

US EPA ARCHIVE DOCUMENT

PROPOSED TOTAL MAXIMUM DAILY LOAD (TMDL)

For Dissolved Oxygen, BOD and Nutrients In East Holloway Canal (WBID 3277B)

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LIST OF ABBREVIATIONS

AWT	Advanced Waste Treatment
BMP	Best Management Practices
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
F.A.C.	Florida Administrative Code
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agriculture Statistics Service
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OSTD	Onsite Sewer Treatment and Disposal Systems
PLRG	Pollutant Load Reduction Goal
Rf3	Reach File 3
RM	River Mile
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WBID	Water Body Identification
WLA	Waste Load Allocation
WMP	Water Management Plan
WWTF	Wastewater Treatment Facility

SUMMARY SHEET

Total Maximum Daily Load (TMDL)

1. 303(d) Listed Waterbody Information

State: Florida

Major River Basin: Biscayne Bay-Southeast Coast Basin

Impaired Waterbodies for TMDLs (1998 303(d) List):

WBID	Segment Name and Type	River Basin	County	Constituent(s)
3277B	East Holloway Canal	Biscayne Bay-Southeast Coast Basin	Broward	Dissolved Oxygen, Nutrients

2. TMDL Endpoints (i.e., Targets) for Class III Waters:

The State of Florida has narrative criteria for nutrients stating that in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. Biochemical Oxygen Demand (BOD) was also addressed as it is a pollutant that impacts dissolved oxygen (DO). BOD shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions.

TMDLs for nutrients, BOD, and low DO in WBID 3288A were addressed by analyzing the effects of BOD, total nitrogen (TN), and total phosphorus (TP) loads on dissolved oxygen concentrations using a Nonpoint Source spreadsheet model. The target for DO is based on the State of Florida's water quality criteria for D.O., which requires that in no case should the concentration of dissolved oxygen be less than 5 mg/L.

3. Allocations:

Stream Name / WBID	Parameter	WLA for MS4 FLS000016	LA	TMDL
East Holloway Canal (3277B)	BOD	55% reduction	55% reduction	55% reduction
East Holloway Canal (3277B)	TN	15% reduction	15% reduction	15% reduction
East Holloway Canal (3277B)	TP	0% reduction	0% reduction	0% reduction

3. Endangered Species (yes or blank): Yes

4. EPA Lead on TMDL (EPA or blank): EPA

5. TMDL Considers Point Source, Nonpoint Source, or both: Both

6. NPDES Discharges to surface waters addressed in TMDLs:

Permit/Co-permit Name	Permit ID Number	MS4 Type
Broward County	FLS000016	Phase I
City of Coconut Creek	FLS000016	Phase I
City of Cooper City	FLS000016	Phase I
City of Coral Springs	FLS000016	Phase I
City of Dania Beach	FLS000016	Phase I
City of Deerfield Beach	FLS000016	Phase I
City of Hallandale Beach	FLS000016	Phase I
City of Lauderdale Lakes	FLS000016	Phase I
City of Lauderhill	FLS000016	Phase I
City of Lighthouse Point	FLS000016	Phase I
City of Margate	FLS000016	Phase I
City of Miramar	FLS000016	Phase I
City of North Lauderdale	FLS000016	Phase I
City of Oakland Park	FLS000016	Phase I
City of Parkland	FLS000016	Phase I
City of Pembroke Pines	FLS000016	Phase I
City of Plantation	FLS000016	Phase I
City of Pompano Beach	FLS000016	Phase I
City of Sunrise	FLS000016	Phase I
City of Tamarac	FLS000016	Phase I
City of Weston	FLS000016	Phase I
City of Wilton Manors	FLS000016	Phase I
FDOT Turnpike District	FLS000016	Phase I
FDOT District 4	FLS000016	Phase I
Town of Davie	FLS000016	Phase I
Town of Lauderdale-By-The-Sea	FLS000016	Phase I
Town of Pembroke Park	FLS000016	Phase I
Town of Southwest Ranches	FLS000016	Phase I
Village of Sea Ranch Lakes	FLS000016	Phase I

