consideration to reuse programs to protect our most valuable resource.

4. Water and sewer permitting

The development of any site requires the basic essentials of water service and sewage disposal. A report of the water and sewer requirements for the study area would not be complete without a summary of the existing procedures that developers must follow to provide utility services. There are several governmental processes and requirements which must be met. They include a governmental approval process for the design drawings, a construction permitting process, a construction observation process and in some instances a developers agreement. There are several differences in the approval processes between Broward and Dade.

Broward County

The typical development process begins with the developer initiating a plat or site plan approval process through the local government. When a site plan has been approved, the developer will hire a consulting engineer to prepare design drawings. The design drawings will include plans and details for the installation of water and sewer utilities.

The engineer will submit the design drawings, along with license applications, for approval to the local government, the utility company that will provide the service, and finally the county approval agency. At each submittal, the agency must approve the design drawing and sign the license applications. Each municipality and utility has its own design standards that it will enforce. The Broward County Public Health Unit (BCPHU) approves the design drawings for the water system and the Broward County EQCB approves the design drawings for the sewer system. Each county agency requires a different application.

Once the design drawings have been reviewed and approved by the county agencies, they are given to a contractor. The contractor will then obtain a construction permit from the local government. The construction will be supervised by the engineer, the local government and the utility company. When the construction is completed in accordance with the design drawings the engineer will forward a certification letter to each county agency along with certification documents for final approval. The county agency or the appropriate city agency will then issue an operating permit to the owner.

The approval process is quite involved and can even become complicated when the utility company is not in the same city as the project.

Dade County

Metropolitan Dade County Code establishes the following criteria for the installation of potable water and wastewater facilities:

- **Residential Development**

  From low density (up to 6 dwelling units per gross acre) to high density (up to 125 dwelling units per gross acre) shall only be permitted with public water and public sanitary sewers. Estates density (up to 2.9 units per gross acre) shall be permitted with public water and septic tanks. Development at densities of more than 25,000 square feet gross per dwelling unit could be permitted with on-site drinking water supply wells and septic tank/drainfield, provided that connection to public facilities is not feasible.

- **Commercial Development**

  Neighborhood business and semi-professional offices that do not generate liquid waste other than domestic sewage could be permitted on public water and septic tanks provided that connection to public facilities is not feasible. Any other commercial development should only be permitted with public water and public sanitary sewers. An operating permit program should be implemented in order to monitor the nature of the businesses.

- **Industrial Development**

  Industrial development can only be permitted on public water and public sanitary sewers.

The approval process in Dade requires the owner to initiate a developers agreement with the utility agency in charge of water delivery and wastewater collection systems. Within the study area, these agencies include WASAD and the utilities departments of the cities of Hialeah and Hialeah Gardens and the Town of Medley.

Drawings of the proposed system are then prepared by a State of Florida Registered Professional Engineer. A minimum of five sets of application forms to construct a drinking water system and three sets for a wastewater collection and transmission system must also accompany the design drawings. These are forwarded for approval to the appropriate utility agency before submittal to the DERM. DERM issues the state general permit for sewer extensions and approves the water extensions as the county environmental regulatory agency. The submittal for water is then routed to the Health Department for further review and approval by the State.

The approved drawings are held at DERM where the contractor will get his construction permit. The construction will be observed by the engineer, with monitoring by utility agency staff and oversight by DERM. Once construction is complete the Certification of Completion of Construction is forwarded to DERM through the appropriate utility agency for approval and operation.

5. Findings and Recommendations

1) Finding: **Infrastructure Capacity**

- Infrastructure for potable water, wastewater and solid waste is not anticipated to be a limiting factor for future development within the study area, given the ability to expand plant capacities and landfills to accommodate growth, provided that natural resources are available and facility construction schedules are met.

Recommendation

All planning for future development should be consistent with the availability of natural resources and the facility construction schedules for those public services and facilities serving the study area.

2) Findings: **Standardization of Capacity Data**

- Utilizing data from permit applications and monthly operating reports provided by facility operators, both the SFWMD and the FDER maintain databases on the potable water system within the study area. There are, however, inconsistencies in the data which make it difficult to compare the permitted consumptive use capacity with the permitted design capacity of potable water treatment plants and their actual production of potable water.

- There is a general need to improve the consistency and reliability of information pertaining to the existing design and permitted capacity of potable water and wastewater treatment facilities serving portions of the study area in Broward County.

Recommendations

a) The SFWMD and the FDER should more closely coordinate the permitting of consumptive use capacity and the permitted plant capacity of potable water treatment plants and work with the Broward County Public Health Department and the Dade County DERM to maintain an accurate and up-to-date database regarding the actual withdrawal, production and use of potable water.

b) Standardized information pertaining to those potable water and wastewater facilities servicing the study area should be generated through a cooperative effort involving all permitting agencies, local governments and facility operators within Broward and Dade Counties. The information generated should include each facility's design and permitted capacity, existing and planned service area, current customer base, committed capacity, projected future needs, excess capacity and planned expansions.

3) Findings: **Regionalization of Treatment Facilities**

- Within the Broward County portion of the study area, potable water and wastewater treatment plants are owned and operated by various public and private interests.

- In Dade County, the WASAD is responsible for the production of potable water and the provision of wastewater service in the study area. The cities of Hialeah and Hialeah Gardens and the Town of Medley operate water distribution and wastewater collection systems in a small portion of the study area.

- Some potable water and wastewater treatment plants serving the study area cannot be renovated and brought up to current minimum federal and state standards.

- Today, most regulatory agencies encourage the regionalization of potable water and wastewater treatment systems because they provide the best known effluent and sludge management techniques, which, in turn, provide for better protection of our drinking water sources. In addition, they provide a more reliable source for the production and use of reclaimed water.

- Regional systems are better able to maximize resources and are more cost effective to maintain.

Recommendations

a) Existing potable water and wastewater treatment plants that cannot be renovated and brought up to current minimum federal and state standards should be phased out.

b) Promote the regionalization of potable water and wastewater treatment facilities, while establishing the long-term goal of having all plants and the corresponding distribution and collection systems operated by local government entities rather than developers or homeowner associations.

4) Finding: **Reclaimed Water**

- Within and outside the study area in both Broward and Dade Counties, a substantial loss of fresh water and diminished aquifer recharge potential occurs as the result of wastewater disposal methods including ocean outfall and deep injection well disposal.

Recommendations

a) In order to conserve limited existing potable water supplies, local government entities within Broward and Dade counties should promote the utilization of reclaimed water, rapid rate infiltration areas and aquifer recharge areas.

b) The environmental and economic implications of water reuse should be carefully evaluated prior to large scale promotion.

c) Broward County EQCB and Dade County DERM should establish uniform effluent quality standards to be adopted by their respective counties.

d) All future wastewater treatment facilities serving the study area should be designed to utilize reclaimed water.

e) Golf courses, parks and similar open space areas should use reclaimed water and spray irrigation whenever feasible.

5) Finding: **Hazardous Waste Generators**

- Hazardous wastes introduced into the study area's wastewater treatment system constitute a threat to the water quality and potable water supplies of both Broward and Dade Counties.

Recommendations

a) Local governments should discourage the location of hazardous waste generators within the study area. However, all existing and future hazardous waste generators located within the study area should be required to provide for the disposal of hazardous wastes through a licensed contractor and connect to a centralized sanitary sewer system and pre-treat hazardous wastes on-site prior to disposal through that system.

b) An operating permit program to monitor industrial activity should be implemented by the regulatory agencies.

6) Findings: **Disposal of Hazardous Waste**

- Broward and Dade Counties both report that the improper disposal of hazardous waste continues to be a problem.
- The only permitted hazardous waste transfer station in southeastern Florida is located in Pompano Beach.
- Broward and Dade Counties both have recently obtained Local Household Hazardous Waste Collection Center grants from the FDER.

Recommendation

The Dade County DERM and the Broward County Office of Environmental Services should both increase the availability of convenient and safe hazardous waste disposal opportunities within the study area including the establishment of special collection programs.

7) Finding: **Solid Waste**

- The Metropolitan Dade County Code restricts the location of landfills within the Northwest Wellfield Protection Area, which includes most of the study area within Dade County. However, landfills and related solid waste facilities within the Broward County portion of the study area may pose a threat to the water quality of wellfields, including the Northwest Wellfield in Dade County.

Recommendation

Before siting any additional landfills within the study area, a thorough evaluation of their potential impacts on water quality within the study area should be conducted.

8) Finding: **Recycling**

- The State of Florida and South Florida Regional Planning Council goal of reducing the solid waste stream by 30 percent over current levels will require the widespread participation of all local government entities within both Broward and Dade Counties in existing and new recycling programs.

Recommendation

Recycling should be required by all local government entities within both Broward and Dade Counties, with public accessibility sufficiently convenient to assure broad acceptance and compliance.

9) Finding: **Illegal Dumping**

- In Broward County the enforcement of illegal dumping is the responsibility of each municipality while in Dade County it is a shared responsibility between the county and each municipality.

Recommendation

Broward County should consider a countywide program to control illegal dumping, which could include a public information campaign, aggressive countywide enforcement and strategically located transfer stations with convenient public accessibility.

V. CONCLUSION

This report is based on available information and data regarding the Southwest Broward/Northwest Dade Subregional Study Area. The findings and recommendations are formulated on the analysis of this information as well as discussion from the various technical committee meetings.

This study is the beginning of an on-going process. The report identifies several areas in need of further expansion and refinement of data, information, and policy development. It will be through the cooperative efforts of a full range of interests, including federal, state, regional and local agencies, that this will occur most effectively.

