SECTION 4

WATER QUALITY ASSESSMENT

CITY OF COCOA BEACH, FLORIDA
STORMWATER MASTER PLAN

PARSONS ENGINEERING SCIENCE, INC.

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WATER QUALITY ASSESSMENT

The Water Quality Assessment section of the Stormwater Master Plan provides an overview of the existing water quality associated with the City in relation to current State and Federal regulations. It further describes the development of pollutant reduction based Level of Service (LOS) criteria on which to assess current conditions and evaluate the effectiveness of future efforts to reduce pollutant loadings and improve water quality. The assessment provides the groundwork for the following sections where detailed discussions of project implementations to address water quality improvement are proposed.

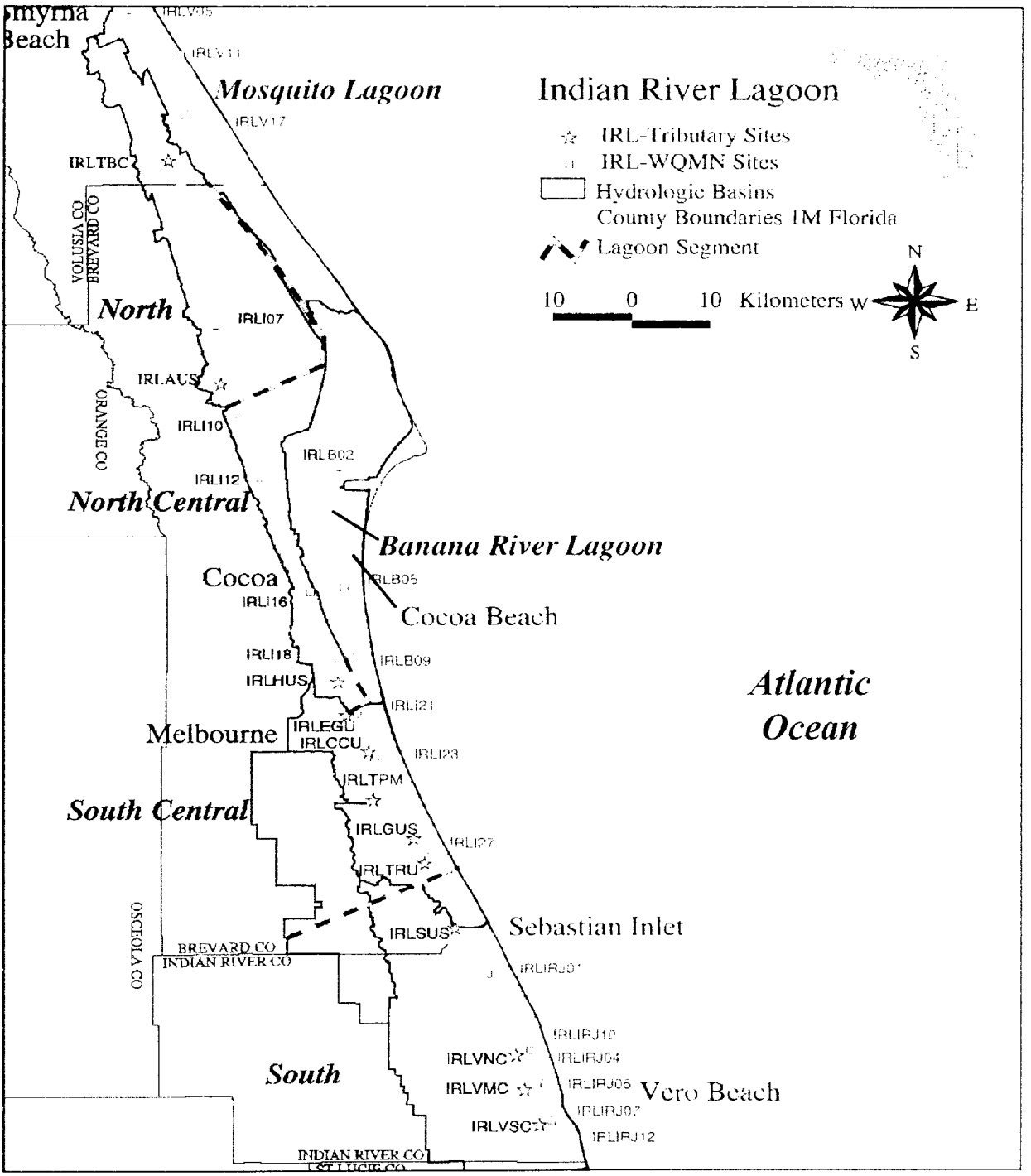
The City of Cocoa Beach will be subject to new, and more stringent upcoming regulations governing water quality impacts over the next several years. As a result of the Federal Clean Water Act, the U.S. Environmental Protection Agency (EPA) and Florida Department of Environmental Protection (FDEP) will establish total maximum daily load (TMDL) criteria which will limit pollutant discharges. For urban municipalities such as Cocoa Beach, the TMDL implementation will in the form of pollutant load reduction goals (PLRGs) which will be established for defining what the acceptable pollutant loading will be for sensitive receiving water bodies. As of the preparation of this Master Plan document, the final regulations defining TMDLs and PLRGs are still under development.

Meeting the intent of upcoming regulations is imperative as the majority of the City's stormwater runoff discharges into the Banana River, a part of the Indian River Lagoon (IRL) system, classified an Outstanding Florida Waterway (see Figure 4.1). This classification is assigned to areas warranting the highest protection from further degradation of water quality. St. Johns River Water Management District (SJRWMD) has received extensive scientific and technical input to attempt to quantify PLRGs within the Banana River that will be required to restore and protect the Indian River Lagoon. The efforts of SJRWMD in quantifying these limits are quite challenging in that SJRWMD must first determine defensible PLRG criteria and practically achievable water quality limits that can achieve water quality conditions.

One procedure SJRWMD is currently evaluating is linking pollutant load reduction goals to meeting the 1943 coverage of seagrass within the Indian River Lagoon, as indicated through aerial photo comparisons. SJRWMD, in their current effort, is assessing water quality conditions required to restore this level of seagrass coverage. The pollutant parameter of primary concern with respect to seagrass are suspended solid and associated constituents which reduce the optical clarity of the water column and reduce the sunlight penetration to the seagrass. To date, however, there has been no specific recommended water quality standards provided to the City by the State to use as a basis for capital improvement or future regulatory planning.

This present uncertainty in upcoming regulations presents a significant challenge to Cocoa Beach in the development of a financially feasible CIP that can address a regulatory goal that has not yet been established, nor is quantifiable at this time. Under this Master Plan, an innovative approach has been taken that provides a proactive program of BMP projects to improve water quality. Successful implementation of the water quality improvement program should provide for an acceptable LOS that will leave the City in an advantageous position when the final regulations are implemented.

FIGURE 4.1
INDIAN RIVER LAGOON MAP
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA



Source: /sjr/irl/arcview proj/wendy stations.apr 04/20/1999

MAP SOURCE: SJRWMD, 2000

4.1 REGULATORY BACKGROUND

In order to understand and appreciate the methods on which the water quality assessment portion of the Master Plan relies, an overview of the various regulatory drivers is warranted. The following subsections provide a summary of the Federal and State regulations and programs that effect the manner in which the City's stormwater utility will manage water quality issues. It is also important to note that the water quality issues are not distinct to stormwater, and must rely on comprehensive solutions to point and non-point source pollution to meet upcoming regulations.

4.1.1 Total Maximum Daily Loads

Section 303(d) of the Federal Clean Water Act (CWA) requires states to submit lists of surface waters that do not meet applicable water quality standards (impaired waters) after implementation of technology-based effluent limitations. The CWA also dictates the development of Total Maximum Daily Loads (TMDLs) for these waters on a prioritized schedule. TMDLs establish the maximum amount of a pollutant that a water body can assimilate without causing exceedances of water quality standards. The maximum amount of pollutants is generally measured through habitat loss. As such, development of TMDLs is an important step toward restoring our waters to their designated uses. These designated uses are generally related to the water bodies classification as defined by State water quality regulations. Examples of designated uses, are waters intended for recreation, navigation, shellfish, harvesting, etc.

In order to achieve the water quality benefits intended by the CWA, it is critical that TMDLs, once developed, be implemented as soon as possible. Implementation of TMDLs refers to any combination of regulatory, non-regulatory, or incentive-based actions that attain the reduction in pollutant loading needed to meet the TMDL. Non-regulatory or incentive-based actions may include development and implementation of Best Management Practices (BMPs), pollution prevention activities, and direct habitat preservation or restoration. Regulatory actions may include issuance or revision of wastewater, stormwater, or Environmental Resource permits to include permit conditions consistent with the TMDL. These permit conditions may be numeric effluent limitations or for technology-based programs, requirements to use a combination of structural and non-structural BMPs needed to achieve a required pollutant load reduction goal (PLRG).

4.1.2 Non-Point Source Pollution

TMDLs address both "point source" and "non-point source" (NPS) pollutant discharges into receiving waters. Examples of point sources are wastewater or industrial treatment facility streams that discharge through one or more distinct pipes or points into the receiving water. In contrast, non-point sources are discharges which do not incur at distinct points, but over many points or areas. Examples of non-point sources are stormwater runoff, agricultural runoff, and atmospheric deposition. Point sources can be managed at definable points, whereas non-point sources must rely on programs and more regional engineering solutions.