**TOTAL MAXIMUM DAILY LOAD (TMDL)
DISSOLVED OXYGEN, BOD AND NUTRIENTS
IN EAST HOLLOWAY CANAL WATER BODY ID 3277B**

1. INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework DEP uses for implementing TMDLs. The state's 52 basins are divided into 5 groups. Water quality is assessed in each group on a rotating five-year cycle. The Group 4 basin is shown in Figure 1 and includes the Biscayne Bay–Southeast Coast Basins Group. The Biscayne Bay–Southeast Coast area encompasses approximately 1,192.70 square miles. To provide a smaller-scale geographic basis for assessing, reporting, and documenting water quality improvement projects, the FDEP subdivided the Group 4 area into smaller areas called planning units. Planning units help organize information and management strategies around prominent subbasin characteristics and drainage features. To the extent possible, planning units were chosen to reflect subbasins that had previously been defined by the South Florida Water Management District (SFWMD). The Biscayne Bay–Southeast Coast Basins Group contains four planning units: Broward, North Dade, South Dade, and Intracoastal. Water quality assessments were conducted on individual waterbody segments within planning units. Each waterbody segment is assigned a unique waterbody identification (WBID) number. Waterbody segments are the assessment units or polygons that have historically been used by the FDEP to define waterbodies in their biannual inventory and reporting of water quality to EPA under Section 305(b) of the federal Clean Water Act. The same WBIDs are also the assessment units identified in the FDEP's biannual lists of impaired waters submitted to EPA as part of their reporting under Section 303(d) of the Clean Water Act.

