Status and Trends in Water Quality in Northeast Florida

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ABSTRACT

Surface water quality data from surface waters within the St. Johns River Water Management District (SJRWMD) were analyzed for status and trends. The SJRWMD is a state agency charged with managing water resources in a 19-county area of northeast Florida.

Status and trends assessments were based on a Water Quality Index (WQI) for streams and springs and a Trophic State Index (TSI) for lakes and estuaries. These indexes were based on an analytical methodology developed by the Florida Department of Environmental Protection (FDEP) for preparing Florida's biannual 305(b) report for submittal to the EPA. The analysis was modified and applied using the SJRWMD's data to better assess its surface water quality. A WQI or TSI was calculated for each waterbody, allowing the waterbody to be rated as good, fair or poor. Status was calculated using data from a 5-year period (1993-1998) while trends were based on the annual mean values of the WQI or the TSI over a 15-year period (1983-1998). Trend calculation allowed each waterbody to be rated as improving, degrading, or stable. Status and trends assessment allowed for a comprehensive evaluation of the water quality in the SJRWMD.

INTRODUCTION

The SJRWMD comprises 12,000 square miles in northeast Florida. The SJRWMD's mission is to manage water resources to ensure their continued availability while maximizing both environmental and economic benefits. One of the management tools produced every five years by staff is the SJRWMD Water Management Plan (WMP). It outlines procedures to improve the supply and quality of water throughout the SJRWMD and also provides a summary of existing water quality. Many SJRWMD programs monitor surface water quality because it provides a basis for describing the status of water resources. Water quality status and trends for specific sites monitored under these programs were analyzed as part of the WMP. This paper describes the methodology and results of that data analysis.

APPROACH

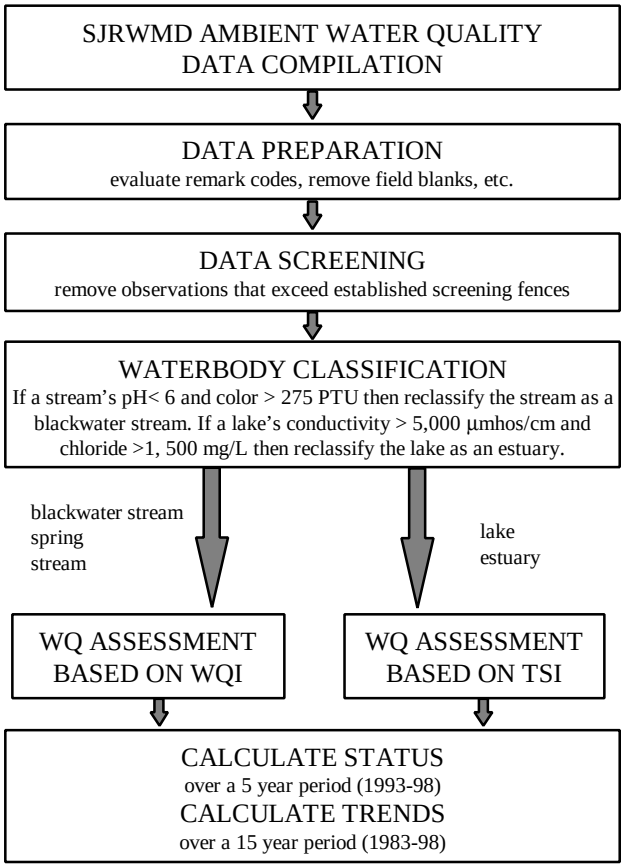

Figure 1. Flowchart of data analysis.