Stormwater represents the primary NPS that must be managed successfully to meet TMDLs. In contrast to point source pollution, which is generally conveyed through pipes into water bodies at discrete points, NPS pollution is varied and non-discrete. NPS pollution is associated with everyday activities of people. In the 1970s, the State of Florida began

receiving grant funding from EPA under the CWA to develop water quality management plans to abate water pollution from point and nonpoint sources of pollution, with the main focus on the identification, assessment, and control NPSs of pollution. A variety of projects were undertaken throughout Florida to quantify the pollutant loads from agricultural and urban settings to assess the effectiveness of different types of pollution controls, such as Best Management Practices (BMPs). These investigations determined that NPS pollution was responsible for over half of the total pollution load entering Florida's surface waters and over 75% of the loadings to lakes. Also, stormwater was responsible for 450 times the amount of suspended solids, nine times the biochemical oxygen demand, and an equal amount of the nutrient loadings is charged to Florida waters as compared to secondarily treated domestic wastewater. Furthermore, stormwater accounted for 80 to 95 percent of the loadings entering Florida waters. These statistics have had a profound effect on State and Federal regulations, which govern local government permitting.

The studies also indicated it is far easier and much more cost-effective to prevent or minimize NPS of pollution, especially from new landuse activities, than it is to restore polluted water bodies. The implementation of cost-effective structural and nonstructural BMPs could be successful in preventing pollutants from entering stormwater or to treat stormwater before it is discharged to surface or ground water. Finally, the effort indicated public education and technical assistance programs were essential in minimizing NPS pollution arising from actions under the direct control of individuals.

Recognition of the importance of NPS pollution, and the realization that Florida was undergoing rapid and continuing growth, led the state to begin implementing a wide variety of programs to minimize adverse impacts to Florida's valuable water resources. Florida's NPS management program has always been a partnership between state, regional, local agencies, and the private sector. The program also has relied upon many mechanisms including a mixture of regulatory and non-regulatory programs, technical assistance, public education, financial assistance, training, technology transfer, and demonstration projects to prevent or minimize NPS pollution. While the point source permitting program has historically been a water quality-based effluent program, the NPS program has been primarily a technology-based program. The future TMDL allocation rules may force NPS management away from the technology-based programs back towards the effluent quality programs.

This program philosophy allows specific performance standards to be achieved through the development of design criteria for BMPs as control techniques that are used for a given set of conditions to achieve water quality and water quantity enhancement at a minimum cost. BMPs are developed, implemented, and monitored for compliance and effectiveness in an iterative process. This allows ongoing monitoring results and other new information to be used to revise BMP design criteria to improve their performance. With this dynamic approach, the NPS program can allow for the accommodation of new science and technology when available.

The State has clear regulatory authority for TMDLs through permitting point sources of pollution via the federally delegated National Pollutant Discharge Elimination System (NPDES) Program and the state Wastewater Program. However, regulatory authority for some NPS pollution has historically not been as well established. Given the number of NPSs and complexity of NPS issues, a non-regulatory and incentive-based approach may be the preferred method to address NPS pollution. However, the upcoming TMDL implementation may establish a regulatory based program with permitting based on specific NPS pollutant reduction. To fully implement NPS TMDLs utilizing non-regulatory and incentive-based

programs will require unprecedented coordination with other agencies and consensus with local stakeholders.

One of the key strengths in implementing a NPS control program is to focus on coordination and stakeholder involvement. This involves contacting the various agencies, with jurisdiction in the watershed or basin, and key stakeholders to develop consensus on preliminary basin assessment, recommendations for management goals, and study plans for the basin. A focus on initial coordination can greatly facilitate chances of success in developing Basin Management Plans. Local stakeholder groups can often successfully achieve necessary pollutant reductions beyond regulatory requirements if the stakeholders feel actively involved in water quality objectives, and allowable loadings are clearly established.

For watersheds or basins with significant urban NPS loading, the State can work closely with local municipalities, EPA Region 4, and the regional water management districts to address the NPSs. While regulatory authority for urban NPS is largely provided via the NPDES stormwater program, close coordination will be required to ensure that NPS pollutant reductions are implemented. In many cases, municipalities with significant NPSs also have domestic wastewater facilities that discharge to the same basin. In this case, pollutant trading can be allowed as a cost-effective means to achieve pollutant reductions.

4.1.3 State Pollutant Load Reduction Goal Development

Florida is unique in not only having established a state-wide program requiring the treatment of stormwater from new developments, but also in establishing performance standards for older stormwater systems. According to FDEP's Water Resource Implementation rule (Section 62-40.432 (5)(c), F.A.C.), "the pollutant loading from older stormwater management systems shall be reduced as needed to restore or maintain the beneficial uses of waters." This rule implies that the regional water management districts will establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a surface water management program. The exact process and procedures of the PLRG development are yet undefined. In any case, stormwater PLRGs will be a major component of the load allocation part of a TMDL.

The first step in establishing a PLRG is to develop a water quality goal or target value related to the improvement or restoration the waterbody. Typically targets can be established in reference to a defined baseline or historical condition of desired water quality. The target water quality condition can be linked to specific pollutant concentration levels or to physical characteristics such as water transparency. In the best case the PLRG can be linked to a measurable biological state, such as re-establishing desired seagrass coverages. Once the target level or condition is defined, the annual average load reduction of pollutants needed to reach the target is determined. Although PLRGs can be established for any number of parameters responsible for waterbody degradation, focus to date has been on reducing specific loads of pollutants such as suspended solids, nitrogen, or phosphorus.

Unlike permitting programs addressing stormwater pollution prevention from new construction, regulating discharges from older stormwater systems presents problems that cannot be handled through regulation alone. Permitting design criteria for new stormwater management system construction are oftentimes difficult or impossible to apply in retrofitting older systems. Retrofitting or upgrading existing systems is also difficult and costly, often constrained by land needs. Addressing the older system must also accommodate measures such as public education and pollution prevention. Based on the foregoing, successful implementation of PLRGs necessitates the involvement of a number of

regulatory and non-regulatory (state, local, private, etc.) players tuned into the needs of specific waterbodies. Although water management districts are the lead agency for establishing PLRGs, all stakeholders in the watershed must be involved to achieve water quality restoration goals.

4.2 EXISTING WATER QUALITY CONDITIONS

In order to manage impacts to water quality from stormwater discharges from the City of Cocoa Beach, an understanding of the characteristics and water quality issues of the receiving water is necessary. As discussed in Section 2, stormwater from Cocoa Beach discharges into the Banana River, which is part of the Indian River Lagoon (IRL) system. An overview of the characteristics and issues related to water quality specific to the IRL, Banana River, and Cocoa Beach are provided in the following sections. A map of the IRL was provided as Figure 4.1.

4.2.1 Indian River Lagoon Water Quality

SJRWMD has specific authority and responsibility for managing the northern part of the IRL Basin, comprised of Volusia, Brevard, and Indian River counties, while the remaining sections of the IRL (Sebastian Inlet to Jupiter Inlet) are controlled by the South Florida Water Management District (SFWMD). The Indian River Lagoon (IRL) region consists of three distinct water bodies–the Banana River, Mosquito Lagoon, and the IRL proper–and extends 156 miles along the Atlantic coast, bounded by Ponce de Leon Inlet to the north and Jupiter Inlet to the south. To protect and restore the rich biodiversity of this estuary, the EPA in 1990 included this system into its National Estuary Program (NEP) to address its environmental problems on a local and national scale. The Indian River Lagoon SWIM program has been merged with the National Estuary Program to make best use of available resources and funding.

Within the last 60 years, population growth and rapid, new development have caused substantial damage to the IRL's ecosystem; specifically, a decline in the amount of native seagrass beds which various animal species such as fish, shellfish, turtles, and manatees depend on for their survival. Seagrasses serve as a source of food and oxygen, provide young fish with a refuge area from larger predators, and reduce turbidity by trapping sediment particles at the bottom and improving water clarity. Changes in land use have increased the amount of nutrients and total suspended solids (TSS) discharged as runoff into the lagoon. This, in turn, has caused an increase in turbidity and algal blooms, reduced the water clarity, and impeded sunlight from reaching the seagrass beds. Once the sunlight is blocked and oxygen is depleted, the seagrass can no longer survive. In an effort to restore the entire IRL, the NEP along with local and state agencies have initiated urban stormwater management programs that target and attempt to control the increase in TSS and nutrient loadings that have caused the loss of this resource.

An increase in the volume of freshwater inflow to the brackish waters of the IRL has led to further impairment of water quality. Freshwater typically enters the lagoon through tributaries (i.e. rivers and streams) and man-made drainage features such as ditches and canals. Particularly during storm events, the increase in freshwater inflow into the estuary can cause the natural salinity levels to fluctuate and adversely impact the fragile ecosystem that contains species of plants, fish, and wildlife capable of survival at a narrow range of salinity. Therefore, the majority of non-point source pollution into the lagoon is caused by

an increase in the volume of freshwater from the artificial drainage features and an increase in stormwater runoff caused by urbanization.

4.2.2 Banana River Water Quality

The Clean Water Act (CWA) of 1972, amended to include stormwater in 1987, established water quality standards and limited the discharge of pollutants to water bodies. The CWA required all waters to be classified according to certain designated uses and assigned the responsibility of achieving and maintaining compliance to local and state governments. The City of Cocoa Beach's watershed drains to the Banana River, located in the northern portion of the IRL. The Banana River is listed in section 303(d) of the CWA as a "critically impaired" water. As discussed previously, this regulation established a program for determining a waterbody's TMDL, the maximum amount of pollutant loading that a waterbody can receive from point (wastewater) and non-point (stormwater) sources and still meet water quality standards enforced through National Pollution Discharge Elimination System (NPDES) permits. Furthermore, the lagoon is classified by the Florida Department of Environmental Protection (FDEP) as an Outstanding Florida Water, which is granted the highest protection from further degradation of water quality. In addition, it is currently classified as a Class III surface water meant for recreational purposes and propagation of fish and wildlife. The portion of the Banana River adjacent to Cocoa Beach is up for reclassification to Class II shellfish harvesting.