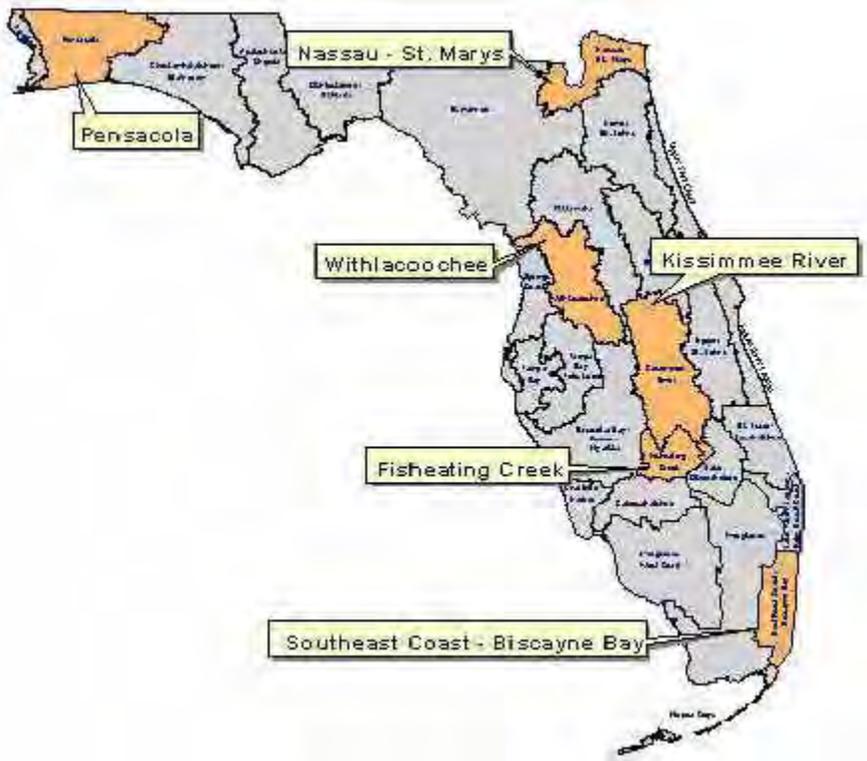


Figure 1: FDEP Group 4 River Basins

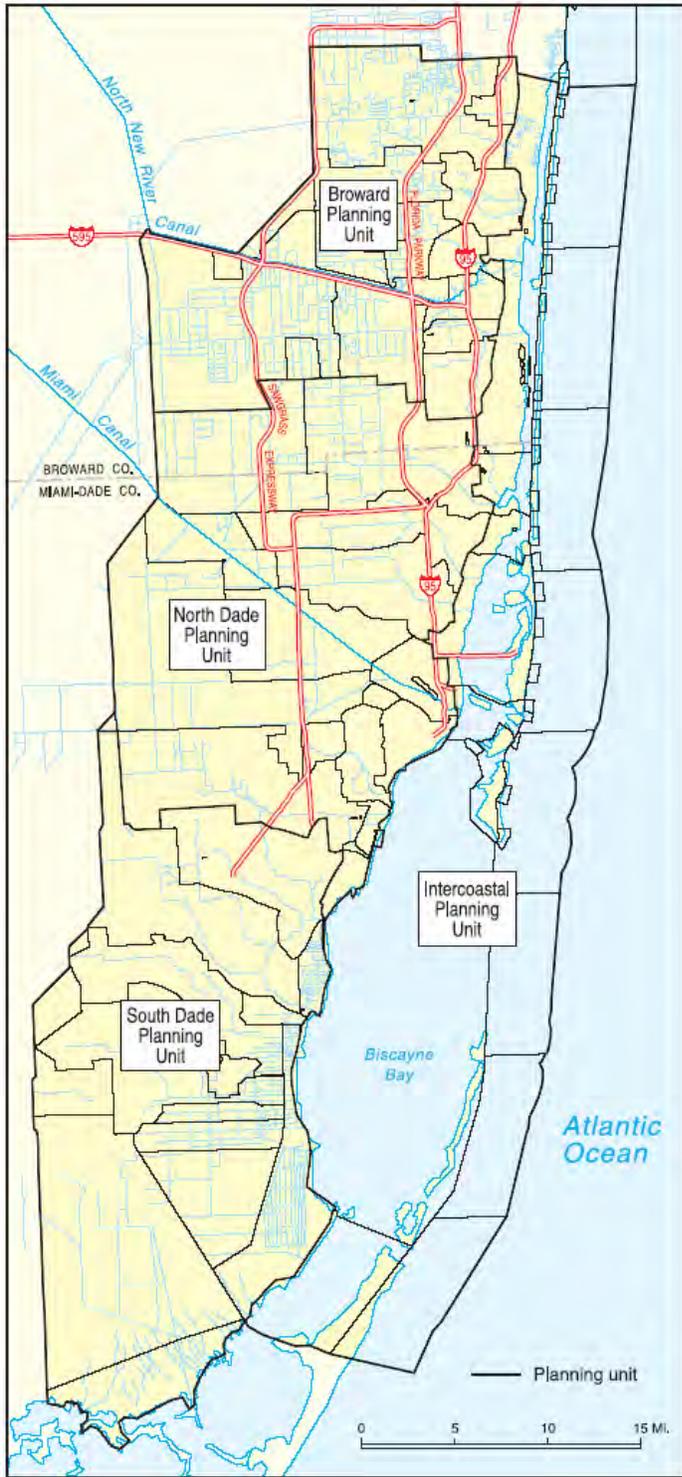


Figure 2: Planning Units in the Biscayne Bay–Southeast Coast Basins Group. WBID 3277B is in the Broward Planning unit.

2. PROBLEM DEFINITION

Florida's final 1998 Section 303(d) list identified WBID 3277B in the Biscayne Bay–Southeast Coast Basins Group as not supporting water quality standards (WQS) due to nutrients, dissolved oxygen and BOD. After assessing all readily available water quality data, EPA is responsible for developing nutrients, dissolved oxygen, BOD TMDLs in WBID 3277B, East Holloway Canal. The location of WBID 3277B is shown in Figure 3. The TMDLs addressed in this document are being proposed pursuant to EPA commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998).

WBID 3277B is designated as a Class III fresh water. The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife.