Streams, blackwater streams, and springs were assessed using the Water Quality Index (WQI), while lakes and estuaries were assessed with the Trophic State Index (TSI) (Fig. 1). A stream was considered to be a blackwater stream if it had a median color >275 platinum-cobalt units and a median pH <6 standard units. Many streams that drain flatwood swamps in the SJRWMD fit this criteria. The methodology developed for preparing Florida's biennial 305(b) report was modified and applied to the SJRWMD's data to assess the status of and trends in surface water quality. The status of each waterbody was rated good, fair, or poor based on the mean WQI or TSI calculated using data from 1993 to 1998. Trends reflect the increase or decrease in annual mean values of the WQI or TSI from 1983 to 1998. Waterbodies were rated as improving, degrading, stable, or having insufficient data. Trend results were evaluated using a standard statistical hypothesis test with a significance level of 0.10.

SJRWMD staff have been collecting water quality samples at fixed stations for many years. Stations were selected to provide a representative cross-section of the region, with respect to surrounding land use patterns and the types of waterbodies monitored. Data from these fixed stations were used for the analyses.

METHODOLOGY

Lakes and Estuaries

Water Quality Status

Data on total phosphorus, total nitrogen, secchi depth, and chlorophyll were used to determine the TSI (Huber et. al., 1982). Annual medians of each of these four constituents were calculated and a TSI was determined for each year. The final TSI was the median of the annual TSI values. The method required at least three values per year to

determine an annual median for each constituent, and at least three out of the five years of data to determine the final TSI. The resultant TSI number ranged from 0 to 100, with lower numbers indicating better quality.

Water Quality Trends

Daily TSI values were determined using daily values of total phosphorus, total nitrogen, secchi depth, and chlorophyll, and an annual mean TSI was determined. Trends were evaluated with a regression on the annual means, resulting in a slope estimate. A minimum of six years of data were required, and a linear trend was calculated for consecutive data years. Nonconsecutive data years resulted in a step trend, which is an evaluation of the difference between the first half and second half of the data record.

Streams, Blackwater Streams, and Springs

Water Quality Status

Data on turbidity, total suspended solids, dissolved oxygen, total organic carbon, coliforms, total phosphorus, total nitrogen, and nitrates were used to determine the WQI (Florida Department of Environmental Protection, 1996). Annual median values of each of these constituents were compared to a percentile distribution of the constituent. The percentile distribution was based on daily values over all similar waterbody types. For example, turbidity medians for each year were compared to a turbidity distribution (percentile 1 to percentile 99), to derive an index value for that annual median turbidity. This method was used for all the constituent parameters, and the resultant index values were then averaged. The final result was a number between 0 and 100, with lower numbers indicating better water quality.

Water Quality Trends

Trends were determined similarly to those for lakes and estuaries. Daily WQI values were calculated, and an annual mean was determined. Trends in the annual means of the WQI values were evaluated. A minimum of six years of data were required, and the slope significance was estimated with $p<0.10$.

RESULTS

The assessment described water quality for most of the major waterbodies in the SJRWMD (Table 1). Fortunately, most of the sites assessed exhibited good or fair water quality. Seventy-one percent of blackwater streams, 62% of lakes, 87% of streams, and 98% of estuarine sites were rated good or fair. Over all waterbody types, 79% were good or fair. Unfortunately, most of the sites did not have sufficient data for a trend assessment. Results for those that did have sufficient data were that 86% of blackwater streams were stable or improving, 56% of lakes were stable or improving, 62% of streams were stable or improving, and 95% of estuarine sites were stable or improving. On average then, 62% of all the sites which had sufficient data for trend assessment were stable or improving. Results for specific sites were plotted on maps (Fig. 2, 3). In the St. Marys River, the sites near the mouth were rated fair, with good quality in the headwaters. However, there were insufficient data for trends. The lower St. Johns River, which is the run between the southern end of Lake George and the mouth, was rated fair in Moncrief Creek, but poor in the Ortega River tributary. Most tributaries to the lower St. Johns River were rated fair, with the exceptions of Peters Creek and the Ortega River. The mainstem of the river was rated good. The stretch between Jacksonville and Palatka was rated fair. With the exception of Rice Creek, most of the mainstem was rated fair or good. Lake George was rated fair or good as well. Unfortunately, many of these areas appear to be getting worse. The middle St. Johns River is the stretch of river between the southern end of Lake George and the area near Lake Jesup. Most of the middle St. Johns River was rated fair or good, except for the contribution of Lake Jesup. All of

Lake Jesup was rated poor. The run of river south of Lake Jesup is the headwaters, also called the upper St. Johns River. This area was rated mostly good, including Blue Cypress Lake. Trends in the upper St. Johns River showed either no change or an improving trend. The Indian River Lagoon is the coastal lagoon stretching from Ponce Inlet

Table 1. Assessment results for waterbody types.