The Banana River is predominantly a mildly brackish surface water with salinity that averages just above the incipient threshold of 20ppt. Because of the distant location of ocean inlets north and south, circulation in the lagoon is not affected by the tidal cycle. Long term increases in freshwater inputs combined with urban development and losses in coastal wetland habitat have resulted in changes in salinity and turbidity regimes within the man-made waterways of the Banana River and within the IRL. Still, water quality within the Banana River has been deemed "good" by SJRWMD and has shown some improvements in recent years. However, long-term concerns persist with respect to light penetration and changes in salinity.

The City of Cocoa Beach is located in the central segment of the Banana River, designated as "BR3-5" by SJRWMD. This section received the highest rating of "good" for seagrass resources since it complied with two of the three index thresholds specified by the SJRWMD for the IRL system. However, of special concern is the susceptibility to low salinity levels experienced in this segment of the Banana River. Urbanization has increased the number of man-made drainage systems, causing greater quantities of freshwater to enter the IRL during storms. Freshwater inputs have a dilution effect on salinity levels, which below a concentration of 20 ppt, cause seagrass growth to decline. Therefore, besides TSS and nutrient loading, seagrass growth is also vulnerable to salinity fluctuations caused by excessive freshwater intrusion. The Banana River has been observed to be susceptible to dramatic salinity declines for long periods. According to SJRWMD, since 1995 salinity in the Banana River has noticeably declined and has stayed relatively low. At times salinity was at levels where growth of most species of seagrass declines or stagnates. The segment of the Banana River adjacent to Cocoa Beach has typically low salinity relative to the rest of the IRL system. Therefore, freshwater inputs are probably more critical to the seagrass resource in Banana River than in most of the other segments of the IRL system. In the case of Cocoa Beach, this inflow is primarily in the form of stormwater runoff.

In the Banana River section of the IRL, a pollutant loading reduction goal (PLRG) based on 1943 historical seagrass coverage is currently being developed by SJRWMD emphasizing

Total Suspended Solids (TSS) reduction to improve water quality through lower turbidity and higher water clarity. Until the final SJRWMD PLRG is developed, a "Provisional PLRG" is being used as a guideline. This provisional target is equal to the estimated difference between existing annual TSS loading conditions and that which existed during the 1943 historical time frame. The goal of this reduction is to allow a minimum of 20% of the incident sunlight to reach depths of at least six feet – the targeted depth for restored seagrass coverage.

4.2.3 Cocoa Beach Water Quality

SJRWMD has indicated that the majority of water quality problems exhibited in the Cocoa Beach area of the IRL result from inputs of stormwater (freshwater) discharges that contain TSS and inorganic nutrients such as nitrogen and phosphorus. TSS is the primary pollutant of concern for its high contribution to turbidity, a measure of the light transmitting properties of water caused by the presence of suspended mater, finely divided organic and inorganic matter, and microscopic organisms such as algae. Due to the City's proximity to the coast and the soil types present, sand particles appear to be the largest contributor to turbidity in the Cocoa Beach area of the IRL.

The City's wastewater treatment plant is an existing point source of discharge that contributes significantly to the Banana River during wet weather discharges. Atmospheric deposition may also contribute to overall pollutant loadings, particularly in the form of TN. These sources of potential water quality impacts must be addressed from a regulatory basis, however, they are not addressed further under this Stormwater Master Plan.

The City has classified water quality problems into three categories based on turbidity concentrations and secchi depth, a measure of water clarity. The present state of water quality is attributed primarily to the discharge of stormwater runoff without sufficient pollutant attenuation. The categories are defined on the problem area evaluation summary included on Table 4-1. Included on the table are all City outfalls. For outfalls where no current data exists, the City may wish to evaluate future sampling to aid in water quality assessment. The water quality data is also shown on Figure 4.2, which summarizes the areas of poor water quality by major and minor outfalls. Note that this data is generally limited to the canals and is not necessarily considered representative of the water quality of the Banana River. From an assessment and regulatory basis, the lagoon would include areas past the furthest landward end of these canals. This data does indicate the magnitude of potential impact that these canals may have on lagoon water quality.

Based on the foregoing discussions, untreated stormwater runoff represents the greatest non-point sources of TSS and freshwater inflow in the Banana River. As such, reduction of TSS loadings from Cocoa Beach along with any reductions in freshwater discharges appear to be most important objectives in the water quality treatment of municipal drainage water.

TABLE 4.1
WATER QUALITY PROBLEM AREA EVALUATION
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA

Outfall # / Problem I.D.	Problem/Canal Location	Water Quality Classification *	Predominant Land Use	Problem Cause
SA039O	Jack/Kent Canal	Poor	Commercial / Highway	Beach sand, highway R-O-W material; limited retention/treatment
SA044O	Jack/Kent Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SA047O	Jack/Kent Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SA050O	Jack/Kent Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SA053O	Jack/Kent Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB050O	Carmine/Barrello Canal	Poor	Residential / Highway	Receives runoff from A1A, residential yard wastes; limited retention/treatment
SB054O	Carmine/Barrello Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB057O	Carmine/Barrello Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB103O	Brightwater/Dorset Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB110O	Brightwater/Dorset Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB135O	Brightwater/Dorset Canal	Poor	Residential / Highway	Receives runoff from A1A, residential yard wastes ; limited retention/treatment
SB138O	Brightwater/Dorset Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB140O	Brightwater/Dorset Canal Dorset/Carmine Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB144O	Brightwater/Dorset Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB147O	Dorset/Carmine Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB150O	Dorset/Carmine Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SB202O	Terminus of Barrello Lane	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SB205O	Barrello/Angelo Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SB215O	Barrello/Angelo Canal	Moderately Poor	Residential / Highway	Receives runoff from A1A, residential yard wastes ; limited retention/treatment
SB302O	Terminus of Angelo Lane	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SB305O	Angelo and SR520 Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SB308O	Angelo and SR520 Canal	Moderately Poor	Residential / Highway	Receives runoff from A1A; no retention/treatment
SB417O	North SR520 - Relief Bridge	Moderately Poor	Commercial / Highway	Beach sand, highway R-O-W material; limited retention/treatment
SC064O	St. Lucie Outfall	Moderately Poor	Residential / Highway	Receives runoff from A1A, residential yard wastes ; limited retention/treatment
SD041O	Seminole between CM140 and CM 142	Moderately Poor	Highway	Receives A1A runoff, limited retention/treatment prior to discharge
SD103O	Outfall near the intersection of Escambia Lane and S. Banana River Blvd.	No Data	Residential / Highway	Evaluate collection of surface water sample(s)
SD202O	Outfall at the terminus of Pinellas Lane	No Data	Residential / Highway	Evaluate collection of surface water sample(s)
SD302O	Outfall at the terminus of Sarasota Lane	No Data	Residential / Highway	Evaluate collection of surface water sample(s)
SD402O	Seminole between CM140 and CM 142	Moderately Poor	Residential / Highway	Receives runoff from A1A, residential wastes; limited retention/treatment
SE036O	Esther/Holiday Canal	Poor	Commercial / Highway	Beach sand, highway R-O-W material; limited retention/treatment
SE039O	Esther/Holiday Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SE052O	Esther/Holiday Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SE053O	Esther/Holiday Canal	Poor	Commercial / Highway	Receives runoff from A1A; no retention/treatment
SE062O	Esther/Holiday Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SE103O	Outfall south of Andros Ave.	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE105O	Outfall at the terminus of St. Croix Rd.	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE108O	St. Croix/Banana River Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE113O	St. Croix/Banana River Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE116O	Outfall north of the terminus of Banana River Blvd.	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE203O	Banana River/Bimini Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE205O	Banana River/Bimini Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE208O	Banana River/Bimini Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE215O	Banana River/Bimini Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE303O	Bimini/Jamaica Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE403O	Jamaica/Bahama Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE406O	Jamaica/Bahama Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE408O	Jamaica/Bahama Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE503O	Outfall at the terminus of Antigua Rd.	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE506O	Bahama/Antigua Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE509O	Bahama/Antigua Canal	Mildly Poor	Residential / Highway	Receives runoff from A1A, residential wastes; no retention/treatment
SE512O	Bahama/Antigua Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SE515O	Bahama/Antigua Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment