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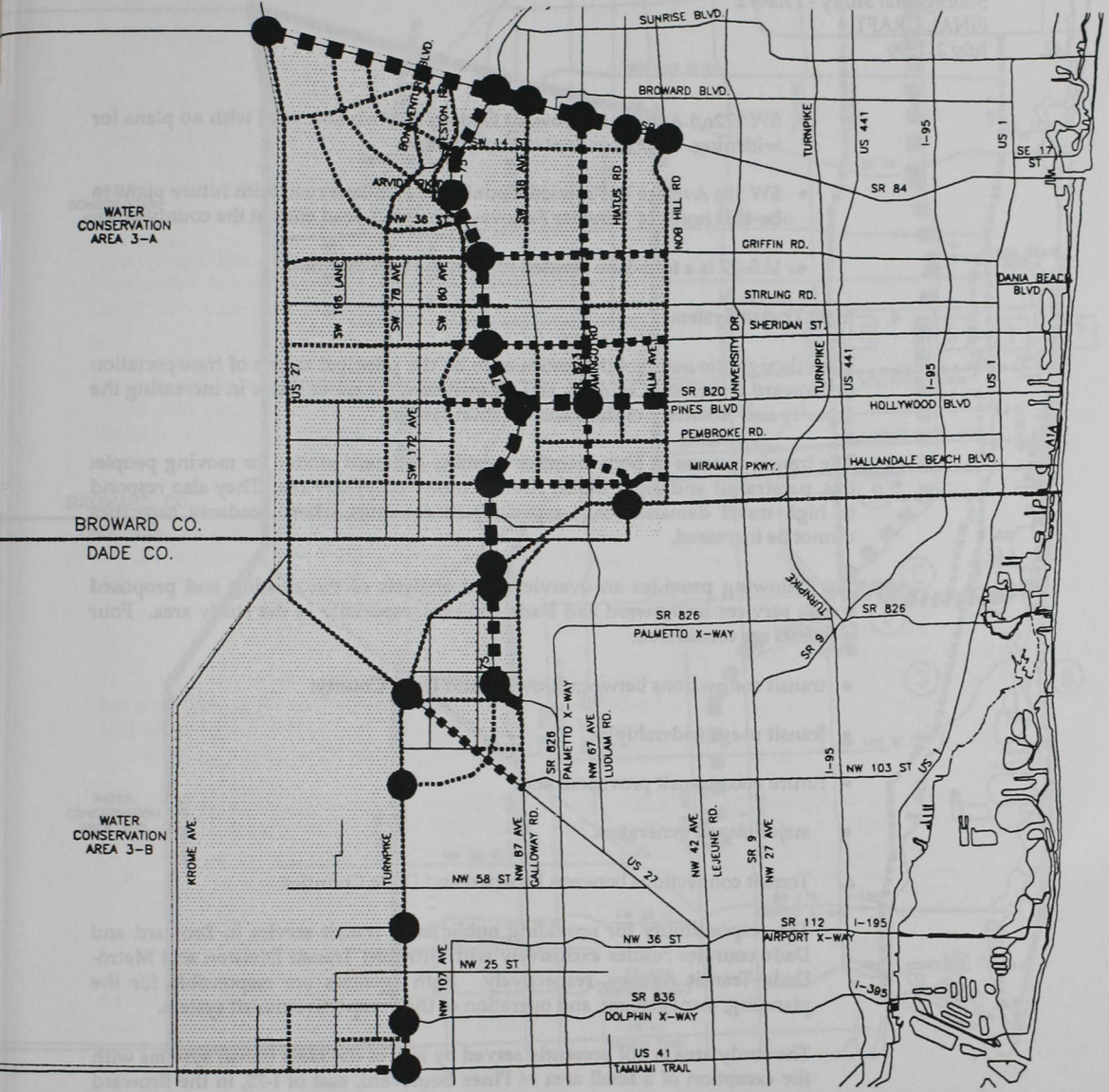

South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Planned Future Transportation Network

2 Lane
4 Lane
6 Lane
8 Lane
10 Lane
Interchange or Fly Over
Study Area

Source: South Florida Regional Planning Council

FIGURE 20

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May 1990

- SW 172nd Avenue in Broward County is a two-lane road with no plans for widening. It dead ends at the county line.

- SW 184 Avenue in Broward County is a two-lane road with future plans to be 4LD north of Miramar Parkway. The road dead ends at the county line.

- U.S. 27 is a four-lane divided road in the two counties.

4. Mass Transit System

Even though the automobile continues to be the principal means of transportation in Broward and Dade Counties, mass transit services are effective in increasing the capacity and efficiency of the transportation system.

The transit systems in both counties combine different modes for moving people: bus, paratransit and rapid transit (Dade County only) services. They also respond to high travel demand areas, especially in corridors where roadway capacities cannot be increased.

The following provides an overview and analysis of the existing and proposed transit services in Broward and Dade counties, especially in the study area. Four elements are considered:

- transit connections between Broward and Dade County;

- transit usage (ridership);

- future mass transit provision; and

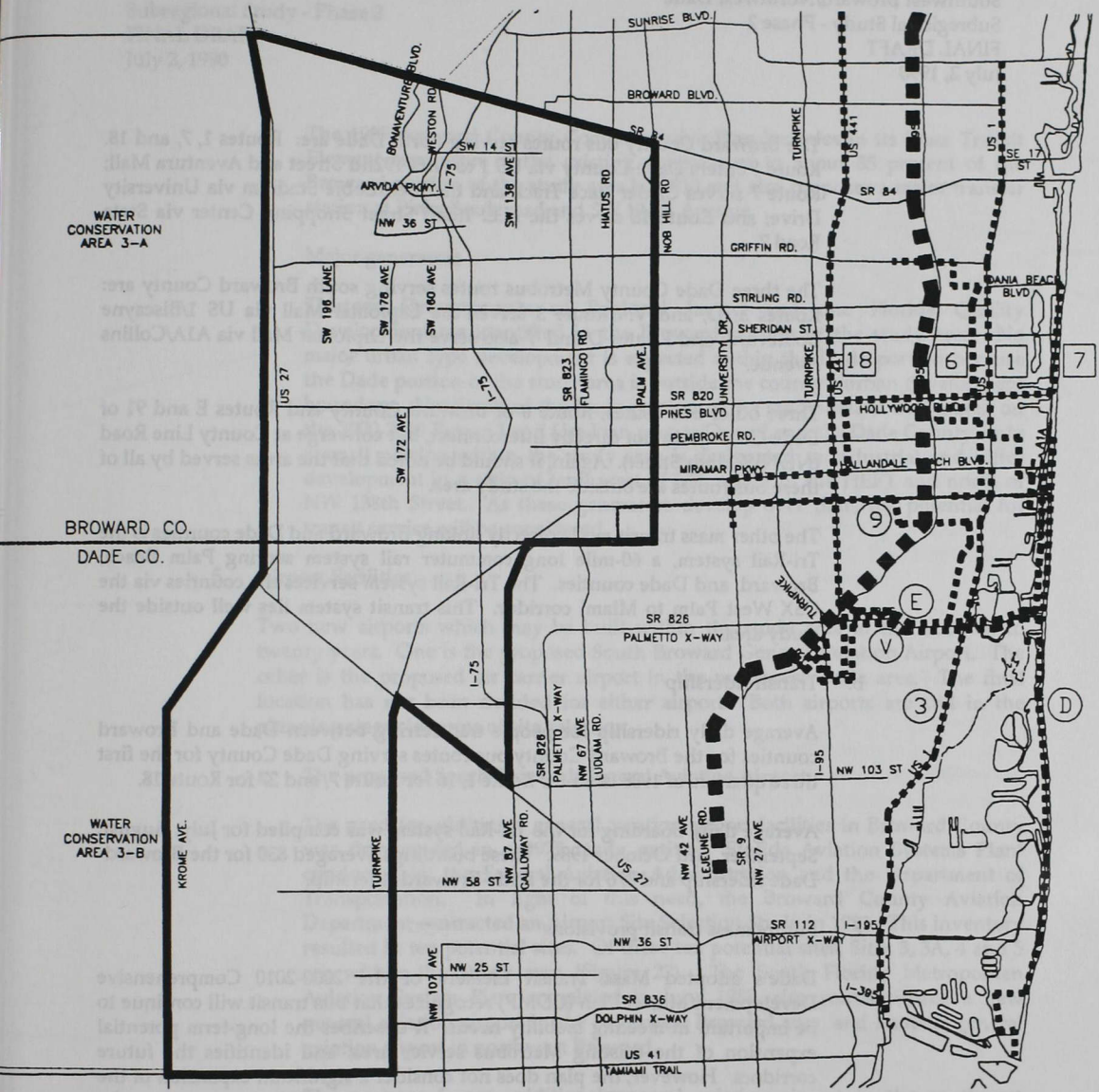
- major transit generators.

a. Transit connections between Broward and Dade Counties

The responsibility for providing public mass transit service in Broward and Dade counties resides exclusively with Broward Transit Division and Metro-Dade Transit Agency, respectively. Both agencies are responsible for the planning, management, and operation of their respective transit system.

The study area is not presently served by any of the mass transit systems with the exception of a small area of Pines Boulevard, east of I-75, in the Broward County portion of the study area. But six bus routes currently connect both counties serving areas east of the study area (Figure 21).

Outside the study area, Broward and Dade counties are connected by two modes of mass transit: a system of bus routes operating on expressway and arterial streets to serve areas of both counties; and the Tri-County Commuter Rail System, better known as Tri-Rail, which serves Palm Beach, Broward and Dade counties (Figure 21). The operation and management of the Tri-Rail System is the responsibility of the Tri-County Commuter Rail Authority. The operation beyond its first three years is still uncertain.



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Mass Transit Network

- Study Area Boundary
- Dade County Bus Route
- Broward County Bus Route
- Tri-Rail Commuter System

Source: MetroDade Planning Department

FIGURE 21

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May 1990

The Broward County bus routes serving north Dade are: Routes 1, 7, and 18. Route 1 enters Dade County via US 1 to N.E. 192nd Street and Aventura Mall; Route 7 serves Calder Race Track and the Joe Robbie Stadium via University Drive; and Route 18 serves the N.E. 163rd Street Shopping Center via State Road 7.

The three Dade County Metrobus routes serving south Broward County are: Routes 3, D, and V. Route 3 serves the Diplomat Mall via US 1/Biscayne Boulevard; and Routes D and V also serve the Diplomat Mall via A1A/Collins Avenue.

Three other bus routes, Route 6 of Broward County and Routes E and 91 of Dade County, do not directly interconnect, but converge at County Line Road (NE/NW 215th Street). Again, it should be noted that the areas served by all of these bus routes are outside the study area.

The other mass transit mode directly linking Broward and Dade counties is the Tri-Rail system, a 60-mile long commuter rail system serving Palm Beach, Broward, and Dade counties. The Tri-Rail system services the counties via the CSX West Palm to Miami corridor. This transit system lies well outside the study area.

b. Transit ridership

Average daily ridership for people transferring between Dade and Broward counties for the Broward County bus routes serving Dade County for the first three quarters of 1988 is: 31 for Route 1, 16 for Route 7, and 27 for Route 18.

Average daily boarding for the Tri-Rail system was compiled for July, August, September, and October 1989. These boardings averaged 830 for the Broward-Dade ridership and 876 for the Dade-Broward ridership.

c. Future mass transit provisions

Dade's adopted Mass Transit Element of the 2000-2010 Comprehensive Development Master Plan (CDMP) recognizes that bus transit will continue to be important in meeting mobility needs. It describes the long-term potential expansion of the existing Metrobus service area, and identifies the future corridors. However, the plan does not consider a significant expansion of the transit system to the Dade portion of the study area with the exception of a small area of Miami Gardens Drive, east of I-75, and Gratigny Drive, northeast of U.S. 27.

Preliminary findings of Dade County's Long Range Transportation Plan Update proposes three new preliminary bus routes, Routes 27x, 29, and 199 for the area east of the study area, but none would serve Broward County directly. In addition, the possibility exists for future service into Broward County via 27th Avenue/University Drive corridor, provided funding sources are available.