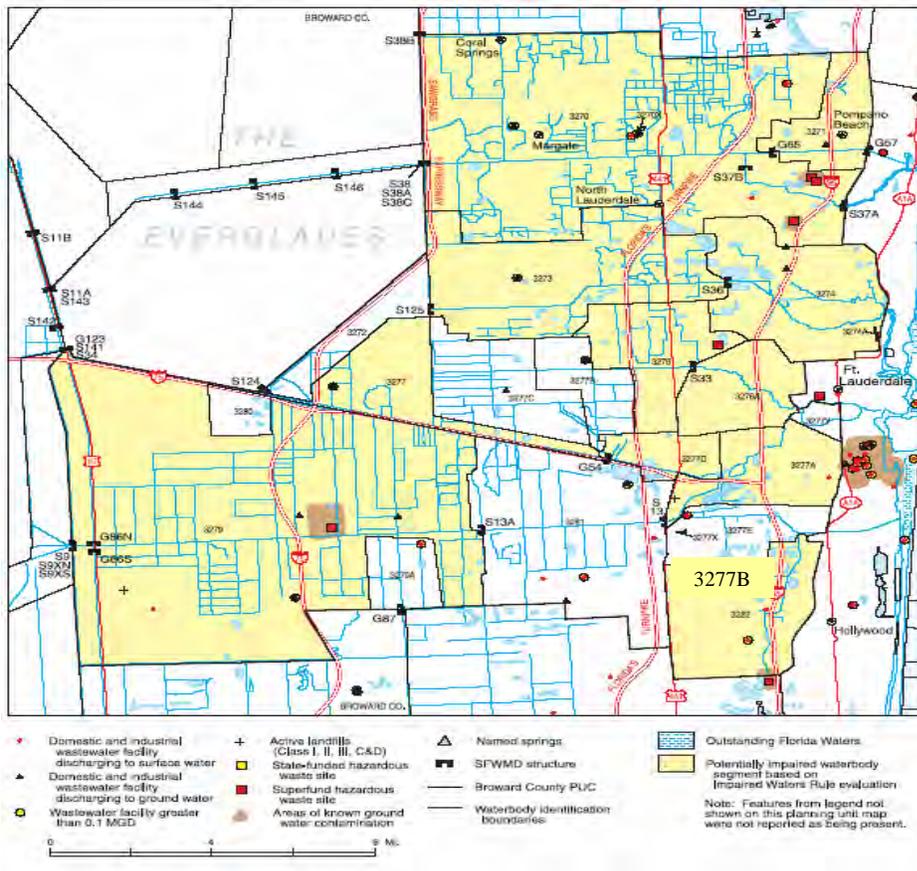


Figure 3: Broward Planning Unit showing the location of WBID 3277B.

3. WATERSHED DESCRIPTION

The primary canal in WBID 3277B is the East Holloway Canal which is a secondary canal of the North New River Canal. The East Holloway Canal runs through the city of Plantation and is one of the main arteries of the Old Plantation Water Control District (OPWCD). According to the July 2000 FDEP Ecosummary Report, the East Holloway Canal is controlled by gates and pumps and discharges to the North New River Canal in response to flooding emergencies or heavy rain events. The canal waters are at rest unless the pumps are discharging or the gates are open, so the canals act as elongated reservoirs.

The following information is from the FDEP, 2005, Water Quality Status Report for the Biscayne Bay–Southeast Coast Basins. The 270-square-mile Broward planning unit includes most of the SFWMD canal basins within Broward County. Urban land uses dominate this planning unit with approximately 76 percent developed. WBID 3277B is a small portion of this planning unit with approximately 4.4 square miles. The main water body in the WBID is the East Holloway Canal, and the landuse is about 97 percent urban and transportation (see Table 1). The planning unit is bounded to the north by the Hillsboro Canal Basin (which lies within the Group 3, Lake Worth Lagoon–Palm Beach Coast area); to the west by the Everglades Water Conservation Areas (WCA) 2A, 2B, 3, and 3B; to the south by the C-9/Snake Creek Canal Basin, which is included in the planning unit to the south; and to the east by the Atlantic Intracoastal Waterway (AICW) and subbasins that drain directly to the AICW. Canal basins within this planning unit include (from north to south) those of the C-14/Cypress Creek Canal, Pompano Canal, C-13/Middle River Canal, C-12/Plantation Canal, North New River Canal, C-11/South New River Canal, and C-10/Hollywood Canal. Figure 3 is a composite map of this planning unit that shows FDEP designated potentially impaired waterbodies. Major canals provide flood protection and drainage for their basins, convey excess water in water conservation areas, as well as maintain ground water elevations to prevent saltwater intrusion. Several of these canals are capable of discharging to both the AICW and WCAs depending on need. Water within the western subbasin of the C-11/South New River Canal is typically backpumped into the WCAs (Cooper and Lane, 1987b, Broward County Department of Planning and Environmental Protection [BCDPEP], 2001). There are approximately 17 water control districts that have water management responsibilities within this planning unit. Some of the larger ones include the Central Broward Drainage District, South Broward Drainage District, Old Plantation Water Control District, and Indian Trace Community Development District. Water control districts within this area are shown in Figure 3. There are many incorporated areas within this planning unit. The larger ones by area include Plantation, Sunrise, Coral Springs, Hollywood, and Davie, as well a portion of Ft. Lauderdale.