TABLE 4.1
WATER QUALITY PROBLEM AREA EVALUATION
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA

Outfall # / Problem I.D.	Problem/Canal Location	Water Quality Classification *	Predominant Land Use	Problem Cause
SE603O	Samar/Ball Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE606O	Samar/Ball Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE610O	Samar/Ball Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE614O	Samar/Ball Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE621O	Samar/Ball Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE625O	Samar/Ball Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE628O	Samar/Ball Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SE704O	Outfall at the terminus of Bermuda Rd.	No Data	Residential	Evaluate collection of surface water sample(s)
SE708O	Outfall at the terminus of Java Rd.	No Data	Residential	Evaluate collection of surface water sample(s)
SE712O	Outfall at the terminus of Nassau Rd.	No Data	Residential	Evaluate collection of surface water sample(s)
SF076O	Northshore/Indian Creek Canal	Poor	Commercial / Highway	Beach sand, highway R-O-W material; limited retention/treatment
SF103O	Outfall north of the terminus of Cocoa Isles Blvd.	No Data	Residential	Evaluate collection of surface water sample(s)
SF107O	Cocoa Isles/Capri Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF111O	Cocoa Isles/Capri Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF115O	Cocoa Isles/Capri Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF119O	Cocoa Isles/Capri Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF127O	Cocoa Isles/Capri Canal	Moderately Poor	Commercial	Commercial debris and residential yard waste; limited retention/treatment
SF130O	Cocoa Isles/Capri Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF134O	Channel 200 near old spoil site	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF138O	Channel 200 near old spoil site	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF142O	Channel 200 near old spoil site	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF324O	Dempsey/Watts Canal	Poor	Commercial / Highway	Beach sand, highway R-O-W material; limited retention/treatment
SF334O	4th Street N. and Blakely Canal	Poor	Commercial / Highway	Beach sand, highway R-O-W material; limited retention/treatment
SF427O	Indian Creek/Azalea Canal	Moderately Poor	Commercial / Highway	Beach sand, highway R-O-W material; limited retention/treatment
SF429O	Indian Creek/Azalea Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF431O	Indian Creek/Azalea Canal	Moderately Poor	Residential / Highway	Receives runoff from Minuteman Cswy, residential yard waste; limited retention/treatment
SF433O	Indian Creek/Azalea Canal	Moderately Poor	Residential / Highway	Receives runoff from Minuteman Cswy, residential yard waste; limited retention/treatment
SF436O	Indian Creek/Azalea Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SF502O	Azalea/Bougainvillea Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SF505O	Azalea/Bougainvillea Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SF511O	Bougainvillea/Crystal Canal	Mildly Poor	Residential / Highway	Receives runoff from Minuteman Cswy, residential yard waste; limited retention/treatment
SF702O	Outfall at the terminus of Crystal River Dr.	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SF705O	Outfall at the terminus of Danube River Dr.	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SG078O	Sunset/Brevard Canal	Poor	Commercial / Highway	Receives runoff from A1A; limited retention/treatment
SG081O	Sunset/Brevard Canal	Poor	Commercial	Receives runoff from Brevard Avenue, commercial debris; limited retention/treatment
SG084O	Outfall at the terminus of Sunset Dr.	Poor	Residential	Receives runoff from AIA and Minuteman, commercial debris; limited retention/treatment
SG132O	Sunset/Brevard Canal	Poor	Commercial / Highway	Receives runoff from A1A; limited retention/treatment
SG133O	Sunset/Brevard Canal	Poor	Commercial	Receives runoff from Brevard Avenue, commercial debris; limited retention/treatment
SG147O	Sunset/Brevard Canal	Poor	Commercial	Receives runoff from Brevard Avenue, commercial debris; limited retention/treatment
SG203O	Aucila/Sunset Canal	Poor	Residential / Highway	Receives runoff from Minuteman Causeway, residential yard waste; limited retention/treatment
SG206O	Aucila/Sunset Canal	Poor	Residential / Highway	Receives runoff from Minuteman Causeway, residential yard waste; limited retention/treatment
SG209O	Aucila/Sunset Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SG212O	Aucila/Sunset Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SG215O	Aucila/Sunset Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SG222O	Outfall at the terminus of Colonial Dr.	Poor	Residential	Residential debris and yard waste, no retention/treatment
SG224O	Outfall near the terminus of Colonial Dr.	Poor	Residential	Residential debris and yard waste, no retention/treatment
SG302O	Boca Ciega/Aucila Canal	Moderately Poor	Residential / Highway	Receives runoff from Minuteman Causeway, residential yard waste; limited retention/treatment
SG305O	Boca Ciega/Aucila Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SG308O	Rose/Riverview Canal	Poor	Residential	Residential debris and yard waste, no retention/treatment
SG313O	Riverview/Westview Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SG038O	Sunset/Brevard Canal	Poor	Commercial	Receives runoff from A1A; limited retention/treatment
SG402O	Chipola/Boca Ciega Canal	Moderately Poor	Residential / Highway	Receives runoff from Minuteman Causeway, residential yard waste; limited retention/treatment

TABLE 4.1
WATER QUALITY PROBLEM AREA EVALUATION
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA

Outfall # / Problem I.D.	Problem/Canal Location	Water Quality Classification *	Predominant Land Use	Problem Cause
SG405O	Chipola/Boca Ciega Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SG408O	Rose/Riverview Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SG411O	Riverview/Westview Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SG414O	Riverview/Westview Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SG505O	DeLeon/Chipola Canal	Moderately Poor	Residential / Highway	Receives runoff from Minuteman Causeway, residential yard waste; limited retention/treatment
SG508O	DeLeon/Chipola Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SG510O	Outfall at the terminus of DeLeon Rd.	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SG512O	Outfall at the terminus of Yachthaven Dr.	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SG517O	Westview/Yachthaven Canal	Moderately Poor	Residential	Residential debris and yard waste, no retention/treatment
SG603O	LaRiviera/DeLeon Canal	Mildly Poor	Residential / Highway	Receives runoff from Minuteman Causeway, residential yard waste; limited retention/treatment
SG605O	Outfall at the terminus of LaRiviera Rd.	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SG702O	Yawl/Sloop Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SG705O	Yawl/Sloop Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SG707O	Yawl/Sloop Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SG711O	Yawl/Sloop Canal	Mildly Poor	Residential	Residential debris and yard waste, no retention/treatment
SG803O	LaRiviera/Thousand Islands	Mildly Poor	Residential / Highway	Residential debris and yard wastes; limited retention/treatment prior to discharge
SG903O	Outfall south of the intersection of Minutemen Cswy. and Danube River Dr.	No Data	Residential / Highway	Evaluate collection of surface water sample(s)
SH072O	Outfall west of the intersection of S. Brevard Ave. and 8th St. S.	No Data	Commercial / Highway	Evaluate collection of surface water sample(s)
SH103O	Outfall west of Harbor Circle	No Data	Residential	Evaluate collection of surface water sample(s)
SH202O	Outfall southwest of the intersection of S. Brevard Ave. and 11th St. S.	No Data	Residential	Evaluate collection of surface water sample(s)
Bayshore / Indian Village	Bayshore/Indian Village Canal	Poor	Residential / Highway	Receives runoff from A1A, residential yard waste; limited retention/treatment
SI102O	Thousand Islands near CM335	Mildly Poor	Highway	Limited retention/treatment prior to discharge
SI104O	Outfall north of Minutemen Cswy and approximately 1000 ft east of the intersection of Minutemen Cswy and Tom Warriner Blvd.	No Data	Highway	Evaluate collection of surface water sample(s)
SI107O	Outfall north of Minutemen Cswy and approximately 750 ft east of the intersection of Minutemen Cswy and Tom Warriner Blvd.	No Data	Highway	Evaluate collection of surface water sample(s)
SI207O	Outfall northeast of the intersection of Minutemen Cswy and Tom Warriner Blvd.	No Data	Commercial / Highway	Evaluate collection of surface water sample(s)
SI305O	Outfall north of Fairway Rd.; discharges to Municipal Golf Course	No Data	Residential	Evaluate collection of surface water sample(s)
SI308O	Outfall north of Fairway Rd.; discharges to Municipal Golf Course	No Data	Residential	Evaluate collection of surface water sample(s)
SI310O	Outfall at the terminus of Fairway Rd.; discharges to Municipal Golf Course	No Data	Residential	Evaluate collection of surface water sample(s)
SI405O	Outfall near the intersection of Minutemen Cswy and Country Club Rd.	No Data	Residential	Evaluate collection of surface water sample(s)
SI409O	Outfall north of Country Club Rd.	No Data	Residential	Evaluate collection of surface water sample(s)
SI412O	Outfall north of Country Club Rd.	No Data	Residential	Evaluate collection of surface water sample(s)
SI502O	Outfall at the terminus of Willowgreen Dr.	Moderately Poor	Residential	Residential debris and yard waste, limited retention/treatment
SI507O	Willowgreen/Country Club Canal	Moderately Poor	Residential	Residential debris and yard waste, limited retention/treatment
SI509O	Willowgreen/Country Club Canal	Moderately Poor	Residential	Residential debris and yard waste, limited retention/treatment
City Complex	Canal south of Municipal Public Works and WWTP	Mildly Poor	Commercial	Commercial debris and wastes, limited retention/treatment

Notes:
Refer to Water Quality Figure for problem identification and physical location
CM - Channel Marker
No Data - No water quality data available for outfall

*** Water Quality Classificatins:**

	Turbidity (NTU)	Secchi depth (ft)
Poor	>9	<2.5
Moderately Poor	5.1 - 9.0	2.6 - 3.9
Mildly Poor	5.0 - 3.0	4.0

4.2.4 Previous Studies

A previous effort at classifying the extent of sediment and nutrients loading on portions of the Cocoa Beach watershed was made by Dr. Ashok Pandit, Associate Professor at Florida Institute of Technology. In a study titled "Cocoa Beach Watershed Modeling Study; Assessment of Annual Pollutant Loads," a minor medium density residential watershed, LaRiviera, and a major mixed land use watershed, Northshore were studied. The study quantified annual pollutant loadings using both a simple calculation method and a continuous simulation method during wet and dry periods. The calculation methods utilized site-specific pollutant event mean concentration (EMC) data based on actual outfall storm event sampling data.

Annual loading results for selected pollutants with associated EMCs from the study (wet period) are described in the following table:

Table 4-2

Pandit Study Total Annual Loading and EMC Summary

	LaRiviera (Drainage Area = 2.88 ac)			Northshore (Drainage Area = 44.50 ac)		
Parameter	**Simple Method Annual Load (lbs.)**	**Continuous Method Annual Load (lbs.)**	**Average EMC (mg/L)**	**Simple Method Annual Load (lbs.)**	**Continuous Method Annual Load (lbs.)**	**Average EMC (mg/L)**
TSS	892	562	41.6	2864	2448	21.3
TN	39	25	2.3	473	404	1.83
TP	8	5	0.45	49	42	0.19

The study indicated pollutant loads evident in the City's stormwater discharges. These outfalls are considered fairly representative of other outfalls throughout the City. Of interest is the higher relative EMCs for the residential area relative to the mixed land use area. This may be a function of the longer flow runs in the mixed land use system providing more of an opportunity for treatment and flushing relative to the small residential area. The EMC values derived by the study were evaluated for use in the water quality pollutant loading assessment discussed in the Section 4.4.2. Because of the limited study areas and variance in sub-basin delineations, annual rainfall amounts, land use areas, and pollutant load calculation methods, the results of the Pandit study are not directly relatable to the pollutant loading analysis performed in this Master Plan.