CATEGORY	WATERBODY TYPE					TOTAL	STATUS	TREND			
		Blackwater						Improving	Degrading	Stable	Insufficient
STATUS/TREND	Springs	Streams	Lakes	Streams	Estuaries	Total	Overall	Overall	Overall	Overall	Data
good/improving	0	0	0	0	3	3		3			
good/degrading	0	1	6	2	1	10			10		
good/stable	0	1	4	7	3	15				15	
good/insufficient	0	6	10	20	4	40	68				40
fair/improving	0	1	0	1	9	11		11			
fair/degrading	0	0	7	5	2	14			14		
fair/stable	0	2	7	4	12	25				25	
fair/insufficient	1	4	8	9	10	32	82				32
poor/improving	0	1	4	0	0	5		5			
poor/degrading	0	0	2	1	0	3			3		
poor/stable	0	1	4	1	0	6				6	
poor/insufficient	0	4	16	5	1	26	40				26
TOTAL	**1**	**21**	**68**	**55**	**45**	**190**		**19**	**27**	**46**	**98**
TOTAL AS PERCENTAGE	**0.53**	**11.05**	**35.79**	**28.95**	**23.68**						
STATUS											
percent good	0.00	38.10	29.41	52.73	24.44		**35.79**				
percent fair	100.00	33.33	32.35	34.55	73.33		**43.16**				
percent poor	0.00	28.57	38.24	12.73	2.22		**21.05**				
TRENDS											
percent improving	0.00	9.52	5.88	1.82	26.67			**10.00**			
percent degrading	0.00	4.76	22.06	14.55	6.67				**14.21**		
percent stable	0.00	19.05	22.06	21.82	33.33					**24.21**	
percent insufficient	100.00	66.67	50.00	61.82	33.33						**51.58**

at the north (south of Daytona Beach) to Vero Beach at the south. Most of the Indian River Lagoon sites were rated fair, with a few rated good. Most of the lagoon showed no change or an improving trend. Upper coastal areas were rated fair or good. The Ocklawaha River and its headwaters are probably in the worst shape, when compared to many of the other waterbodies in the District. The headwaters, especially Lake Apopka, were rated poor for water quality. The Ocklawaha River chain of lakes were rated poor. Farther downstream, the Ocklawaha River was rated good. Trends showed that the Ocklawaha River is getting worse. The lakes around Gainesville are also questionable, especially Newnans Lake and Lochloosa Lake. Orange Lake was rated both fair and good.

CONCLUSIONS

Most of the waterbodies in the SJRWMD were rated fair or good. The areas that were rated poor are primarily those near urban and agricultural areas. Unfortunately, many areas have declining water quality. The continued economic development in the SJRWMD, along with runoff from point and nonpoint sources, will likely continue to cause a deterioration of water quality.

REFERENCES

Florida Department of Environmental Protection, 1996. 1996 Water Quality Assessment for the State of Florida, Section 305(b) Main Report, Chapter 2, pp. 75-105.

Huber W.C., P.L. Brezonick, J.P. Heaney, R.E. Dickinson, S.D. Preston, D.S. Dwornik, and M.A. DeMaio, 1982. A Classification of Florida Lakes. University of Florida Water Resources Research Center, Publication No. 72, Chapter 3, pp. 1-74.