For many years Broward County has maintained a sampling network to monitor water quality trends in significant canals and the AICW (BCDPEP, 2001a). Broward County monitoring data were relied upon heavily in the Water Quality Status Report evaluation of water quality. There are 22 waterbodies and waterbody segments in this planning unit that were evaluated. Waterbodies represented by these data include the main SFWMD canals, segments thereof, as well as several tributary canals and lakes that have been monitored. Segments of canals below

salinity control structures were evaluated separately using estuarine water quality criteria.

Table 1: Land Cover Distribution for WBID 3277B in acres and percentage

Land Cover	Acreage	Percentage
Residential (1100-1390)	2050	73%
Commercial, Industrial, Public (1400, 1500, 1800)	530	19%
Agriculture (2000 series)	0	0%
Rangeland (3000 series)	0	0%
Forest (4000 series)	9	0%
Water (5000 series)	92	3%
Wetlands (6000 series)	0	0%
Barren & Extractive (7000, 1600)	3	0%
Transportation & Utilities (8000 series)	138	5%
TOTAL (acres)	2822	

4. WATER QUALITY STANDARD AND TARGET IDENTIFICATION

Florida's surface waters are protected for five designated use classifications, as follows:

- Class I Potable water supplies
- Class II Shellfish propagation or harvesting
- Class III Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife
- Class IV Agricultural water supplies
- Class V Navigation, utility, and industrial use (there are no state waters currently in this class)

Waterbodies are classified as Class III freshwaters, with a designated use of recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The water quality criteria for protection of Class III waters are established by the State of Florida in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative criteria are specified in F.A.C. Section 62-302.530. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time. While the State of Florida does not have numeric criteria for nutrients, a narrative criterion exists as described below. The specific criteria are:

4.1 Nutrients (Freshwater)

The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter [Section 62.302 F.A.C.]. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora and

fauna [Section 62.302.530 F.A.C.]

Because the State of Florida does not have numeric criteria for nutrients, chlorophyll and D.O. levels are used to indicate whether nutrients are present in excessive amounts.

4.2 Dissolved Oxygen

Freshwater: Dissolved Oxygen (D.O.) shall not be less than 5.0 (milligrams/liter). Normal daily and seasonal fluctuations above these levels shall be maintained.

4.3 Biochemical Oxygen Demand (Freshwater)

Biochemical Oxygen Demand (B.O.D.) shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions.

4.4 Natural Conditions

In addition to the standards for nutrients, D.O. and B.O.D. described above, Florida's standards include provisions that address waterbodies which do not meet the standards due to "natural background" conditions.

"Natural Background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data." [Section 62-302.200(15) FAC].

Florida standards also state at 62-302.300(15) FAC that "Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this State and shall not be allowed. Waters having water quality below the criteria established for them shall be protected and enhanced. However, the Department shall not strive to abate natural conditions."

5. WATER QUALITY ASSESSMENT

To determine the status of surface water quality in Florida, three categories of data – chemistry data, biological data, and fish consumption advisories – were evaluated to determine potential impairments. The level of impairment is defined in the Identification of Impaired Surface Waters Rule (IWR), Section 62-303 of the Florida Administrative Code (F.A.C.). The IWR defines FDEP's threshold for identifying water quality limited WBIDs to be included on the state's 303 (d) list. In addition, all waters on the 1998 303 (d) list that were not de-listed remain on the current 303 (d) list and require TMDLs. WBID 3277B is on FDEP's planning list for DO, BOD and nutrients. EPA assessed this WBID and concluded that it is impaired, and these TMDLs must be developed.

FDEP maintains ambient monitoring stations throughout the basin. All data collected at monitoring stations within the impaired WBID are used in the analysis. Appendix A shows the

data available for DO, BOD and nutrients. There was a waste water discharge directly to East Holloway Canal during this time that ceased discharging in 1988. Additional observations are needed to assess the current water quality.

6. SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of pollutants in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated sanitary wastewater or stormwater (i.e., Phase I or II MS4 discharges) are considered primary point sources of BOD and nutrients.

Non-point sources are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation on land surfaces and wash off as a result of storm events. Typical non-point sources of BOD, nutrients and include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Urban development (outside of Phase I or II MS4 discharges)

A geographic information system (GIS) tool was used to display, analyze, and compile available information to characterize potential sources in the impaired WBID. This information includes land use, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics.