The 1989 Broward County Comprehensive Plan includes in its Mass Transit Element expansion of the existing service area to about 85 percent of the Broward portion of the study area by 2010 and also proposes a major transfer station at Pines Boulevard and SW 136th Avenue.

d. Major generators

Thirteen Developments of Regional Impact and one Florida Quality Development are identified in the Broward portion of the study area. No major urban type development is expected within the Dade portion because the Dade portion of the study area is outside the county's urban development boundary. Nearly all of the Dade portion of the study area is designated on the 2000-2010 Future Land Use Plan map as Open Land. In Dade County, only a small portion within the study area is designated as industrial and office development in a strip of land west of I-75, south of the HEFT and north of NW 138th Street. As these generators develop over time, the potential for transit service will be considered.

5. Airport Facilities

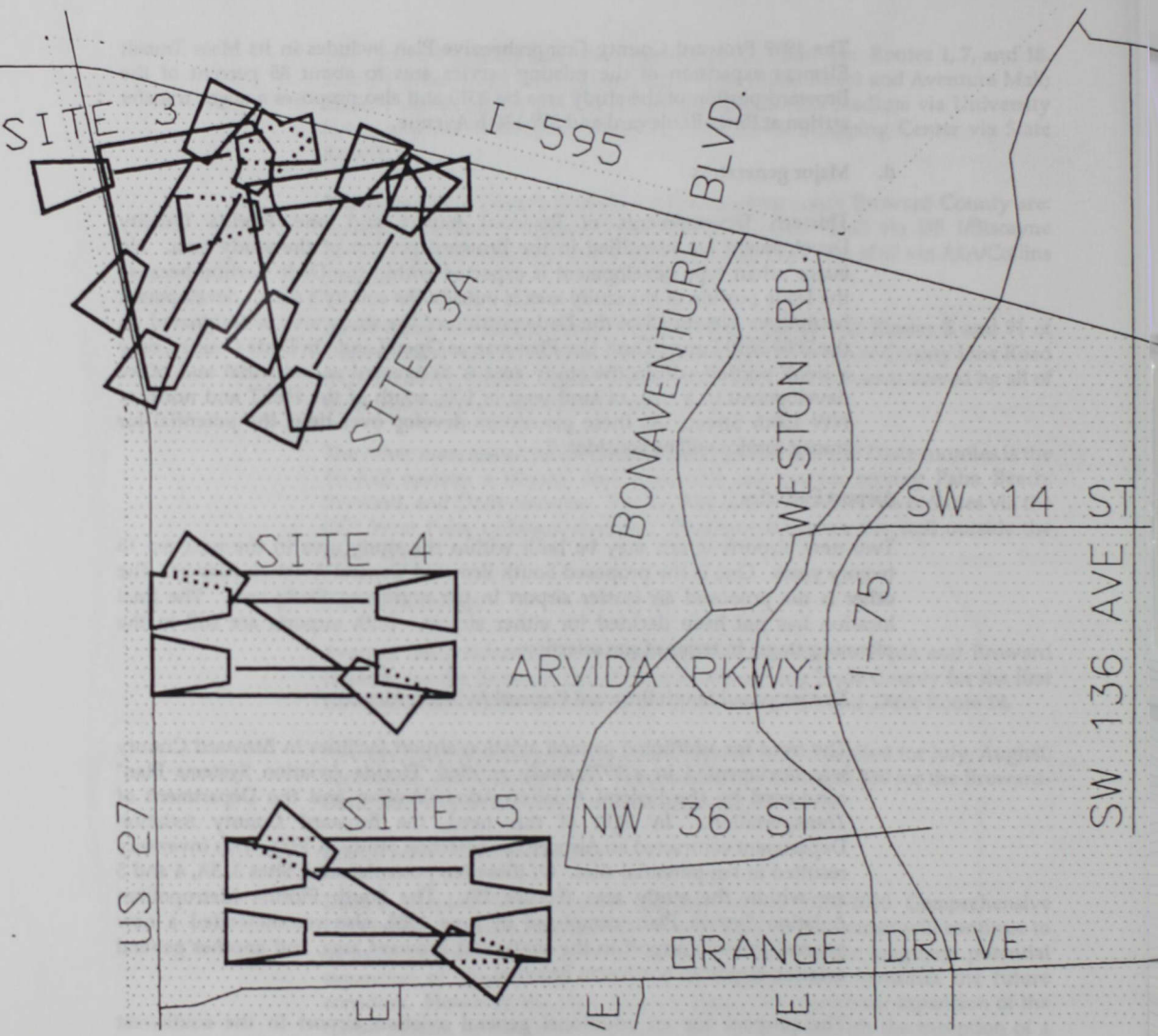
Two new airports which may be built within the study area in the next ten to twenty years. One is the proposed South Broward General Aviation Airport. The other is the proposed air carrier airport in the northwest Dade area. The final location has not been decided for either airport. Both airports are still in the planning stages in terms of site selection.

a. The proposed South Broward General Aviation Airport

The need for additional general aviation airport facilities in Broward County was documented in a 1975 study entitled "Florida Aviation Systems Plan" conducted by the Federal Aviation Administration and the Department of Transportation. In light of this need, the Broward County Aviation Department contracted an Airport Site Selection Study in 1981. This inventory resulted in ten potential sites. Of these ten potential sites, Sites 3, 3A, 4 and 5 are within the study area (Figure 22). The South Florida Metropolitan Aviation System Plan, completed in June 1988, also recommended a new general aviation airport in the southwest Broward area, and another general aviation airport in northwest Broward.

The purpose for an additional general aviation airport in the southwest Broward area is threefold: first, to relieve the general operational activity at Fort Lauderdale/Hollywood International to allow for safe and continued growth of scheduled airline passenger flights; second, to divert excess general aviation demands and student flying from other regional airports such as Fort Lauderdale Executive and North Perry; and third, to relieve air congestion on the existing airports.

Several studies have been conducted and more are anticipated in the near future. An environmental assessment (EA) for the basic transport airport for south Broward County, revised in June 1990, has been submitted to the Federal Aviation Administration (FAA) for approval. If this document is



South Florida Regional Planning Council

Southwest Broward/Northwest Dade Subregional Study
Alternative Sites for the Proposed South Broward Airport

Clear zone at the end of a runway

Source: South Florida Regional Planning Council

FIGURE 22

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May 1990

approved by the FAA, a finding of no significant impact will be issued. If the EA does not adequately address all of the impacts expected to be created by the proposed airport, an environmental impact statement will be required.

Site 3 has been part of the development plan for the area since the mid-1970s. Both Site 4 and Site 5 are located within the approach path of the Ft. Lauderdale/Hollywood International Airport. Neither Site 4 or 5 will be compatible with the adjacent residential areas. Hence, while recognizing that the final site selection has not been decided, the following section will focus on sites 3 and 3A only.

Under the Broward County Comprehensive Plan (BCCP), an airport facility can only be located within land designated as agriculture, industrial or transportation. Otherwise, a land use amendment will be needed. An airport designation has remained on Site 3 since the adoption of the Broward county Land Use Plan in 1977. The subject property was then proposed for use as a general aviation airport as part of the development order for the Weston DRI. Development of the surrounding area has proceeded with this airport site under consideration to avoid establishing any incompatible uses.

The BCCP General Aviation element has a goal for providing additional general aviation airports. It also has specific policy stating that the plans to develop "Weston" and "Parkland" airports should be pursued to accommodate future demand of developing areas in the western sectors of the county.

Preliminary runway configurations and clear zones are designed to minimize the impact of aviation activities upon existing and planned residences. However, the location of Site 3A may have a greater impact upon this existing residential area than Site 3, particularly with regard to the Bonaventure area.

For Sites 3 and 3A, the Airport Site Evaluation indicated that currently sanitary sewer and potable water are not available. Expansion of the Indian Trace Community Development District will be required.

Other potential impacts from Site 3 or 3A will include at least the following: impacts on water resources, threatened and endangered species, and noise impacts.

b. The proposed Dade County supplemental air carrier airport.

The Southeast Florida Metropolitan Aviation System Plan conducted by the Florida Department of Transportation and concluded in 1988 studied aviation needs in South Florida through the year 2005. This study concluded that additional air carrier airport capacity will be needed to support South Florida's aviation needs by shortly after the turn of the century. The study recommends that a site be identified, purchased, and land banked for that purpose in south Broward County or north Dade County.

The Dade County Aviation System Planning Study, also concluded in 1988, determined that additional air carrier capacity is needed by the year 2005. The study recommends that a site somewhere in northwest Dade county be selected and land banked, to be used for a supplemental air carrier airport when increased volumes of activity warrant the need.

The Dade County Board of County Commissioners established criteria for the proposed site which dictated that it be outside the urban development area described in the Comprehensive Development Master Plan, outside of any designated wetlands, and that it not interfere with any designated well fields.

When considering one other important siting criterion, that of integrating the anticipated air carrier flights into the airspace, only one site in Dade County meets all of these criteria. This site is generally located south of the Dade-Broward County line, west of the HEFT, north of Okeechobee Road and east of U.S. 27.

In February 1990, the Dade County Board of County Commissioners authorized a feasibility study of the proposed site to determine if it would be possible to build and operate an air carrier airport there. These studies, which will be undertaken over the next two years, will evaluate engineering aspects of the site, provide airport layout and operational plans, evaluate ground transportation access needs, and provide an environmental assessment. Consideration for the development of regional impact analysis will also be included.

6. Air Quality and Transportation Control Methods

Dade and Broward Counties currently are not meeting the federal air standard for ozone and are classified as non-attainment areas for this pollutant. Air quality concerns in the region were evaluated to ensure that growth would not increase pollution, especially as it affects local public health and the quality of life.

Staff from Dade Environmental Resource Management, Broward EQCB and DER in West Palm Beach performed an analysis of three parameters; ozone, 24 hour total suspended particulates and carbon monoxide, through actual field monitoring results of air pollutants (Table 16). It was found that during a consecutive nine-year period (1980 to 1988), the region had monitoring results above the federal ozone standard in 1981, 1986 and 1987. The region also recorded monitoring results for the same time period above the 24 hour standard for total suspended particulates in 1981, 1986 and 1987. Computer modeling for projected carbon monoxide concentrations was performed for fifteen different years, beginning with 1985 and ending with 2006 (Table 17). While no exceedences were forecast, the maximum allowable concentration was predicted for 1989, 1991, 1997 and 2002. An air quality trend was established by examining the 17 different roadway intersections that were modeled for carbon monoxide for two or more years. Of these 17 intersections, 15 showed increases in projected carbon monoxide concentrations and two showed declines. In some cases the increases were dramatic, one was almost four times the original concentration, while the two declines were minimal.