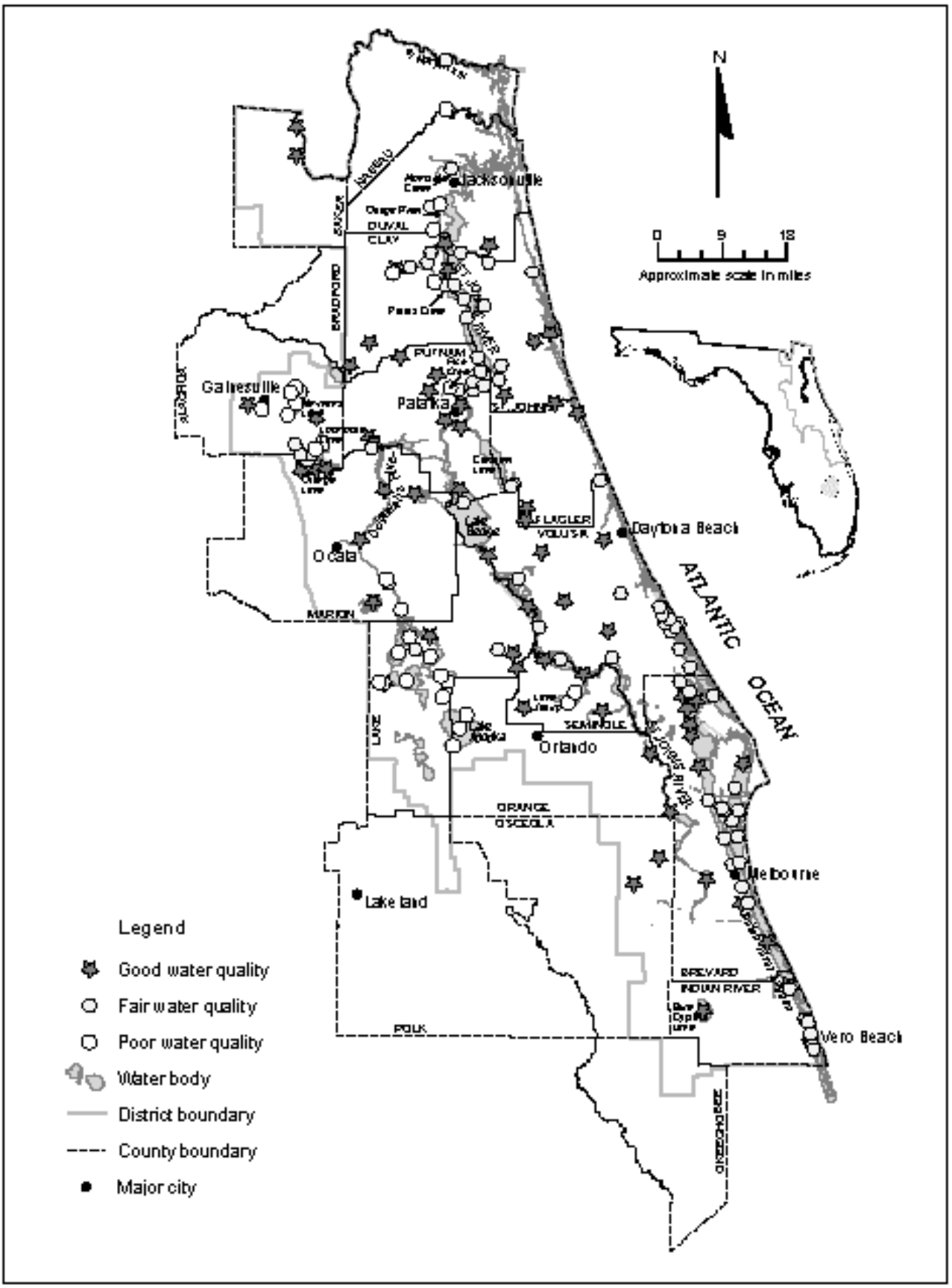

Figure 1. Water quality status in the St. Johns River Water Management District