6.1 Point Sources

In this planning unit, FDEP records indicate that there are 27 permitted wastewater treatment facilities, 12 of which have federal National Pollution Discharge and Elimination System (NPDES) permits for discharge to surface water. Four of the NPDES facilities are domestic wastewater treatment plants, the most significant being the Broward County North Regional Wastewater Treatment Plant (design capacity 80 million gallons per day [mgd]). NPDES facilities also include 3 industrial wastewater facilities (2 of which discharge cooling water or reverse osmosis plant brine). There are 9 permitted landfills in the planning unit (2 of which are

active Class I or II solid waste facilities), 7 Brownfields redevelopment areas, and 5 federal Superfund sites. In addition, there are 6 delineated areas of ground water contamination. WBID 3277B is a small portion of the Broward planning unit and there are currently no NPDES facilities in the WBID. However, during the time the water quality data for this WBID was collected the City of Plantation wastewater facility discharged secondarily treated wastewater to the East Holloway Canal which is the main canal in this WBID. This discharge ceased in 1988.

Municipal Separate Storm Sewer Systems (MS4s) may also discharge to water-bodies in response to storm events. Large, medium, and small MS4s serving populations greater than 50,000 people, or with an overall population density of 1,000 people per square mile, are required to obtain a NPDES storm water permit. The Broward planning unit includes regulated municipal MS4s. There are 31 permitted MS4s in Broward County, and most of these are covered under the Broward County permit (see Table 2). The cities of Ft. Lauderdale and Hollywood are in Broward County, but have separate MS4 permits. These are coastal cities and are not close enough to WBID 3277B to discharge pollutants to the WBID.

Table 2: MS4 Permits in Broward County

Permit/Co-permit Name	Permit ID Number	MS4 Type
Broward County	FLS000016	Phase I
City of Coconut Creek	FLS000016	Phase I
City of Cooper City	FLS000016	Phase I
City of Coral Springs	FLS000016	Phase I
City of Dania Beach	FLS000016	Phase I
City of Deerfield Beach	FLS000016	Phase I
City of Hallandale Beach	FLS000016	Phase I
City of Lauderdale Lakes	FLS000016	Phase I
City of Lauderhill	FLS000016	Phase I
City of Lighthouse Point	FLS000016	Phase I
City of Margate	FLS000016	Phase I
City of Miramar	FLS000016	Phase I
City of North Lauderdale	FLS000016	Phase I
City of Oakland Park	FLS000016	Phase I
City of Parkland	FLS000016	Phase I
City of Pembroke Pines	FLS000016	Phase I
City of Plantation	FLS000016	Phase I
City of Pompano Beach	FLS000016	Phase I
City of Sunrise	FLS000016	Phase I
City of Tamarac	FLS000016	Phase I
City of Weston	FLS000016	Phase I
City of Wilton Manors	FLS000016	Phase I
FDOT Turnpike District	FLS000016	Phase I
FDOT District 4	FLS000016	Phase I

Town of Davie	FLS000016	Phase I
Town of Lauderdale-By-The-Sea	FLS000016	Phase I
Town of Pembroke Park	FLS000016	Phase I
Town of Southwest Ranches	FLS000016	Phase I
Village of Sea Ranch Lakes	FLS000016	Phase I
City of Ft. Lauderdale	FLS000017	Phase I
City of Hollywood	FLS000020	Phase I

6.2 Non-point Sources

Nonpoint sources within this planning unit that may contribute to impairment of waterbodies are associated with land use. Based on Level I and II land use summary information, urban land uses dominate this area, constituting approximately 69 percent of the total area. These include low, medium, and high-density residential development (27.5 percent), commercial (17.5 percent), and industrial (4 percent) uses. Transportation and utilities also constitute a significant portion of the total land use (7.5 percent). Only about 8.5 percent the total land area is delineated as agriculture, most of that being in pasture (5.6 percent). Natural areas (upland forest, wetlands, and water) constitute only about 9 percent of the land cover. Land use in the East Holloway Canal water body ID (3277B) is similar to that of the planning unit with 97 percent developed. Residential land uses constitute 73 percent of the WBID area, commercial, industrial and public make up 19 percent, and transportation and utilities make up 5 percent of the WBID as shown in Table 1.

6.3 Wildlife

Wildlife deposit their feces onto land surfaces where it can be transported during storm events to nearby streams. BOD and nutrients load from wildlife is assumed background, since the contribution from this source is small relative to the load from urban and agricultural areas.