TABLE 16

FIELD MONITORING RESULTS

Site	Pollutants	Year 1980	1981	1982	1983	1984	1985	1986	1987	1988
11251 Taft Street	TSP	73	120	92	126	67	54	78	78	64
SR 821/U.S. 27	TSP	114	236	84	130	113	131	139	176	204
Thompson Park/U.S. 2	Ozone	.12	.13	.09	.115	.09	.106	.16	.13	.12
Pembroke Pines	CO1 Hr.	-	-	-	-	-	-	-	-	-

Total Suspended Particulate (TSP) results reported above are for a 24-hour maximum and are measured as micrograms per cubic meter (ug/m^3). The standard, not to be exceeded more than once per year, is 150 ug/m^3.

Ozone results are based upon a daily maximum hourly average and are measured as parts per million (ppm). The standard, not to be exceeded an average of more than once per year over three years, is 0.12.

Carbon monoxide (CO) results are based upon a daily maximum hourly and eight-hour average and are measured as parts per million. The standards, not to be exceeded more than once per year, are 35 ppm for one-hour and 9 ppm for eight hours.

SOURCE: Florida Department of Environmental Regulation, West Palm Beach

TABLE 17

8-HOUR CO CONCENTRATIONS (ppm) PREDICTED BY COMPUTER MODELING

Intersections/Year	85	86	87	89	91	92	93	94	96	97	98	01	02	03	06
Hollywood B/Flamingo R	4.2t	4.1t						4.7t							
Pembroke Meadows B/136 A	2.6p					4.0p				5.9p		5.9p			
Pines B/136 A	3.2p					4.9p				6.1p		5.5p			
Pembroke Meadows B/Sheridan S	2.7p				3.3p				3.6p		4.2p				
Taft S/Flamingo R	3.7p					3.3p				4.2p		4.3p			
Flamingo R/NW 292 S			5.7b		5.6b				5.4b						
NW 57 A/NW 183 S			5.4b		8.6b				8.2b						
NW 67 A/NW 186			5.4b		7.4b				7.0B						
Johnson S/U.S. 27			3.0c							6.6c			6.9c		
Pines B/U.S. 27			4.2c							6.0c			6.4c		
Pines B/SW 184 A			3.3c							7.3c			7.2c		
Pines B/I-75			2.0c							8.0c			7.9c		
Pines B/Flamingo R			6.5c	9.0k		8.1c				8.5c			9.0c		
Hiatus R/Pines B				9.0k											
Johnson S/Flamingo R				8.0k											
Hiatus R/Johnson S				9.0k											
Miramar Parkway/Executive Way						3.8m									
Pines B/Main Drive							4.7s				6.1s			8.0s	
Bonaventure B/Arvida Park										8.0w					7.9w
Bonaventure B/Post R										7.9w					
Bonaventure B/Entrance 1										7.9w					
Bonaventure B/Entrance 2															7.8w
Bonaventure B/Griffin R										7.2w					7.8w
Flamingo R/Griffin R										7.1w					8.0w
Weston R/Griffin R															7.9w

Legend:

R = Road; S= Street; B = Boulevard; W = Way; A= Avenue

b - Bluegrass Lakes DRI
c - Chapel Trails DRI
k - Pembroke Lakes DRI
m - Miramar Park of Commerce DRI
p - Pembroke Meadows DRI
s - Silver Lakes DRI
t - Centrum Complex Source
w - Weston DRI

The range of the increases were from 0.5 to 5.9 parts per million (ppm), whereas the reductions were 0.1 and 0.3 ppm. Based on these findings, it was decided that concerns over air quality were justified and corrective actions should be considered.

The analysis showed that the region has recorded monitoring results above the federal standards for ozone and total suspended particulates three times over the last nine years. A review of computer modeling for carbon monoxide (CO) indicates that four times in the next fifteen years the CO levels are forecasted to be at the maximum allowable concentration.

Since surveys show that motor vehicles may cumulatively contribute as much as 75 percent of all the man-made pollution in metropolitan areas, it is suggested that Dade and Broward counties together address reduction of automobile emissions. The most effective means available would be joint implementation, perhaps through the MPOs, of the TCMs listed in Table 18. These TCMs can be coupled with a good public information campaign designed to encourage support for programs aimed at reducing vehicle miles travelled.

7. Concurrency Management Related to Transportation Facilities

   a. Level of service coordination

      Level of service for transportation systems is one consideration for development within the study area. All jurisdictions within the study area have prepared and adopted major updates of their respective comprehensive plans as mandated by the state growth management legislation. These documents include a traffic circulation element which, by statute, must establish minimum level of service (LOS) standards.

      Establishment of these standards began with the adoption of minimum LOS standards for state roadways by FDOT. The FDOT criteria recognize the difficulties in maintaining high levels (non-congested roadways) of service in urban areas and allow certain roadway categories to operate at LOS "E". On the other hand, LOS standards for small urban or rural areas are generally higher.

      Both Broward and Dade Counties have adopted levels of service standards which apply within the respective unincorporated areas. LOS standards at the municipal level are generally the same or more stringent than the corresponding county LOS standard. The standards established by both counties have been effective in recognizing existing low LOS and constraints. Dade County also recognized different levels of mass transit as a transportation mitigation tool which allows low levels of service on roadways in areas where effective mass transit is available. This is applicable primarily in areas outside of the study area.

TABLE 18

RECOMMENDED TRANSPORTATION CONTROL MEASURES (TCMs)

1. Roadway improvements--synchronized signals, grade separated intersections, one-way pairs, reversible lanes, additional lanes
2. Obtaining right-of-way for future exclusive mass transit corridors
3. New mass transit routes
4. Car and van pooling
5. Posting of mass transit schedules
6. Bus shelters
7. Bus turnout lanes
8. Preferential parking spaces for car and vanpool users
9. Exclusive bus and car pool lanes
10. Bicycle lanes
11. Programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas
12. Programs to limit portions of road surfaces to the use of non-motorized vehicles or pedestrian use, both as to time and place
13. Require that streets be designed for pedestrians and bicycles as well as cars.
14. Fringe and transportation corridor parking facilities serving multiple occupancy vehicle programs or transit service
15. Programs to limit or restrict vehicle use during periods of peak use, through road use charges, tolls, parking surcharges, or vehicle registration programs
16. Establish employee data base for ride sharing matching service
17. Require that development be mixed use, detailed in such a way that pedestrian travel within the development is more convenient and desirable than automobile
18. Transportation management plans for developers for VMT reduction
19. Assess developments, based on square footage and/or vehicle trips generated, for funding TCMs.
20. Limit development around trafficways which are operating at unacceptable level of service standards

SUGGESTED TRANSPORTATION CONTROL MEASURES (TCMs)

1. Staggered hours of work and four-day work week
2. On-site amenities - day care, restaurants, shops
3. Endorsement of the new Automobile Anti-Tampering and Inspection Program
4. Shuttle system including free lunch-time service
5. Require streets to connect with one another such that local trips will not impact collector and arterial streets: no cul-de-sacs
6. Require that streets within a development connect with streets in adjacent developments when it does not interfere with Crime Watch activities
7. Employer-based transportation management plans on reduction of VMT
8. Trip-reduction ordinances
9. Limit parking and on-street parking restrictions including loading/unloading restrictions for trucks
10. Require telecommuting, i.e. work at home, use of teleconferencing, Fax and computer
11. Restrict truck operations to specific periods of the day
12. Programs for conversion of fleet vehicles to cleaner engines or fuels
13. Prohibit all drive thru
14. Encourage tourists commuting during off-peak hours, i.e. early bird dinner specials, attraction discounts
15. Stage II Vapor Recovery
16. Support the continuing operation of the Tri-Rail

The Broward County circulation LOS standards considers existing levels of service (1989). In essence, roadways operating at LOS "D" or better will not be allowed to deteriorate below LOS "D" and long range improvements are planned. The objective would be to achieve LOS "D" with the adopted improvement. In the case where the existing LOS is below "D" and improvements are not planned, the objective is to prevent the LOS from deteriorating too far beyond the existing levels. Building permits in areas

where the existing levels of service are below "D" will continue to be issued until projected traffic volumes reach a maximum of 10 percent below the existing levels.

The Dade County adopted LOS standard is subdivided in two time periods: through 1994 and beginning from 1995. The standards are also sensitive to geographic areas. The intent of the geographic stratification is to promote infill development and discourage urban sprawl. The comprehensive plan defined three basic geographic areas as follows:

- The area outside the urban development boundary (western Dade County),
- The urban infill area (east of the Palmetto Expressway),
- The area between the urban development boundary and the urban infill area.

The short term LOS standard (through 1994) establishes relatively high levels of service outside the urban development boundary level (LOS "C" or "D" depending on the type of roadway) LOS "E", however, is allowed inside the urban development boundary. Additionally, traffic volumes on roadways presently operating below LOS "E" could continue to increase up to 10 percent of existing levels in the area between the urban development boundary and the urban infill area. A 15 percent increase in traffic is permitted on roadways within the urban infill area. LOS "E" and up to 20 percent of certain roadways below LOS "E" are allowed in Special Transportation Areas.

The Dade County long term LOS standard (beginning from 1995) is based both on geographic location and level of mass transit service. In essence, high traffic levels of service are required in the less developed areas with no transit service while low traffic levels of service (as low as 150 percent of the roadway capacity - LOS "E") is allowed in the more dense areas with significant transit service (including Metrorail, Metromover, Commuter Rail or Express Bus).

The adopted levels of service in the Dade municipalities are, for the most part, LOS "D". This standard is compatible with or higher than the LOS standards in the state, regional and county comprehensive plans. The details of the municipal levels of service standards vary widely. Many of them do not recognize the lower levels of service standards allowed in other plans under certain conditions. From that standpoint, there are certain discrepancies which make comprehensive planning somewhat difficult. For instance, in certain cases, acceptable levels of service can be found on one side of the jurisdictional line for a roadway with a certain traffic volume and cross-section. Under the same conditions, on the other side of the jurisdictional line, the resulting LOS may be deemed unacceptable.

b. Concurrency management

Both Broward and Dade counties have adopted and currently implement a concurrency management program. Municipalities, for the most part, lag behind the counties in the implementation of these programs. The lag is more noticeable in Dade County where, in many cases, platting and building permits are approved at the municipal level. In Broward, platting is a county function, therefore, concurrency management is more centralized and easier to effect.

The Broward County Concurrency Management Program is based on the TRIPS model. The county, through the use of the model, keeps track of all approved development and associated traffic. The model is used as a tool to accumulate traffic volumes, therefore providing projections of existing plus approved developments on all principal county roads. Traffic projections, coupled with roadway capacity estimates, establish existing and anticipated levels of service on these roadways.

Broward County has published a map illustrating areas with anticipated deficient roadway levels of service (compact deferral areas). Generally, development is not allowed in compact deferral areas within one-half mile in each direction from the end of a deficient roadway segment as well as one mile in each direction parallel to each deficient roadway link. the program, however, allows for development applicants in those areas to submit an Action Plan designed to mitigate the impact of a proposed development. Action Plans showing complete mitigation of project impacts may be determined to fulfill the concurrency requirement and are used as a basis for issuance of development permits.