4.2.5 Water Quality Summary and Goals

Based on the foregoing, the regulatory process and procedures are well underway by the State for addressing water quality in the IRL that will impact the City of Cocoa Beach. It must be kept in mind that these processes and procedures are still interim as of the time of this Master Plan preparation. Nevertheless, these methods should provide for the development of justifiable targets for use in guiding the City's Stormwater Utility until the final regulations are completed. The following subsections detail the pollutant load estimation process for the constituents deemed important to Cocoa Beach's water quality and discusses the development of a site specific PLRG based water quality LOS assessment procedure.

4.3 COCOA BEACH'S PLRG - BASED LOS DEVELOPMENT PROCESS

The main goal of Cocoa Beach's Stormwater Master Plan is to develop a cost-effective, benefit-maximized CIP to address flooding and water quality problems and/or deficiencies. The traditional manner in which the magnitude of current problems or deficiencies is measured is through comparison to *level of service* (LOS) criteria. The success of a CIP in addressing problems can then be measured through relative improvements in LOS subsequent to project implementation. These projects are in the form of engineered or non-engineered *best management practices* (BMPs).

Flooding problems are typically easy to quantify and prioritize with established level of service (LOS) criteria such as "arterial roads should not flood during storms of equal to or less than the 25 year return period", etc. LOS criteria to address the current state of water quality is more difficult to define as water quality impacts can be subtle and less obvious. Typically, attempts are made to tie water quality LOS criteria to site specific environmental impacts or numerical standards. Verification of improvement in water quality LOS can be subjective and expensive to monitor, particularly when expansive surface and stormwater sampling programs are involved.

The PLRG development process undertaken for the IRL by SJRWMD provides an excellent framework to develop Cocoa Beach specific pollutant reduction targets for water quality improvement. Through the use of historical, current, and hypothetical future case pollutant load case comparisons, reasonable goals can be established which are tied to technically feasible water quality improvement BMP projects. This process can also provide a gauge for evaluating LOS for the current water quality condition and evaluating the effectiveness of future CIP project implementation.

The generalized PLRG process in use by SJRWMD in the IRL was used as a guideline in the development of Cocoa Beach's water quality improvement goals, with the incorporation of site specific considerations unique to City and its location in the IRL. The PLRG development process developed for the water quality assessment portion of Cocoa Beach's Stormwater Master Plan consists of the following main components:

1. *Establish stormwater pollutants of concern through regulatory requirements, research, and available water quality data;*

2. *Establish a baseline water quality target based on a historical "pristine" condition (e.g., 1943 seagrass coverage in IRL and pollutant loads);*

3. *Estimate current pollutant loadings that most accurately represent existing conditions (pollutant loadings based on current land use and BMPs);*

4. *Compare existing pollutant loads to historical loads to form a provisional PLRG which would, if met, presume acceptable water quality conditions have been restored;*

5. *Evaluate feasibility of provisional PLRG as a tool for developing and evaluating LOS of CIP program for water quality improvement given site specific constraints;*

6. *Determine a theoretical, best possible pollutant reduction case based on the technology available (pollutant loadings based on implementation of all technically feasible water quality control measures);*

7. *Compare technically feasible pollutant loads to existing loads to form a technically achievable PLRG (TAPLRG) which would, if met, would represent a realistic, best good faith effort towards restoring an acceptable water quality conditions;*

8. *Establish a water quality benefit maximized program of engineering projects (CIP) to meet appropriate PLRG.*

9. *Evaluate current and progressive water quality LOS based on incremental implementation of CIP projects.*

This PLRG development process is shown on the flow chart on Figure 4.3. Further details of relationship between the various pollutant loading cases and PLRGs are shown in Figure 4.4. Also, shown on Figure 4.4 is the LOS relationship developed in reference to the TAPLRG and the CIP implementation. The LOS evaluation process is further detailed on the hypothetical LOS matrix provided as Figure 4.5.

As shown in the figures, the PLRG development and integrated LOS evaluation developed under the Master Plan provides both a focused goal on which to target the CIP, and also viable LOS criteria on which to measure the CIP's success. Additional details on the process are discussed in the following subsections.

4.3.1 Pollutant Loading Cases

Once pollutants of concern are established (see Section 4.4.1), estimates of pollutant loadings are made (see section 4.4.3). This is a multi-step process involving not only the traditional estimate of current pollutant loadings, but also the estimation of a historical baseline and hypothetical future pollutant loading cases for comparison and from which to develop reasonable reduction goals. The various pollutant loading cases utilized are described in the following subsections.

4.3.1.1 1943

Calculated pollutant loadings based on 1943 land use data provided by SJRWMD. Represents historical point in time with "pristine" water quality condition exhibiting an acceptable level of seagrass coverage.

4.3.1.2 Existing

The existing pollutant loads are calculated based on the current land use present in the City. The existing case does not incorporate any BMPs or other water quality practices that may exist in the City, so it is directly comparable to the 1943 case from a calculation standpoint. There are two cases which represent existing conditions as follows:

- EXISTING BASELINE: Calculated pollutant loadings based on current City land use. Represents raw pollutant loadings without incorporating BMPs or other pollutant reduction measures that currently exist.

- EXISTING AREA WEIGHTED: The comparison of calculated pollutant loads from the existing baseline case to 1943 is complicated by the fact that a large portion of the current land area was not present in 1943, being created by dredge and fill operations and beach restoration projects over the last 50 years. This difference in overall land area (~53%) is depicted on the land use comparison on Figure 4.6 (reproduced from the land use figures in section 2). Given this condition, it was considered politically insensitive to penalize the current state of the land area of the City. In this regard, it was considered appropriate to apply an area-weighting factor to the *EXISTING BASELINE* case pollutant loads to account for this significant land area difference. In the case of Cocoa Beach, subbasin area weighting factors were applied to those subbasins that were all or in some portion open water or tidal marsh (i.e., no effective runoff) in 1943. This comparative case is calculated by subtracting the relative portion of pollutant load (subbasin by subbasin) from currently existing land areas that were not present in 1943. This case was included to highlight the impacts to pollutant loadings based on the increased land area between 1943 and present. This case was not used in any of the other pollutant load comparisons or PLRG development.

4.3.1.3 EXISTING BMP

This case represents a true existing case wherein the *EXISTING BASELINE* case pollutant loadings are modified to incorporate existing BMPs and reduction measures that are currently present or in action in the City. This case is considered representative of current conditions of City, and the load levels from which pollutant reductions would start.

4.3.1.4 FULL BMP

This case represents the *EXISTING BMP* case modified to include pollutant load reduction effects from implementation of all technically feasible BMPs. That is, all BMPs that could feasibly be implemented given unlimited money and time, but with respect to public and political considerations such as land availability and regulatory constraints. The BMPs include both capital projects (projects that could be implemented under a CIP) and non-capital projects where implementation would be the responsibility of entities other than the City's Stormwater Utility (other City departments, FDOT, County, etc.).

4.3.1.5 CIP BMP

Represents the *FULL BMP* case modified to account for pollutant load reduction expected with actual projects recommended in the CIP.

4.3.2 Pollutant Load Reduction Goals

The Cocoa Beach specific PLRGs were developed to provide targets to direct the City towards regulatory compliance and also to provide a framework for current and further water quality LOS assessment. The PLRGs developed are described in the following subsections along with their relationship to the pollutant loading cases described above.

4.3.2.1 Provisional Pollutant Load Reduction Goals (PPLRG)

The *Provisional PLRG* represents reduction goal that would theoretically return water quality conditions to a 1943 equivalent with regard to seagrass sustainability. If pollutant loads were reduced in accordance with the *PPLRGs*, a *presumed* regulatory compliance would exist with the understanding that the City would have met water quality goals. BMP projects would be implemented under a CIP to reduce existing pollutant loads (*EXISTING BMP* case) to the 1943 case levels. In general, this target may or may not be realistic given site specific conditions and constraints. In the case of Cocoa Beach, land area changes and BMP implementation constraints make this PLRG unrealistic.

4.3.2.2 Technically Achievable Pollutant Reduction Goals (TAPLRG)

The PPLRG would generally be considered sufficient for most municipalities on which to establish a reasonable scope and schedule for the implementation of a CIP. This appears unrealistic for Cocoa Beach, however, as many areas had very little development and relatively minimal pollutant impacts to the IRL in the 1943 timeframe. This results in upwards of 85-90%+ differences in annual pollutant load reductions as "Provisional Targets". Given this, a more realistic approach is to consider evaluation of a target PLRG not simply based on a calculated PPLRG but also on a target goal based on technological factors and site specific constraints. In other words, determine what pollutant load reduction could realistically be achieved given the current physical and economic characteristics and constraints of the municipality.

The *Technically Achievable PLRG* represents reduction goal to a realistic, technically feasible water quality condition. This goal first looks at what could possibly be done with regard to BMP project implementation (*FULL BMP* case) as a realistic target to reduce pollutant loading from the existing conditions (*EXISTING BMP* case). As this TAPLRG is tied to technology-based criteria, it would be of particular benefit in establishing actual reduction targets and evaluation procedures used in the development of a CIP.

The pollutant loading endpoints of this reduction goal provide reasonable LOS bounds that can be applied to rate the progressive effectiveness of CIP project implementation. This can occur as a long-range project implementation approach or as a stepped approach implemented in smaller time increments. In either case, the implementers would have defined interim goals through which to evaluate progress. This would in effect represent a "due diligent" effort in meeting the intent of the upcoming regulations while they are still being defined.