6.4 Agricultural Animals

Agricultural animals are the source of several types of BOD and nutrients loadings to streams, that impact water quality. This source includes agriculture runoff from pastureland and cattle in streams. The land use within the impaired WBID is basically non-agricultural, so this landuse likely discharges an insignificant amount of the BOD and nutrients load.

6.5 Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs) including septic tanks are commonly used where providing central sewer is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of

domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water. The State of Florida Department of Health (www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm) publishes septic tanks data on a county basis. Table 3 summarizes the cumulative number of septic systems installed since the 1970 census. The data does not reflect septic tanks removed from service.

Table 3. County Estimates of Septic Tank Installations (FDEP, 2004)

County	Number Septic Tanks (1970- 2002)
Broward	106,418

6.6 Urban Development

BOD and nutrients loading from urban areas is attributable to multiple sources including storm-water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of non-point source pollution by requiring new development and redevelopment to treat storm-water before it is discharged. The Stormwater Rule, as outlined in Chapter 403 Florida Statutes (F.S.), was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. Florida's storm-water program is unique in having a performance standard for older storm-water systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older storm-water management systems shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-4-.432 (5) (c), F.A.C.).

Nonstructural and structural BMPs are an integral part of the State's storm-water programs. Nonstructural BMPs, often referred to as "source controls", are those that can be used to prevent the generation of NPS pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimizing impervious surfaces. Technology-based structural BMPs are used to mitigate the increased storm-water peak discharge rate, volume, and pollutant loadings that accompany urbanization.

7. Analytical Approach

The approach for calculating DO, BOD and nutrients TMDLs depends on the number of water quality samples and the availability of data. For BOD and Nutrient loads the existing loads are calculated using the Nonpoint Source Spreadsheet Model. The TMDL is expressed as a percent reduction to meet a pollutant concentration target based on natural conditions. The assumption made is that BOD and nutrients have the major controllable impacts on dissolved oxygen. To return dissolved oxygen to a “naturally” expected condition, not impacted by pollutants, the BOD and nutrient loadings will also need to be returned to natural loading conditions. However since dissolved oxygen is also impacted (lowered) by the instream modifications such as dredging and channelization. These processes slow down the water velocity and reduce reaeration and increase solids settling there by increasing sediment oxygen demand (SOD) and may result in a low DO condition. Therefore, the dissolved oxygen may not achieve the designated water quality standards. Further analyses and monitoring will have to be completed to develop an appropriate site specific dissolved oxygen criterion.

Using the landuse distribution the existing and natural Total Nitrogen (TN), Total Phosphorus (TP) and Biochemical Oxygen Demand (BOD) loads were calculated based on an average rainfall of 50 inches per year. The natural values were calculated by assigning the non-water portion of the drainage area half to forest and half to wetlands loading values, see Table 4.

Table 4 WBID 3277 Estimated Existing and Natural or Targeted TN, TP and BOD Loads

WBID	Total Annual Load (lbs/year)*		
	TN	TP	BOD
3277	2,095	117	7,340
3277 Natural	1,740	117	3335

*To calculate the total daily load, divide the total annual load by 365.

8. Development of Total Maximum Daily Loads

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{WLAs} + \Sigma \text{LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measures. The TMDLs for the East Holloway Canal WBID are expressed as percent reductions.

8.1 Critical Conditions

Critical conditions are accounted for in the analyses by using annual loads and all water quality information and data available for the WBIDs.

8.2 Margin of Safety

TMDLs shall include a margin of safety that takes into account any lack of knowledge about the pollutant loading and in-stream water quality. In this case the measured water quality was used directly to determine the reduction to meet the water quality standard. In this case the lack of knowledge concerns the data, and how well it represents the true water quality. There are two methods for incorporating a MOS in the analysis: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In this WBID 3277B TMDL, an implicit MOS was used by targeting a background loading based on natural landuses

8.3 Determination of TMDL, LA and WLA

The TMDL values represent the maximum daily load the stream can assimilate and maintain water quality standards. TMDL components for the impaired water-bodies required to achieve the targets are summarized in Table 5.