Dade County is in the process of establishing a Concurrency Management Information Center. In the meantime, concurrency requirements are being reviewed by the appropriate county departments. Traffic concurrency is the responsibility of the Public Works Department.

Concurrency determinations are performed prior to issuance of any development approval. The determination takes into consideration programmed and planned improvements. The future roadway improvements may be recognized in the concurrency determination depending on the type of development permit and geographic location. For example, rezoning applications will recognize roadway improvements in the long range plan (as late as the year 2010), on the other hand, programmed improvements in areas outside the urban development area must be present concurrently with or before the proposed development.

Dade County has an extensive database of existing traffic counts. Previously approved developments are taken into consideration. Traffic volumes generated by a new project are estimated and added to the roadway network as appropriate. Levels of service with the approved and the proposed development is calculated. Development approvals are issued if the projected LOS is consistent with the comprehensive plan.

Generally speaking, Dade and Broward Counties perform their own concurrency determinations. Municipalities in Broward rely heavily on Broward County for concurrency calculations. Municipalities in Dade, however, must prepare their own concurrency determinations. Often the burden is put on an applicant to provide the necessary concurrency information.

Due to differences in LOS standards and concurrency management program implementation procedures, concurrency conclusions can be very different across jurisdictional lines. In general, concurrency is a jurisdictional issue. Not only does each jurisdiction have potentially different levels of service standards and concurrency programs, but also only one jurisdiction has the legal powers to approve or deny development orders. In other words, even though concurrency conclusions may vary across a boundary line, the adjoining jurisdiction across from a proposed development has no legal authority to approve or disapprove a project in the adjoining jurisdiction.

Jurisdictional barriers are one issue that the growth management legislation does not specifically address. In theory, through the implementation of consistent municipal, county, regional, and state plans discrepancies should not arise. In reality, each local jurisdiction, through its inherent power to adopt local regulations and goals (which are compatible with the desires and resources of its constituency), differences in standards are inevitable. A variety of development approval policies, therefore, has resulted.

8. Findings and Recommendations

1) Findings: Highway Planning Coordination

- The future motor vehicle traffic forecasts between the Broward and Dade Counties are compatible except for few instances; however, there is a need to strengthen the dialogue between the county agencies for highway planning.

- Due to the divergent land use policies of the two counties, there are few existing or planned inter-county connections of the roadway network within the study area.

Recommendations

a) The mechanisms for coordination of motor vehicle planning such as traffic count surveys at the Broward/Dade county line should be strengthened.

b) Within the study area, if Dade County's Comprehensive Plan is amended in the future to authorize urban development adjoining Broward County, the need for additional inter-county roadway connection should be addressed.

2) Findings: **Mass Transit Integration**

- Within the study area, there are no connections between the two mass transit systems due to different land use and associated transportation policies of the two counties.

- Outside the study area, the Broward and Dade mass transit systems have few connections.

Recommendations

a) As land use changes within and outside the study area are proposed, coordination between Broward and Dade Counties is needed to address greater connectivity issue between their respective mass transit systems.

b) In order to more fully evaluate the need for greater system connectivity, the South Florida Regional Planning Council, in conjunction with the appropriate agencies, should initiate an inter-county transit study.

3) Findings: **Proposed Airport Facilities**

- The proposed northwest Dade air carrier airport and the south Broward general aviation airport would share common airspace, which will impact the operations and design of the proposed airports.

- NEPA (National Environmental Policy Act) process will require the planning of the proposed airports to be multi-jurisdictional.

- The proposed northwest Dade air carrier airport is in close proximity to the Broward/Dade county line.

Recommendation

All stages of the planning of the proposed airport facilities, including before entering the NEPA process, shall be multi-jurisdictional.

4) Finding: **Air Quality**

- Declining air quality has been associated with increases in automobile transportation activities. Use of transportation control measures (TCMs) can help alleviate this problem.

Recommendation

The TCMs described in Table 18 should be considered as part of the public/private planning and permitting process within Broward and Dade Counties.

5) Findings **Level of Service and Concurrency Management**

- State growth management law allows each county to adopt and enforce its own level of service standards.

- Transportation level of service standards and concurrency management system are different between Broward and Dade Counties. These differences could impede an effective impact review process.

Recommendations

a) To facilitate a more effective impact review process, the inconsistencies should be resolved through measures such as inter-jurisdictional agreements.

b) A transitional area which blends the different level of service standards and concurrency management systems should be established at the Broward/Dade county line. The South Florida Regional Planning Council should coordinate these efforts.

C. Potable Water, Wastewater and Solid Waste

Growth in the study area will result in the need for local governments to provide water, wastewater and solid waste service. Local governments already have some ability to provide these services, but the existing infrastructure will need to be expanded as further development takes place.

1. Infrastructure Availability

Tables 19 and 20 indicate the existing capacity and expansion plans for potable water and wastewater facilities serving the study area. Most of these facilities also provide service to areas outside the study area, and it was not possible to obtain data which would identify the capacity currently allocated or projected to be allocated specifically to the study area. Therefore the figures should be taken only as a rough approximation of total service capability available to the area.

a. Potable water

Both the South Florida Water Management District (SFWMD) and the Florida Department of Environmental Regulation (FDER) regulate potable water service. The SFWMD issues permits for the withdrawal of raw water from wells, while the FDER issues permits for the treatment plants. Both institutions maintain data bases, which contain information on the permits issued, as well as data gathered from monthly operating reports prepared for each treatment facility.

There are, however, some inconsistencies in the data coming from the two sources, which make it difficult to compare permitted consumptive use capacity with the permitted design capacity of potable water treatment plants and their actual production of potable water.

TABLE 19

SOUTHWEST BROWARD/NORTHWEST DADE SUBREGIONAL STUDY
POTABLE WATER TREATMENT FACILITIES SERVING THE STUDY AREA - 1990

County/Entity	SFWMD Current Allocation (MGD)	FDER Design Capacity (MGD)	Current Maximum Demand (MGD)	Available Capacity (MGD)	Projected Maximum Demand (MGD)	Planned Capacity Expansion MGD)
Dade County:						
WASAD	165.5	225.0	178.0	47.0	263.0	20.0
Broward County:						
Cooper City	3.3	4.9	2.8	2.1	7.5	
Pembroke Pines	5.9	12.0	8.2	3.8		
Miramar	3.4	6.0	3.8	2.2	12.8	
Sunrise	13.6	21.5	14.1	7.4		3.0
S. Broward Utility	0.7	2.0	0.9	1.1	0.2	
Ferncrest Utilities	0.9	1.2	1.1	0.1		
Davie	3.1	7.4	4.1	3.3		
TOTAL	196.4	280.0	213.0	67.0	283.3	23.2

SOURCES: FDER, Drinking Water Program - System Inventory Information (April 5, 1990)
SFWMD, Public Water Supply Database (April 10, 1990).

TABLE 20

SOUTHWEST BROWARD/NORTHWEST DADE SUBREGIONAL STUDY
WASTEWATER TREATMENT FACILITIES SERVING THE STUDY AREA - 1990

County/Entity	Rated Capacity (MGD)	Current Demand (MGD)	Available Capacity (MGD))	Planned Capacity Expansion (MGD)
Dade County:				
North District	90.0	78.3	11.7	40.0
Central District	133.0	127.2	5.8	0.0
Broward County:				
Cooper City	3.5	2.0	1.4	6.5
Cenvill	1.3	0.9	0.4	7.5
Hollywood	38.0	34.7	3.3	46.0
Sunrise	6.0	5.8	0.3	11.0
S. Broward Utility	0.5	0.3	0.2	1.0
Ferncrest Utilities	0.5	0.6	-0.1	
Davie	3.0	1.6	1.40	
TOTAL	275.8	251.4	24.3	112.0

SOURCES: Local Government Comprehensive Plans (1989) and direct collection.

The following definitions are used in the tables:

SFWMD Current Allocation
The amount allocated in the consumptive use permit issued by the South Florida Water Management District. These permits are valid for anywhere from two to ten years.

FDER Design Capacity
The maximum amount of water that a system is permitted by FDER to produce (as measured by a finished water flow meter) on any given day, regardless of how often that peak occurs in a given year. The permitted capacity is equal to or less than the rated capacity.

Current Maximum Demand
The maximum volume of treated potable water actually withdrawn for distribution on any given day.

Available Capacity
FDER design capacity minus current maximum demand. The existence of storage capacity for treated potable water may increase the maximum amount of water actually available for distribution.

Projected Maximum Demand
The volume of water projected to be needed by the population expected to reside within the plant's service area, based on a 2010 planning horizon.

Planned Capacity Expansion
The amount of capacity which is currently planned to be added to the system within the planning horizon.

A total of 19 potable water treatment plants provide service to the study area, two for all of Dade County, under the responsibility of WASAD, and 17 for varying local governments and private entities in Broward County. Of these 17, three do not currently treat water (they are used as repump stations).

Although these plants have a total design capacity of 280 MGD (million gallons a day), they are currently permitted to withdraw only 196 MGD by the SFWMD. Actual use averages between 160 and 180 MGD. It is worth repeating, however, that a significant part of this capacity serves population outside of the study area. This is notably the case in Dade County where the population in the study area is a small portion of the total population served by the Hialeah-Preston plant.

Planned expansions will provide an additional 23 MGD over the planning horizon, according to the local comprehensive plans and data collected from the facility operators.

b. Wastewater

The FDER issues permits for wastewater treatment plants. The following definitions are used in the tables:

Rated Treatment Capacity
The system is assigned a rated capacity based on its most limiting component. Each treatment and disposal unit within a treatment facility is given a rated capacity based on its ability to process hydraulic and organic loadings. This is equal to the capacity permitted by FDER.

Current Demand
The volume of wastewater actually taken in for treatment, expressed as a peak day demand.

Available Capacity
Permitted treatment capacity minus current demand, expressed in peak day terms.

Projected Maximum Demand
The volume of wastewater treatment capacity projected to be needed by the population expected to reside within the plant's service area, based on a 2010 planning horizon.

Planned Capacity Expansion
The amount of capacity which is currently planned to be added to the system within the planning horizon.

The overall capacity of the facilities which service the study area is estimated to be 275 MGD, of which 80 percent is located in Dade County. Once again, the population in the study area represents only a small portion of the total demand served by those facilities. Current demand is estimated to be 251 MGD. Planned capacity expansion will provide an additional 112 MGD within the planning horizon.

c. Solid waste

The FDER regulates the disposal of solid waste in Florida.