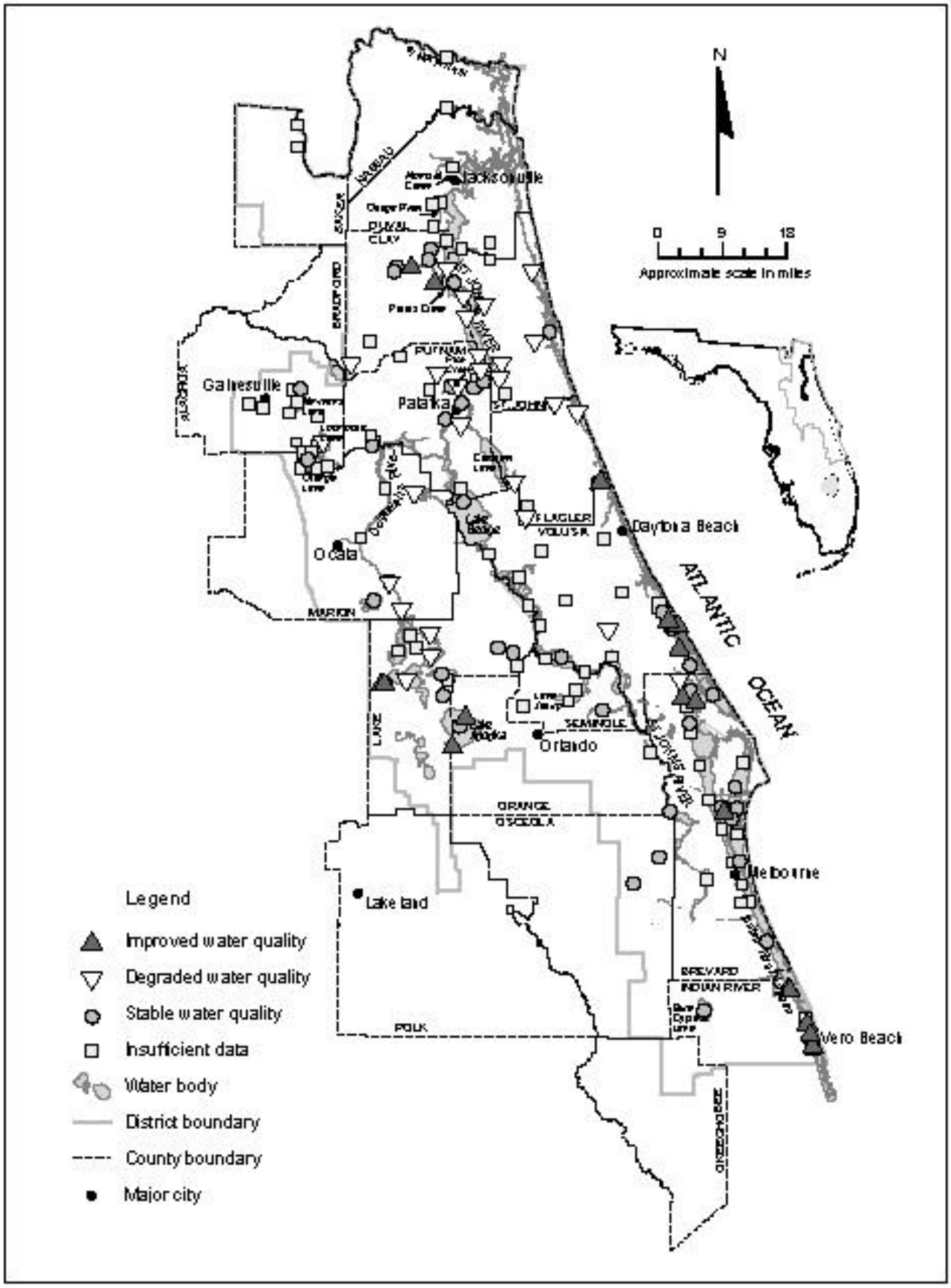

Figure 2. Water quality trends in the St. Johns River Water Management District