Table 5. Summary of TMDL Components

Stream Name / WBID	Parameter	WLA for MS4 FLS000016	LA	TMDL
East Holloway Canal (3277B)	BOD	55% reduction	55% reduction	55% reduction
East Holloway Canal (3277B)	TN	16% reduction	16% reduction	16% reduction
East Holloway Canal (3277B)	TP	0% reduction	0% reduction	0% reduction

8.4 Waste Load Allocations

There are 29 permitted MS4s covered under the Broward County permit FLS000016 (see Table 2) in the East Holloway Canal (3277B) for reduction percentages.

8.5 Load Allocations

There are two modes of transport for non-point source loading into the stream. First, loading from failing septic systems and animals in the stream are considered direct sources to the stream, since they are independent of precipitation. The second mode involves loadings resulting from accumulation on land surfaces transported to streams during storm events. Since exceedances were observed in wet and dry conditions, the load allocations reductions should target both types of sources.

8.6 Seasonal Variation

Seasonality was addressed by using all water quality data associated with the impaired WBIDs, which was collected during multiple seasons.

8.7 Recommendations

Determining the source of BOD and nutrients in waterbodies is the initial step to implementing this TMDL. FDEP employs the Basin Management Action Plan (B-MAP) as the mechanism for developing strategies to accomplish the necessary load reductions. Components of a B-MAP are:

- Allocations among stakeholders
- Listing of specific activities to achieve reductions
- Project initiation and completion timeliness
- Identification of funding opportunities
- Agreements
- Local ordinances
- Local water quality standards and permits
- Follow-up monitoring

As this TMDL is implemented, the Agency strongly encourages the development of site-specific dissolved oxygen and nutrient criteria for these WBIDs

9. REFERENCES

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APPENDIX A: Water Quality Data

Date	East Holloway Canal	DO (mg/l)	Temperature	pH (Units)	TN (mg/l)	TP (mg/l)	TSS (mg/l)	Turbidity (ntu)
5/17/1994	SITE - 1	8.6	31.6	7.2	0.7	0.12	3	3
8/25/1994	SITE - 1	4.1	29.7	6.9	1.9	0.09	1	1
11/30/1994	SITE - 1	9.1	27	7.7	1.15	0.15	4	2.5
2/24/1995	SITE - 1	8.7	21.3	7.3	0.88	0.03	2	0.78
5/16/1995	SITE - 1	7.3	28.3	7.3	0.6	0.01	2	0.49
8/29/1995	SITE - 1	6.8	30.2	7.4	0.88	0.05	2	0.39
11/21/1995	SITE - 1	4.9	21.9	7.5	1.14	0.02	5	1.3
2/28/1996	SITE - 1	7.8	25	7.4	1.3	0.02	3	0.63
8/15/1996	SITE - 1	5.7	31.9	7.53	0.99	0.03	2	0.78
11/22/1996	SITE - 1	9.2	23.4	8.23	1.89	0.02	1	0.72
2/21/1997	SITE - 1	6.7	24.4	6.75	1.6	0.02	1	0.86
5/23/1997	SITE - 1	5.2	29.9	8.03	1.33	0.033	2	1.78
8/19/1997	SITE - 1	1.7	30.9	7.89	0.49	0.018	2	1.4
11/21/1997	SITE - 1	1.8	23.8	8.18	1.47	0.004	4	0.89
2/16/1998	SITE - 1	6.1	21	7.39	2.34	0.018	1	0.68
5/19/1998	SITE - 1	3.99	3	7.08	1.39	0.014	1	0.95
8/14/1998	SITE - 1	2.8	33.2	5.97	1.55	0.117	3	0.59
3/4/1999	SITE - 1	4.2	21.1	7.6	0.77	0.02	1	0.59
6/17/1999	SITE - 1	5.7	29.5	7.7	0.71	0.03	4	1.5
10/13/1999	SITE - 1	4.5	28.8	7.8	0.64	0.01	3	0.67
1/6/2000	SITE - 1	5.3	24.6	7.7	1	0.01	4	0.57
4/20/2000	SITE - 1	3.8	26.7	7.7	2.3	0.01	1	0.89
7/28/2000	SITE - 1	4.5	31.3	7.4	0.96	0.02	3	1.6
10/30/2000	SITE - 1	5	26.2	7.3	1.23	0.008	2	1.7
1/29/2001	SITE - 1	6.6	19.8	7.7	1.37	0.017	5	1.5
Average		5.60	25.78	7.47	1.22	0.04	2.48	1.11

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