Dade County has three primary solid waste disposal sites operated by Metro-Dade Solid Waste Management and one private facility. The North Dade Landfill is closest in proximity to the Dade portion of the study area, located near the Dade-Broward line, south of the HEFT. It has a capacity of 11,500 tons per week and an expected life of eight years. The South Dade Waste Disposal Facility has a capacity of 25,000 tons per week and an expected remaining life of 15 years. The county resource recovery facility, located adjacent to the county's 58th Street landfill, is designed to process approximately 17,692 tons per week into electrical energy. These figures are based on 1988-1989 data and assume disposal alternatives, such as recycling and composting programs. If these programs perform marginally or not at all, landfill capacity will be reduced at a faster rate. The private facility was scheduled to close in 1992; however, the contract agreement with the county has been extended until the landfill has received sufficient quantities of solid

waste to achieve its design contours. This extension occurred as part of Waste Management's agreement to undertake substantial environmental agreement. None of the sites is located in the study area.

Broward County currently operates two major solid waste facilities, the Central Disposal Sanitary Landfill (CDSL) and the Broward County Interim Contingency Landfill (BCIL). The latter facility is located on a 588-acre site within the study area, directly east of US 27 at the proposed extension of Sheridan Street. It is expected to be operational for another 17 years and accommodates primarily trash and unprocessable waste. In addition, the county has an Office of Resource Recovery which is developing a solid waste resource recovery system. The system will include two subregional resource recovery facilities, one next to the CDSL and the other at SR 441 and I-595. These are scheduled to come on line in 1990, with a combined capacity of 3,673 tons per day and generating capacity of 124 megawatts of electrical energy.

Both Dade and Broward have solid waste programs that will meet the needs of the study area. Dade County has a county-wide plan for solid waste collection and disposal which will meet their needs until the year 2005. The plan includes transfer stations and public trash drop off sites to control illegal dumping. Detailed capacity analyses are currently being undertaken and are an ongoing activity of the planning and engineering departments to determine changes in remaining capacity. Broward County has a plan that includes solutions for the disposal of solid waste through the year 2030. However, Broward does not have a countywide collection program. The method of waste collection and the enforcement of prohibitions of illegal dumping are the responsibility of each city or municipality within their jurisdiction.

The FDER has specific requirements regarding the disposal of hazardous waste which are enforced at a county level by Metro-Dade Department of Environmental Resources Management (DERM) and Broward County Environmental Quality Control Board (EQCB). Both counties report that improper disposal is widespread. There is only one permitted hazardous waste transfer station in southeastern Florida, located in Pompano Beach.

The data reviewed on existing and planned capacity for potable water, wastewater and solid waste in the study area was insufficient to determine the capacity available for attending expected development in the study area. This was primarily due to the difficulty of separating expected population growth and capacity estimates for the study area from jurisdiction-wide data for each facility operator. This problem was exacerbated in Broward County due to the large number of public and private operators of facilities.

Solid waste planning typically establishes a long-term horizon, and both Broward and Dade Counties indicate the ability to satisfy the demand for solid waste facilities in the next 20 years.

On the other hand the planning horizon for potable water and wastewater facilities is much shorter. In Broward County, the treatment of projected demand for each facility is not systematic in the different local comprehensive plans. Moreover, because the surplus capacity identified in some of the plants

that service the study area is also available for areas outside the study area, it is not possible to compare projected growth within the study area with the existing plant capacity and planned expansions. In the case of potable water, this evaluation is complicated by the need to analyze both consumptive use capacity and water treatment capacity.

There is a general consensus that physical plant capacity can be expanded to meet the needs of future development in the study area provided that the necessary natural resources are available and capital facilities funding is guaranteed; however, available financing is often a primary factor in landfill expansion. The costs and fiscal resources associated with the acquisition of land, design and construction must be carefully evaluated.

2. Potable Water

a. Water supply

As discussed in the water resources section, the sole source of potable water in South Florida is the Biscayne Aquifer. In its naturally occurring state, water from the Biscayne Aquifer is generally hard and often contains high concentrations of iron, which are primarily attributed to the large natural organic content of the aquifer. This large natural organic content has contributed to the formation of trihalomethanes during the chlorination of public water supplies. Locally, portions of the Biscayne Aquifer have been contaminated by industrial discharges, landfill leachate and fuel spills. East of the study area, wellfields have also become contaminated from nearby saline water (salt water intrusion).

Within the study area, no public water supplies currently draw raw water from the Floridan Aquifer system. In this area the aquifer is confined and artesian. Several adjacent supplies have constructed test wells to investigate the feasibility of this source. The overall water quality from this formation is lesser than from the Biscayne, but it is less vulnerable to contamination because of its overlying, confining formation.

b. Potable water treatment

There are two objectives of water treatment as discussed herein: to make it safe for human consumption and to make it appealing to the consumer, both of which must be provided for reasonable cost. The type of treatment depends on the quality of the source and the quality desired in the finished product.

Private Wells

Because of the low population density within the area, many of the residents in the study area are not served by public water supplies, but have individual wells. Treatment provided for private well supplies runs the spectrum. Many private wells use the water just as it is taken from the ground, while others may provide some treatment. Treatment may include aeration (for removal of taste and odor), package softeners, disinfection and cartridge filters.

Treatment Methods

Ground water supplies are highly mineralized. In this locale this is nearly synonymous with hard water and the type of hardness is defined as bicarbonate hardness. Hardness causes soaps and detergents to perform poorly, reduces fabric life with repeated washing and causes scaling problems on pipes, water heaters and cooking utensils.

The present treatment process incorporates the following unit processes:

- Chemical addition
- Softening
- Filtration
- Disinfection

All public water supplies in the study area employ the lime softening process to remove hardness. Chemicals are added to the raw water as it enters the plant. At this point, lime, the principal agent used in softening, is added. Also an oxidant or activated carbon may be added to combat taste and odor problems. A polymer may also be added to enhance coagulation in the softening process.

In this process chemicals (primarily lime) are added and mixed with the raw water. The chemically rich raw water is fed to a solids contact unit. There are several solids contact units in the area. These units are fundamentally similar in design in that they combine solids contact mixing, flocculation, solids-water separation and continuous removal of sludge in a single package type basin. In these units water enters at the bottom of the units, flows up through a suspended sludge blanket and the softened water is withdrawn.

Filtration follows softening to remove colloidal matter from the softened water. Disinfection is a unit process used to render pathogenic and enteric organisms harmless. Chlorine is the disinfectant of choice. State regulation requires that a residual be maintained in the distribution system. Several utilities now add ammonia to allow the chlorine residual to last longer in the distribution system.

The present softening process used produces large amounts of sludge, a soupy substance which is extremely difficult to dispose of properly. Presently, most utilities are lagooning or land spreading the sludge.

c. Regulations

An increased awareness and public concern about the quality of the water we drink has brought about two major pieces of legislation in the last two decades: the Safe Drinking Water Act (SDWA) of 1974 and the more recent 1986 Amendments. The new rules from this legislation will have profound impacts on the future treatment of public drinking water supplies.

d. Emerging treatment processes

With the advent of the new regulations several new treatment processes and ancillary unit process may emerge. They are:

- Membrane Softening
- Reverse Osmosis
- Aeration
- Absorption
- Ozonation

Membrane softening is a recent modification of the reverse osmosis process used for saline and brackish water desalination. In the membrane softening process, semi-permeable membranes have been specifically formulated to retain calcium, magnesium and other multi-valent ions that comprise water hardness, while allowing suitable water flux at relatively low pressures (90-150 psi). The membranes filter out humic and fulvc acids and other long chained organic molecules, including trihalomethanes, that are by-products of disinfection. Complete retention of bacteria, viruses and protozoans in conjunction with the nearly complete removal of color allows the use of free chlorine at relatively low doses to satisfy disinfection requirements.

Basically, membranes have been used for softening, desalination and, more recently, removal of volatile organic compounds (VOCs), manmade pollutants. The composition of the membrane and the pressure applied to the feed water distinguish the different processes.

Aeration is used as a water treatment method for oxidizing iron and manganese, by adding oxygen to the water, a process referred to as a gas absorption. Conversely, aeration also has been used to release or strip sparingly soluble gases, such as hydrogen sulfide and carbon dioxide, from the water, a process which is referred to as air stripping. The fact that the most frequently occurring organic compounds in ground water are very slightly soluble in water, and thus are volatile, causes aeration to be a feasible alternative for removing these compounds from contaminated ground water supplies.

Adsorption, a technique for removing organic chemical contaminants from drinking water, has received the most attention to date in this country, especially for decontaminating large surface water supply systems. In contrast, the treatment of affected ground water supplies using adsorption techniques has only recently been the subject of pilot and full-scale plant projects. Adsorption techniques which have been considered for removing organics from ground waters are:

- Granular activated carbon (GAC)
- Powdered activated carbon (PAC)

Ozonation is a process using ozone (strong oxidant) that has been heralded as the disinfectant of the future because it does not generate halogenated by products often associated with the use of chlorine. However, a residual cannot be maintained in the distribution system. It now appears that other (secondary) disinfectants will also be required.

3. Wastewater Management

The provision of wastewater treatment and disposal has long been recognized as an important factor in influencing urban growth patterns. With today's increased awareness of environmental quality it has become a major investment of local municipal governments. From past experiences, health hazards associated with high density use of on-site disposal systems, increasing land costs, and the need to protect surface and groundwater quality have been recognized. In many cases, the presence or absence of wastewater systems has meant the financial success or failure of land development activities.

Planning for wastewater management involves three design parameters:

- the ultimate extent of the service area,
- the ultimate service area population, and
- the projected capital service level requirements.

Therefore, it requires decision making by both planners and design engineers. Choice of techniques to be utilized for wastewater treatment lies in the identification of local conditions within an area to the point that alternative investments can be considered. Trade-offs can be made between high first costs with low operating and maintenance costs and low first costs with a relatively high operation and maintenance component.

There are many different types of wastewater treatment systems. They can range from individual septic tanks and drain fields to large regional systems which include gravity collection sewers, lift stations, transmission mains, regional treatment plants and reclaimed wastewater (effluent) disposal facilities. A decision to develop a regional system versus local facilities will depend on the savings in capital (i.e., size of the facility) and the cost of operations (i.e.., transport of waste over greater distances) with septic systems being the most cost effective.

a. Septic systems

The Florida Department of Health and Rehabilitation Services (HRS) regulates septic tanks and drain field installation for systems up to 5,000 gallons per day (gpd) for domestic sewage and 3,000 gpd for food service establishments. The rules which regulate septic tanks are in Chapter 10D-6, F.A.C. County health departments or health units issue individual permits for septic tanks. Additionally, in Dade County DERM regulates all wastewater disposal, including septic tank/drainfield systems. Severe restrictions for the usage of septic tanks are established by section 24-12.1 of the Metropolitan Dade

County Code for the Northwest Wellfield Protection Area, which occupies most of the Dade County portion of the study area. In Broward the EQCB has regulatory responsibility.

Septic tanks are generally used to serve single housing units, although relatively large scale systems have been created. The system consists of the septic tank and the drain field. The tank receives wastewater and provides a period of settling, during which time a significant portion of the suspended solids settle out. The remaining liquids are discharged through underground perforated drainage pipes into the drain field and allowed to percolate into the soil. Micro-organisms and filtration processes remove the solids from the liquids. Septic tanks generally require removal of the settled solids (septage) every two to three years.

A detailed discussion of septic tanks is included in the water resources section of this report.

b. Package treatment plants

Package plants are essentially small treatment systems which have a collection network, treatment plant and disposal system. They can be designed to provide any level of treatment, dependent upon state and local regulations. Capacities can range up to one million gallons per day. They generally serve isolated developments and are usually partially or completely pre-assembled by the manufacturer prior to shipment. Effluent disposal is generally in the form of drain fields, percolation ponds or spray irrigation. Most of the package plants in existence today are privately owned and operated. The average small package plant has an operator on-site for only one-half hour per day, five days per week and a weekend visit. There are no package treatment plants in the study area at this time.

Package plants and regional systems are governed by the Federal Water Pollution Control Act (PL 92-500), as well as local regulations. The goal of this act is the restoration and maintenance of the chemical, physical and biological integrity of the nation's waters. The Environmental Protection Agency is responsible for implementing the act. The Florida Department of Regulation (FDER) is responsible for ensuring that the state implements the federal legislation. FDER regulates wastewater facilities under Chapter 17-600, F.A.C. These rules apply to facilities which treat flows exceeding 5,000 gallons per day for domestic establishments, 3,000 gallons per day for food service establishments, and where sewage contains industrial, toxic or hazardous chemical wastes.

Dade County DERM enforces these requirements on behalf of FDER through an interagency agreement for all package plants in Dade County. Package treatment plants cannot be administratively approved in Dade County. They can only be approved through a variance granted by the Environmental Quality Control Board (EQCB), in a process which requires a public hearing.

c. Regional facilities

Regional facilities are large-scale sanitary sewage systems which generally provide service to densely populated areas. These facilities are comprised of three components which perform the basic functions of collection, treatment and disposal of domestic sewage and industrial waste.

A collection system is composed of a network of gravity sewer pipes and pressure sewer mains which collect sewage from individual sources and convey it to a central location for treatment. In South Florida, these systems generally contain lift stations which raise the sewage flow to higher elevations. Lift stations discharge into force mains, other lift stations, other gravity sewer systems or into a treatment plant.

The treatment plant functions to remove solid and organic materials from the sewage. Primary treatment refers to the removal of between 30 percent to 35 percent of the organic materials and up to 50 percent of the solids which can be accomplished with screens and settling tanks. Secondary treatment refers to the removal of between 80 and 90 percent of total organic material and suspended solids. This level of treatment generally requires multiple steps involving at least one biological process and one or more processes for removal of suspended solids. Tertiary or advanced treatment provides processes to remove synthetic organic compounds and inorganic chemicals.

Treated water produced by the wastewater treatment system is known as effluent and is disposed of through ocean outfalls or deep injection wells into the boulder zone. Beneficial reuse of wastewater may be permitted subject to state and local regulations and requirements. It should be noted that effluent reuse is not permitted within the Northwest Wellfield Protection Area due to water quality considerations. Effluent is not discharged into the region's canals. The effluent is generally disinfected by chlorination. The solid by-product or residual is known as sludge. Sludge is usually subjected to one or more additional processes to remove pathogens, stabilize and dewater. Common disposal methods include burial in solid waste landfills, land application as a soil conditioner for agricultural purposes or incineration.

d. An Evaluation of wastewater treatment systems

Septic Systems

Septic systems are the least expensive method of treatment, but they provide the least amount of treatment. Problems arise generally due to periodically high water tables, poor drainage, lack of space, improper installation, hydraulic overloading from washing machines and lack of maintenance. Also, the use of non-biodegradable products and chemicals which destroy bacteria may result in septic system failures.

There are no federal, state or local rules to require the proper maintenance of these systems or disinfection of the effluent. In a 1986 U.S. Geological Service study, effluent in sand substrate was detected more than 20 feet below the septic tank outlet, but diluted to near background within 50 feet down

gradient from the tank, while effluent in a limestone substrate was detected to depths greater than 25 feet and was diluted, but still detectable at distances 40 feet down gradient from the tank.

Much of Florida's soil is unsuitable for septic tanks. However, in some areas it is thought that septic systems may provide significant amounts of groundwater recharge. A 1985 report by the University of Florida's Institute of Food and Agricultural Sciences stated that 1.3 million families (27 percent of the existing housing units) in Florida were served by on-site sewage disposal systems, while introducing an estimated 170 million gallons of effluent per day into the subsurface environment.

Package Treatment Plants

Package treatment plants are a step up from septic tanks, in that they provide tertiary treatment for the wastewater, which lessens the chance of groundwater contamination. Initial cost and management of the plant is relatively low compared with the cost and management of regional facilities. Because they are generally utilized to serve isolated communities, it provides for the decentralization of large amounts of effluent, which in turn, provides for more wide-spread opportunities for the use of reclaimed water. Problems occur within package plants generally as a result of poor maintenance practices and failure of percolation ponds due to poor soils and high water tables. Private ownership of most of these plants has contributed to many of these maintenance problems. Several counties now are taking a stand to either purchase these facilities, or phase them out by requiring hook-up to existing regional systems.

Regional Systems

Regional systems are a necessity for densely populated areas. Because they are capable of treating large quantities of sewage, there is less chance of ground and surface water contamination in the areas they serve. Initial cost and management of these systems is high. Problems generally arise at regional facilities due to poor maintenance practices and occasionally from the introduction of toxic substances from outside sources (i.e., illegal dumping or stormwater runoff).

Many of these systems are very old and still may have connections to existing stormwater systems, which may over-load the plant during periods of heavy rainfall. Other problems are associated with final disposal of the effluent and sludge. Disposal of effluent to surface water bodies (including fresh, brackish and oceanic waters) does contribute to the pollution of these natural resources, particularly when the effluent is toxic; and it discourages the use of reclaimed water. The use of deep well injection systems results in a permanent loss of large volumes of water from the system, discourages water reuse and has a high initial cost. On the positive side, deep well injection systems have lower operating costs than other methods of disposal, require minimal amounts of land, and require only a secondary level of treatment of the effluent. Sludge

disposal may create problems due to the presence of bacteria and viruses, as a result of inadequate treatment, and from the accumulation of heavy metals and high levels of nutrients.

Low pressure sewer systems have lower construction cost per lineal foot than regional gravity systems. Problems arise with the serviceability of the on-site components, electrical failures (power outages and groundwater seepage), and the accumulation of hazardous and potentially smelly gases under the pressurization unit wetwell cover. STEP systems do have additional storage capacity in the pump wetwell which is useful during prolonged power outages. The operation and maintenance of the pressure sewer systems must be the responsibility of a central management entity. Homeowners cannot be relied upon to take a responsible role in the management of these systems. Periodic inspections must be made of the pressurization unit, pressure sewer valve and the septic tank residual accumulation. Specialized training is required for overall maintenance and operation of these systems.

Today, most regulatory agencies encourage the regionalization of wastewater treatment systems because they provide the best known effluent and sludge management techniques, which, in turn, provide for better protection of our drinking water sources. In addition, they provide a more reliable source for the production of reclaimed water, which will be very important in our efforts to conserve water in South Florida.

e. Wastewater effluent reuse

The challenges South Florida faces with the diminishing supply of quality groundwater and the ever-increasing demands of a growing population are well documented. One water conservation and management method that will play an ever-increasing role in Florida's future is the reuse of wastewater effluent for non-potable purposes. As a typical community uses 50 percent of its potable water supply for irrigation purposes, the potential benefits of a reuse program are significant. (Wastewater effluent reuse is commonly referred to as reuse, reclaimed, recycled, or gray water).

Florida, through its State Water Policy, Chapter 17.40, F.A.C., is very supportive of wastewater reuse, referring to it as a beneficial replacement for the use of higher quality water. Under this policy, the state and the water management districts are required to "promote water conservation and reuse as an integral part of water management programs, rules and plans and encourage the use of water of the lowest acceptable quality for the purpose intended."

Federal, state and local regulatory agencies have stringent treatment standards on wastewater facilities which govern the quality of the effluent which they discharge to surface waters, deep wells or the ocean. With additional treatment, effluent previously disposed can be reused for irrigation and other uses which do not require potable water, such as cooling for industrial plants and flushing of toilets. For a typical secondary wastewater treatment plant, the additional treatment required for reuse includes filtration and high-level disinfection typically utilizing chlorine.

The FDER, through Rule 17-610, F.A.C., regulates the reuse of wastewater effluent for irrigation purposes where there may be public access such as golf courses, parks and residential properties. Effluent reuse must contain less than five milligrams per liter of total suspended solids prior to high-level disinfection. High-level disinfection must accomplish at least 75 percent of all fecal coliform observations made on a daily basis during a month to be below detectable limits. No sample shall exceed 25 fecal coliform per 100 milliliters. Effluent reuse which meets these standards is considered extremely safe, as there have been no documented health problems in Florida.

Reuse Programs in the State

Nearly 20 million gallons per day (MGD) of reclaimed water was used for irrigation purposes by over 5,000 customers in St. Petersburg in 1987. By the year 2000, it is estimated the St. Petersburg reclaimed water system will have the potential to serve approximately 17,000 customers and irrigate almost 9,000 acres.

The City of Naples is currently using six MGD of reclaimed water for irrigation at local golf courses. The city is currently negotiating with other golf courses to expand the program.

In the Loxahatchee River Environmental Control District (ENCON), a reclaimed water system has been developed to help recharge groundwater. The system currently reclaims 4.3 MGD by irrigation of eight golf courses and has contracts for 6.2 MGD with a waiting list for this resource.

The City of Altamonte Springs is currently developing a reclaimed water program which involves the installation of an extensive reclaimed water distribution system. By means of this system, reused water will be delivered throughout the city for irrigation of residential, public and commercial properties, citrus groves, farm trees, crops, golf courses and other recreational facilities. It is ultimately the intent of the city to install dual water systems in homes, commercial buildings and factories, where, in addition to irrigation, the reclaimed water will be used for toilets, fire protection sprinkler systems, cooling water and processed water, and is projected to be fully operational by 1993.

Local Reuse Programs

In August 1989, the City of Pompano Beach placed in operation its 2.5 MGD reuse plant which withdraws effluent from Broward County's North Regional Wastewater Treatment Plant (NRWWTP) for further treatment prior to irrigation of the city's two public golf courses. The NRWWTP currently utilizes 1.25 MGD for site irrigation and process purposes and is currently planning expansion of its reuse system to increase capacity to approximately 10 MGD by 1991. Users of the reclaimed water include the county's North Resource Recovery Plant for cooling purposes and potentially expanding irrigation of local parks and golf courses.

The Miami-Dade Water and Sewer Authority Department (WASAD) is planning to install a one MGD reuse system at their North District Wastewater Treatment Plant. Florida International University is expected to use 70,000 gallons per day for irrigation. It is estimated that WASAD currently reuses approximately nine MGD at its three regional treatment plants for irrigation, maintenance and other non-potable uses. However, reuse of effluent is prohibited in Dade County within the Northwest Wellfield Protection Area due to water quality considerations.

Economic Considerations for Wastewater Reuse

It is significantly less expensive to withdraw water from local surface or underground supplies than from a wastewater reuse facility. However, the incentive for developing and implementing wastewater reuse programs involves more than economic considerations.

A local example is the situation faced by the City of Pompano Beach. Continued irrigation of golf courses by pumping groundwater at approximately five cents per thousand gallons was clearly the most cost-effective option. However, this practice was not viable because of saltwater intrusion which led the SFWMD to refuse to renew their water consumptive use permit. In other words, the city was forced into an effluent reuse program because suitable water for irrigation was unavailable.

Similar situations have already been addressed by St. Petersburg, Naples and Altamonte Springs, and certainly more will be faced with this challenge.

It is clear that further utilization and expansion of wastewater effluent reuse programs will be a vital component of the state's efforts to manage its water resources. Public and private interests must give due consideration to reuse programs to protect our most valuable resource.

4. Water and sewer permitting

The development of any site requires the basic essentials of water service and sewage disposal. A report of the water and sewer requirements for the study area would not be complete without a summary of the existing procedures that developers must follow to provide utility services. There are several governmental processes and requirements which must be met. They include a governmental approval process for the design drawings, a construction permitting process, a construction observation process and in some instances a developers agreement. There are several differences in the approval processes between Broward and Dade.

Broward County

The typical development process begins with the developer initiating a plat or site plan approval process through the local government. When a site plan has been approved, the developer will hire a consulting engineer to prepare design drawings. The design drawings will include plans and details for the installation of water and sewer utilities.

The engineer will submit the design drawings, along with license applications, for approval to the local government, the utility company that will provide the service, and finally the county approval agency. At each submittal, the agency must approve the design drawing and sign the license applications. Each municipality and utility has its own design standards that it will enforce. The Broward County Public Health Unit (BCPHU) approves the design drawings for the water system and the Broward County EQCB approves the design drawings for the sewer system. Each county agency requires a different application.

Once the design drawings have been reviewed and approved by the county agencies, they are given to a contractor. The contractor will then obtain a construction permit from the local government. The construction will be supervised by the engineer, the local government and the utility company. When the construction is completed in accordance with the design drawings the engineer will forward a certification letter to each county agency along with certification documents for final approval. The county agency or the appropriate city agency will then issue an operating permit to the owner.

The approval process is quite involved and can even become complicated when the utility company is not in the same city as the project.

Dade County

Metropolitan Dade County Code establishes the following criteria for the installation of potable water and wastewater facilities:

- **Residential Development**

  From low density (up to 6 dwelling units per gross acre) to high density (up to 125 dwelling units per gross acre) shall only be permitted with public water and public sanitary sewers. Estates density (up to 2.9 units per gross acre) shall be permitted with public water and septic tanks. Development at densities of more than 25,000 square feet gross per dwelling unit could be permitted with on-site drinking water supply wells and septic tank/drainfield, provided that connection to public facilities is not feasible.

- **Commercial Development**

  Neighborhood business and semi-professional offices that do not generate liquid waste other than domestic sewage could be permitted on public water and septic tanks provided that connection to public facilities is not feasible. Any other commercial development should only be permitted with public water and public sanitary sewers. An operating permit program should be implemented in order to monitor the nature of the businesses.

- **Industrial Development**

  Industrial development can only be permitted on public water and public sanitary sewers.

The approval process in Dade requires the owner to initiate a developers agreement with the utility agency in charge of water delivery and wastewater collection systems. Within the study area, these agencies include WASAD and the utilities departments of the cities of Hialeah and Hialeah Gardens and the Town of Medley.

Drawings of the proposed system are then prepared by a State of Florida Registered Professional Engineer. A minimum of five sets of application forms to construct a drinking water system and three sets for a wastewater collection and transmission system must also accompany the design drawings. These are forwarded for approval to the appropriate utility agency before submittal to the DERM. DERM issues the state general permit for sewer extensions and approves the water extensions as the county environmental regulatory agency. The submittal for water is then routed to the Health Department for further review and approval by the State.

The approved drawings are held at DERM where the contractor will get his construction permit. The construction will be observed by the engineer, with monitoring by utility agency staff and oversight by DERM. Once construction is complete the Certification of Completion of Construction is forwarded to DERM through the appropriate utility agency for approval and operation.

5. Findings and Recommendations

1) Finding: **Infrastructure Capacity**

- Infrastructure for potable water, wastewater and solid waste is not anticipated to be a limiting factor for future development within the study area, given the ability to expand plant capacities and landfills to accommodate growth, provided that natural resources are available and facility construction schedules are met.

Recommendation

All planning for future development should be consistent with the availability of natural resources and the facility construction schedules for those public services and facilities serving the study area.

2) Findings: **Standardization of Capacity Data**

- Utilizing data from permit applications and monthly operating reports provided by facility operators, both the SFWMD and the FDER maintain databases on the potable water system within the study area. There are, however, inconsistencies in the data which make it difficult to compare the permitted consumptive use capacity with the permitted design capacity of potable water treatment plants and their actual production of potable water.

- There is a general need to improve the consistency and reliability of information pertaining to the existing design and permitted capacity of potable water and wastewater treatment facilities serving portions of the study area in Broward County.

Recommendations

a) The SFWMD and the FDER should more closely coordinate the permitting of consumptive use capacity and the permitted plant capacity of potable water treatment plants and work with the Broward County Public Health Department and the Dade County DERM to maintain an accurate and up-to-date database regarding the actual withdrawal, production and use of potable water.

b) Standardized information pertaining to those potable water and wastewater facilities servicing the study area should be generated through a cooperative effort involving all permitting agencies, local governments and facility operators within Broward and Dade Counties. The information generated should include each facility's design and permitted capacity, existing and planned service area, current customer base, committed capacity, projected future needs, excess capacity and planned expansions.

3) Findings: **Regionalization of Treatment Facilities**

- Within the Broward County portion of the study area, potable water and wastewater treatment plants are owned and operated by various public and private interests.

- In Dade County, the WASAD is responsible for the production of potable water and the provision of wastewater service in the study area. The cities of Hialeah and Hialeah Gardens and the Town of Medley operate water distribution and wastewater collection systems in a small portion of the study area.

- Some potable water and wastewater treatment plants serving the study area cannot be renovated and brought up to current minimum federal and state standards.

- Today, most regulatory agencies encourage the regionalization of potable water and wastewater treatment systems because they provide the best known effluent and sludge management techniques, which, in turn, provide for better protection of our drinking water sources. In addition, they provide a more reliable source for the production and use of reclaimed water.

- Regional systems are better able to maximize resources and are more cost effective to maintain.

Recommendations

a) Existing potable water and wastewater treatment plants that cannot be renovated and brought up to current minimum federal and state standards should be phased out.

b) Promote the regionalization of potable water and wastewater treatment facilities, while establishing the long-term goal of having all plants and the corresponding distribution and collection systems operated by local government entities rather than developers or homeowner associations.

4) Finding: **Reclaimed Water**

- Within and outside the study area in both Broward and Dade Counties, a substantial loss of fresh water and diminished aquifer recharge potential occurs as the result of wastewater disposal methods including ocean outfall and deep injection well disposal.

Recommendations

a) In order to conserve limited existing potable water supplies, local government entities within Broward and Dade counties should promote the utilization of reclaimed water, rapid rate infiltration areas and aquifer recharge areas.

b) The environmental and economic implications of water reuse should be carefully evaluated prior to large scale promotion.

c) Broward County EQCB and Dade County DERM should establish uniform effluent quality standards to be adopted by their respective counties.

d) All future wastewater treatment facilities serving the study area should be designed to utilize reclaimed water.

e) Golf courses, parks and similar open space areas should use reclaimed water and spray irrigation whenever feasible.

5) Finding: **Hazardous Waste Generators**

- Hazardous wastes introduced into the study area's wastewater treatment system constitute a threat to the water quality and potable water supplies of both Broward and Dade Counties.

Recommendations

a) Local governments should discourage the location of hazardous waste generators within the study area. However, all existing and future hazardous waste generators located within the study area should be required to provide for the disposal of hazardous wastes through a licensed contractor and connect to a centralized sanitary sewer system and pre-treat hazardous wastes on-site prior to disposal through that system.

b) An operating permit program to monitor industrial activity should be implemented by the regulatory agencies.

6) Findings: **Disposal of Hazardous Waste**

- Broward and Dade Counties both report that the improper disposal of hazardous waste continues to be a problem.
- The only permitted hazardous waste transfer station in southeastern Florida is located in Pompano Beach.
- Broward and Dade Counties both have recently obtained Local Household Hazardous Waste Collection Center grants from the FDER.

Recommendation

The Dade County DERM and the Broward County Office of Environmental Services should both increase the availability of convenient and safe hazardous waste disposal opportunities within the study area including the establishment of special collection programs.

7) Finding: **Solid Waste**

- The Metropolitan Dade County Code restricts the location of landfills within the Northwest Wellfield Protection Area, which includes most of the study area within Dade County. However, landfills and related solid waste facilities within the Broward County portion of the study area may pose a threat to the water quality of wellfields, including the Northwest Wellfield in Dade County.

Recommendation

Before siting any additional landfills within the study area, a thorough evaluation of their potential impacts on water quality within the study area should be conducted.

8) Finding: **Recycling**

- The State of Florida and South Florida Regional Planning Council goal of reducing the solid waste stream by 30 percent over current levels will require the widespread participation of all local government entities within both Broward and Dade Counties in existing and new recycling programs.

Recommendation

Recycling should be required by all local government entities within both Broward and Dade Counties, with public accessibility sufficiently convenient to assure broad acceptance and compliance.

9) Finding: **Illegal Dumping**

- In Broward County the enforcement of illegal dumping is the responsibility of each municipality while in Dade County it is a shared responsibility between the county and each municipality.

Recommendation

Broward County should consider a countywide program to control illegal dumping, which could include a public information campaign, aggressive countywide enforcement and strategically located transfer stations with convenient public accessibility.

V. CONCLUSION

This report is based on available information and data regarding the Southwest Broward/Northwest Dade Subregional Study Area. The findings and recommendations are formulated on the analysis of this information as well as discussion from the various technical committee meetings.

This study is the beginning of an on-going process. The report identifies several areas in need of further expansion and refinement of data, information, and policy development. It will be through the cooperative efforts of a full range of interests, including federal, state, regional and local agencies, that this will occur most effectively.

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