Meeting this target would not be a *presumed* regulatory compliance for pollutant load reductions, but would be considered the best good-faith efforts towards meeting water quality regulations. Since much of the underlying theory behind this PLRG is consistent with current SJRWMD pollutant loading assessment practices, this PLRG may ultimately be sufficient to meet the intent of upcoming regulations.

4.3.3 Water Quality LOS

The City of Cocoa Beach Stormwater Utility has taken a responsible position in planning, design, construction and maintenance of stormwater facilities and infrastructure for protection of water quality within the Banana River. The ultimate goal of this process is to attain fishable and swimmable waters. The City's Comprehensive plan requires that the Cocoa Beach Stormwater Utility establish and maintain a Level of Service (LOS) in water quality to achieve measurable improvements with projects identified in the CIP. For the City

of Cocoa Beach, the Level of Service for water quality is linked to the implementation of a definable set of BMP's to achieve compliance with pollutant load reduction goals that are in the process of being established by the SJRWMD.

The PLRG framework lends itself to establishing water quality LOS criteria. The current LOS is defined in reference to historical and technically achievable conditions to which the existing water quality condition can be compared. Using the TAPLRG, a target is set up to which future water quality improvements can be compared to evaluate LOS improvements. In this way, the CIP's success can be measured in tangible terms to provide a sense of comfort that actual progress is being made towards water quality regulatory compliance. The improvements in LOS can easily be tracked by year and/or project utilizing a LOS matrix such as shown on Figure 4.5.

Because of this requirement, the LOS for Cocoa Beach has been defined based on the goal of achieving technically achievable pollutant load goals using best available technologies to reduce total suspended solids as the key pollutant of concern..

The various Levels of Service for Cocoa Beach have been established as quantifiable goals in TSS reduction as follows:

Level of Service A: This goal is defined as implementation of a set of best management practices, which represents the *EXISTING BMP* case modified to include pollutant load reduction effects from implementation of all technically feasible BMPs to reduce TSS pollutant loadings 95 percent or higher from the current condition.

Level of Service B: This goal is defined as implementation of a set of best management practices, which represents the *FULL BMP* case modified to account for pollutant load reduction expected with actual projects recommended in the CIP to reduce TSS pollutant loadings 85 to 95 percent from the current condition. This case is representative of the realistic target goal of the City. Based upon the best available technologies and the costs known for the various BMPs, the program is realistically achievable with the implementation of the full CIP.

Level of Service C: This goal is defined as implementation of a set of best management practices, which represents the *FULL BMP* case modified to account for pollutant load reduction expected with most of the actual projects recommended in the CIP to reduce TSS pollutant loadings 65 to 85 percent from the current condition. The difference in this case to a Level of Service "B" is directly related to the difference in implementing the Full CIP versus some program in which less than the full CIP is implemented. The large range in this program is due to the wide range of projects in the CIP.

Level of Service D: This goal is defined as implementation of a set of best management practices, which represents a true existing case wherein the *EXISTING BASELINE* case pollutant loadings are modified to incorporate existing BMPs and reduction measures that are currently present or in action in the City. This case is considered representative of current conditions of City, and the load levels from which pollutant reductions would start to reduce TSS pollutant loadings 40 to 65 percent from the current condition. The Cocoa Beach Stormwater Utility has implemented BMP's which include trash traps, street sweeping and various other sediment control measures that has reduced pollutant loading from the base loading of TSS pollutants by 60 percent. The current

condition of service is considered Level of Service "D" and represents a below average practice of maintaining surface water quality.

Level of Service F: This level is defined as implementation of a set of best management practices that would only reduce TSS pollutant loadings 0 to 40 percent from the current condition.

The City of Cocoa Beach Stormwater Utility has taken a responsible position in planning, design, construction and maintenance of BMP stormwater facilities and infrastructure for protection of water quality within the Banana River. These BMP's currently include stormwater retention/detention, swales, maintained canals, and street sweeping. With the existing BMP's in place, TSS loadings are estimated to be reduced from 217,800 lbs per year to less than 60,000 lbs per year (about 73 percent reduction). With the implementation of new stormwater BMP's identified in the CIP there will be additional measurable improvements in water quality as a result of further reductions in TSS.

The City's Comprehensive plan requires that the Cocoa Beach Stormwater Utility establish and maintain a Level of Service in water quality that will meet provide a measurable standard towards meeting state water quality regulations. For the City of Cocoa Beach, the Level of Service for water quality is linked to the TSS loading goals and for the City, TSS has been determined to be the measurable standard.

Although a provisional PLRG has been established by the SJRWMD, no defined standard value has been determined for TSS loading. The goal of the City's BMP projects must be focused on meeting achievable goals and this is based on implementation of the full BMP. Therefore, this goal has been established as the standard to measure progress.

Application of this standard defines measurable pollutant load reduction goals that are linked to the standard as follows:

$$\text{Level of Service} = \frac{\text{Annual TSS Loading of Full BMP}}{\text{TSS Loading with BMP}} = \text{Std of Measure to Full BMP}$$

According to this standard, Table 4.3 provides achievable and quantifiable reduction goals for TSS.

Table 4.3
Level of Service Goals

Level of Service	Standard of Measure to Full BMP Case	TSS Range (lbs/year)	
A	0.950 to 1.000	33,257	SJRWMD PLRG
B	0.850 to 0.949	37,170	33,256
C	0.650 to 0.849	48,606	37,169
D	0.400 to 0.649	78,985	48,605
F	0.000 to 0.399	217,824	78,984

Based on this analysis, the City currently provides a Level of Service "D" with regards to water quality; however, implementation of all projects in the City CIP will result in meeting a LOS B.

The level of service schedule was established to be similar to a typical "education" system "grading scale" (ie: A, B, C, D, and F). This structure was set up as a means for the general public to better relate to the assessed performance of the overall stormwater program. However, the standard grading "scale" (ie: A= 90 to 100, B= 80 to 90, etc..) for a typical school systems is far too skewed. In that it is far too weighted for lower grades. For example, in school if a score of 59 or lower is achieved, the student is given a grade of "F". However, in the case of performance for stormwater issues, the City could be expending large amounts of funds and still only achieving a Level of Service grade "F". For example, the City is currently removing 58 percent of the estimated annual pollutant loads. This is being accomplished by the implementation of many BMPs around the City. However, on a typical grading scale, a 58 percent would be an "F". Since, as stated, the City has implemented many BMPs, a failing grade was not justified. Therefore, the numerical grading scale was modified to better reflect the effort currently being expended and the level of effort needed to achieve an "A".

Therefore, the "Grading" scale was balanced to give more credit for doing something (implementing BMPs). The letter grades are still indicative of the performance one would normally associate with that letter grade. In order to achieve a score of an "A", the City will be required to expend the necessary funds to attain the ultimate goal. This will encourage the City to allocate the appropriate funds and manpower to accomplish better grades. Thus, raising the chin bar in an effort to achieve its true goals. As noted, the City will in essence have to spend funds above and beyond the CIP to achieve a Level of Service grade "A".

4.3.4 Regulatory Compliance

Although the use of this methodology cannot provide a guarantee of compliance with the TMDL regulations when they are implemented, it does provide a level of comfort that the municipality is putting forth the best "good faith" effort towards meeting these goals. This is particularly important when considering some the unique constraining characteristics the City of Cocoa Beach has. These constraints include the land area in the City being essentially "built-out" with little room for land acquisition for BMPs. Also, the City having such a significant difference in land area between the current and historical (provisional goal) case is a constraint with respect to interim PLRGs development based on the processes discussed above.

In most cases, the SJRWMD expects that municipalities following procedures such as what is outlined herein will put themselves in a position for compliance with the TMDL regulations. In some case it is expected that municipalities may even be in the comfortable position of ramping down project effort by the time the final regulations are established. At the very least, SJRWMD feels that will be a significant step in the right direction towards compliance that the municipality will be in a good position to meet the regulation in the short-term future as compared to municipalities that have not been as proactive.

FIGURE 4.3
POLLUTANT LOAD REDUCTION GOAL DEVELOPMENT PROCESS FLOW CHART
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA

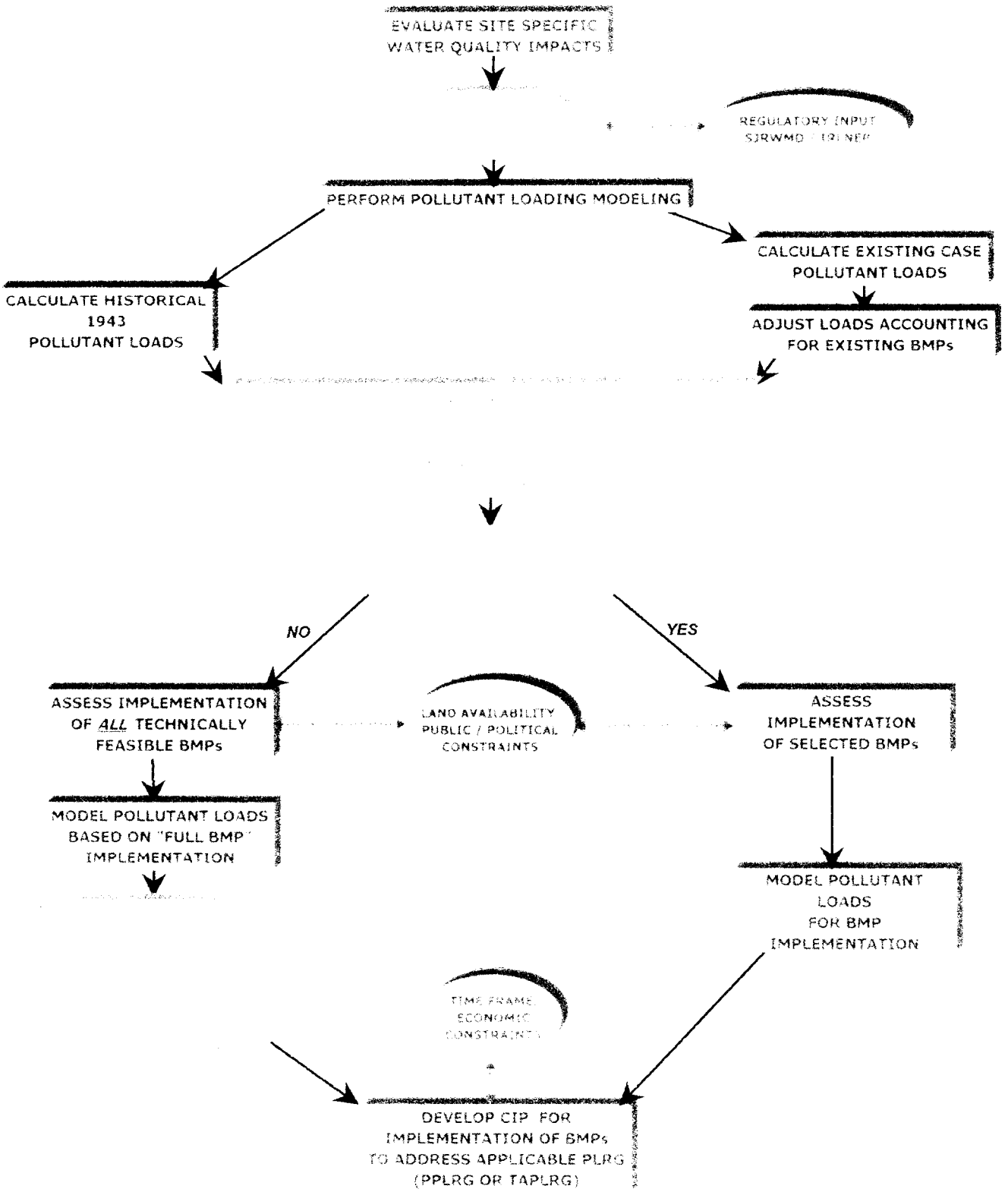


FIGURE 4-4
POLLUTANT LOADING CASE AND PLRG RELATIONSHIP
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA

POLLUTANT LOADING CASES		
PRIMARY POLLUTANT LOADING CASE	SECONDARY LOADING CASE FOR COMPARATIVE PURPOSES	DESCRIPTION
1943		Calculated pollutant loadings based on 1943 land use provided by SJRWMD. Represents historical "pristine" water quality condition with acceptable level of seagrass coverage. Unmodified model output.
EXISTING	EXISTING BASELINE	Calculated pollutant loadings based on current City land use. Represents raw pollutant loadings *without* incorporating BMPs or other pollutant reduction measures that currently exist.
	EXISTING AREA WEIGHTED	Comparative case calculated by subtracting the portion of pollutant load (subbasin by subbasin) from currently existing land areas that were not present in 1943. Provided to highlight the impacts of the increased land area only, not used in other cases.
EXISTING BMP		Existing Baseline case with existing BMPs and reduction measures incorporated to adjust pollutant loading values. This case is considered representative of current conditions of City - the point from which pollutant reductions would start. Does not include area weighting.
FULL BMP		Represents Existing BMP case modified to include pollutant load reduction effects from implementation of all technically feasible (non cost and time limited) BMPs.
CIP BMP		Represents the Existing BMP case modified to account for pollutant load reduction expected with projects recommended in the CIP and not including non-capital BMPs recommended as enhancements.

POLLUTANT LOAD REDUCTION GOALS	
PLRG	DESCRIPTION
	Represents reduction goal that would theoretically return conditions to a 1943 equivalent with regard to seagrass sustainability. If pollutant loads were reduced in accordance with the PPLRGs, a presumed regulatory compliance would exist. Given land area changes and BMP implementation constraints, this case may be unrealistic for Cocoa Beach.
[illegible]	Represents reduction goal from existing pollutant loadings to a realistic technically feasible condition. Provides reasonable "Level of Service" bounds that can be applied to rate the PROGRESSIVE effectiveness of CIP project implementation.

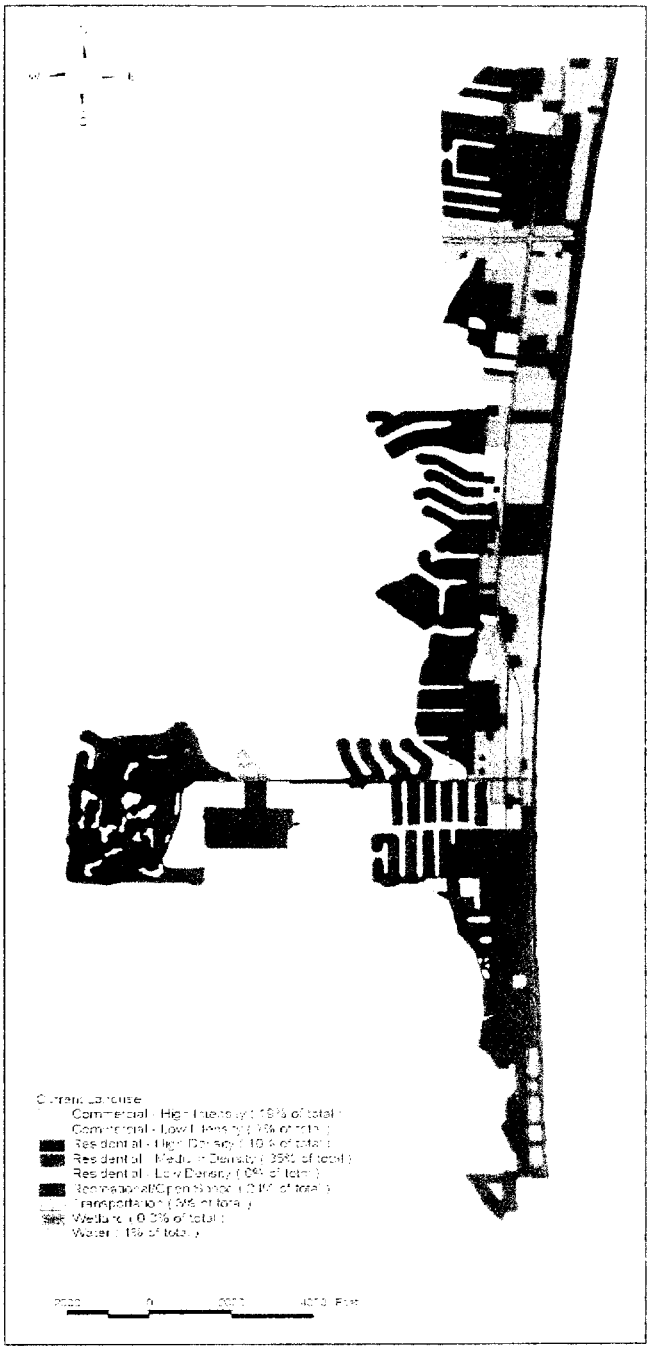
LOS

Project(s) to be implemented through CIP - check each through LOS

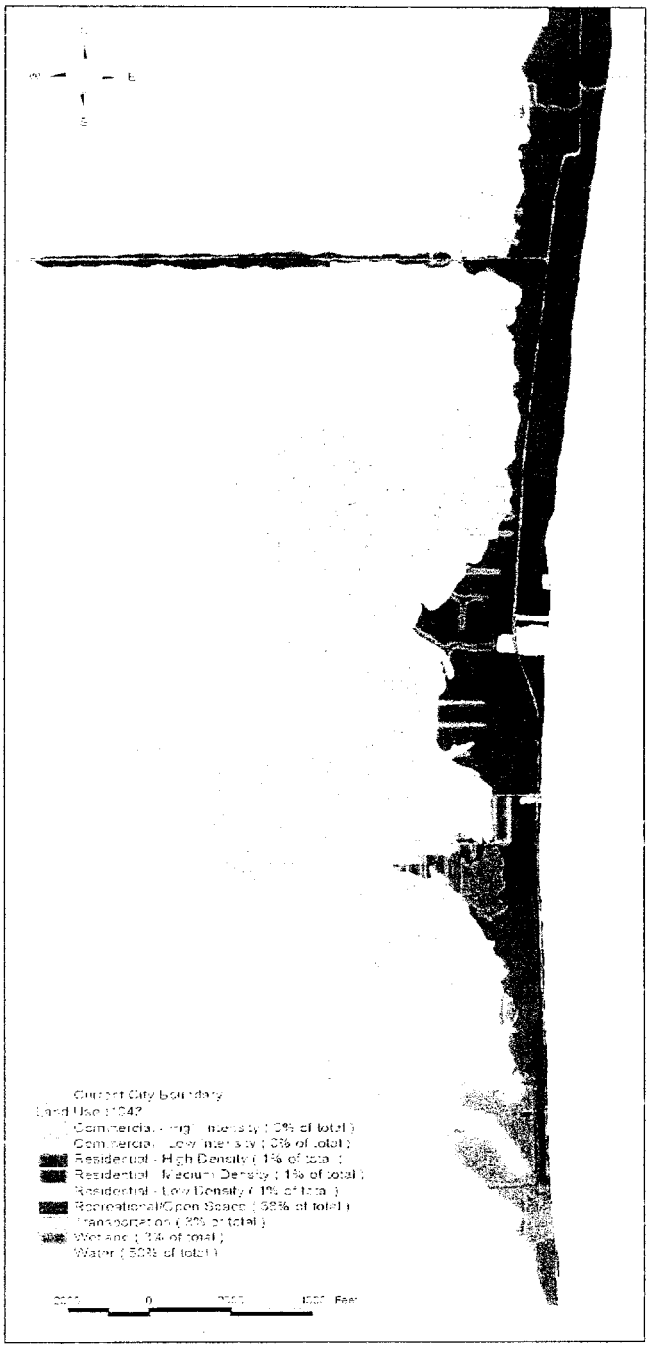
FIGURE 4.5
CONCEPTUAL WATER QUALITY LEVEL OF SERVICE MATRIX
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA

POLLUTANT LOADING CALCULATION CASE		TSS		FRESHWATER		TN		TP	
		Annual Total (lbs/yr)	Reduction (lbs/yr)	Annual Total (MGal/yr)	Reduction (MGal/yr)	Annual Total (lbs/yr)	Reduction (lbs/yr)	Annual Total (lbs/yr)	Reduction (lbs/yr)
EXISTING BASELINE CASE		XXXXXX		XXX		XXXX		XXXX	
EXISTING BMP CASE		XXXXXX	0%	XXX	0%	XXXX	0%	XXX	0%
5 YEAR CIP PROJECT IMPLEMENTATION	Project 1		XX		XX		XX		XX
	Project 2		XX		XX		XX		XX
	2002 PROGRESS	XXXXXX	%	XXX	%	XXXX	%	XXX	%
	Project 3		XX		XX		XX		XX
	Project 4		XX		XX		XX		XX
	2003 PROGRESS	XXXXXX	%	XXX	%	XXXX	%	XXX	%
	Project 5		XX		XX		XX		XX
	Project 6		XX		XX		XX		XX
	2004 PROGRESS	XXXXXX	%	XXX	%	XXXX	%	XXX	%
	Project 7		XX		XX		XX		XX
	Project 8		XX		XX		XX		XX
	2005 PROGRESS	XXXXXX	%	XXX	%	XXXX	%	XXX	%
	Project 9		XX		XX		XX		XX
	Project 10		XX		XX		XX		XX
	2006 (after 5-Year CIP)	XXXXXX	%	XXX	%	XXXX	%	XXX	%
FULL BMP CASE		XXXXXX	100%	XXX	100%	XXXX	100%	XXX	100%
1943 CASE		XXXX		XX		XXX		XX	

FIGURE 4.6
LAND USE COMPARISON
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA



CURRENT LAND USE



1943 LAND USE

4.4 POLLUTANT LOADING ANALYSIS

The goal this Master Plan with respect to water quality is to provide a plan of action for implementing planning and corrective measures for addressing water quality to not only meet upcoming regulations but to provide a better quality of life for the City's population. In order to define water quality goals, a quantification of pollutant loads is necessary. Typically, current pollutant loadings are calculated and compared to some historical baseline and a future case scenario to account for the effects of development. The historical case is important for establishing a baseline or pristine condition to which to evaluate the degree of degradation the current case represents. Evaluation of a future case scenario is important in developing various BMPs and engineering controls to address increasing pollutant loads.

The City of Cocoa Beach presents an unusual case in that the City is essentially built out from a land development standpoint. As a result, there would not be any expected significant change in land use in the foreseeable future. With respect to water quality, this infers that it would be expected that there would not be any significant increase or change in pollutant loadings from the City in the foreseeable future as compared to the present. As such, attention to a distinct future case pollutant loading scenario is considered unwarranted under the scope of this Master Plan. Accordingly, the focus of this Master Plan is limited to quantifying pollutant loads in the current case with comparison to a historical condition only. The methodology for the calculation of pollutant loadings and the estimation of pollutant load reduction goals is presented in the following subsections.

The first step in the process is to determine what pollutants are of concern based on what is known of the water quality in the vicinity of the City. From there, current pollutant loadings must be defined and calculated in order to determine the City's current level of service for water quality with respect to a baseline or historical condition. Once the current service level is established, realistic pollutant load reduction goals can be developed as described in Section 4.3 to which a specific improvement program (i.e., CIP, regulatory, maintenance) can be tailored.

4.4.1 POLLUTANTS OF CONCERN

An important aspect of this Master Plan is the characterization of water quality. Although many different constituents are found in stormwater, the following parameters are the most common pollutants and generally are assessed:

- Suspended solids (sediments);
- Nutrients (e.g, nitrogen and phosphorus);
- Heavy metals (e.g., lead and zinc);
- Oxygen demanding substances (i.e., BOD);
- Oils, greases, and hydrocarbons; and
- Pathogens

Based on the water quality discussion in Section 4.2, the primary constituents of concern with respect to non-point source impacts from Cocoa Beach to the IRL are freshwater inputs and TSS from stormwater runoff. Of secondary significance are concerns from TN and TP impacts from stormwater runoff. The other parameters have not been identified as a significant enough regulatory concern to warrant focused pollutant loading assessment

under this Master Plan. Origins and sources of freshwater, TSS, TN, and TP are discussed in more detail in the flowing subsections.

4.4.1.1 Forms and Sources of Freshwater

Contributions of freshwater to a brackish, inter-coastal receiving water such as the Banana River can be considered from these sources: direct precipitation, groundwater inflow, wastewater treatment plant discharge, septic tanks, water-to-air AC system waste, and stormwater runoff. Effective management techniques can only be applied to the last three, of which stormwater and AC discharge is addressed in this Master Plan. Stormwater can be discharged via stream or canal flow, overland sheet flow (direct runoff to the lagoon), or through storm sewer outfalls. Cocoa Beach's discharges occur almost exclusively from storm sewer outfalls and overland flow.

The discharge of freshwater as stormwater runoff into the Banana River acts to impair the natural condition of the water body. As such, freshwater is considered a pollutant in this regard similar to TSS, TN, and TP. In contrast to the other pollutants, however, the freshwater can also be considered a resource that can be managed with some benefit to the City. These benefits can include groundwater recharge, inhibiting saltwater intrusion, reuse for irrigation, etc. As such, the successful management of stormwater discharges in Cocoa Beach would benefit not only lagoon water quality but could also provide a resource to be utilized in other ways.

4.4.1.2 Forms and Sources of TSS

Turbidity in surface water causes scattered and reflected light that inherently reduces visibility within the water column. Color is a function of organics and chlorophyll that results in the adsorption of light and loss of light penetration waters of the lagoon. The combined occurrence of color, suspended solids, chlorophyll a, and turbidity constitute *"optical constituents"* that can synergistically affect light attenuation and limit penetration in the water column. According to SJRWMD (Steward et al, 2001), turbidity followed by chlorophyll a are the primary "optical pollutants" affecting the light penetration to the seagrass in the Banana River segment adjacent to Cocoa Beach. Furthermore, these turbidity levels are considered to be largely dictated by total suspended solids (TSS), especially inorganic suspended solids (soils, muck-like material).

Sources of TSS in stormwater can be from numerous forms including sand/soil erosion, yard clippings, and trash. In Cocoa Beach, one of the most significant contributors is beach sand. In many areas where the sand dunes are not adequately vegetated, significant amount of sand is washed off or blown by the wind onto the nearby streets where it can wash off into the storm sewers. In the commercial areas of the City, TSS loadings can be caused by un-vegetated right-of-way, construction sites with earthwork/building/roadway materials, automotive shops, and other industrial sites. Residential areas are also significant contributors with large amounts of leaves, seeds, yard clippings, and other materials making their way into storm sewers, swales, and directly into the lagoon.

4.4.1.3 Forms and Sources of Nitrogen

The primary forms of nitrogen in the environment include the following: nitrogen gas (N_2); ammonium (NH_4^+)/ammonia (NH_3); nitrite (NO_2^-)/nitrate (NO_3^-); and organic nitrogen.

Total nitrogen refers to all forms of soluble and insoluble organic and inorganic nitrogen within the water column. Nitrogen undergoes transformation through the nitrogen cycle and can be stored in sediments, incorporated into biomass, and possibly released from sediment in soluble forms. In aquatic systems, soluble inorganic forms (nitrate and nitrite) are available for immediate algal or plant uptake and may govern the productivity of a waterbody at any given time.

Sources of nitrogen in stormwater runoff include pesticides and fertilizers, faulty or leaky septic tanks, animal wastes, detergents, leaves, grass clippings, domestic wastewater, and atmospheric deposition.

4.4.1.4 Forms and Sources of Phosphorus

Phosphorus in lakes can exist in various organic and inorganic forms including: dissolved species such as $H_2PO_4^-$, HPO_4^{2-}, and PO_4^{3-}; and as particulate/non-particulate organic and inorganic phosphorus. Similar to nitrogen, phosphorus undergoes biological, and chemical transformations within the aquatic system through the phosphorus cycle. Orthophosphate and related inorganic species are available for immediate plant uptake, and can govern productivity. Other organic and particulate forms of phosphorus represent sinks within the phosphorus cycle.

Sources of phosphorus in stormwater runoff may include pesticides and fertilizers, animal wastes, detergents, cleaners, leaves, grass clippings, faulty or leaky septic systems, phosphate detergents, and domestic wastewater.

4.4.2 Event Mean Concentrations

Pollutant calculations for TSS, TN, and TP were carried out using a computer model (assuming complete pollutant mass conservation) for the desired pollutant loading cases based on land use specific event mean concentration (EMC) data. The EMC concentrations (mass of pollutant per volume of stormwater) were continuously applied by land use in the pollutant model during each rainfall event. This results in pollutant specific mass loading values (pounds of pollutant per year) being generated on a subbasin-by-subbasin basis, which can then be summed by major basin and on a city-wide basis produce annual pollutant loading values. The pollutant loading model is discussed in further detail in the next subsection.

Event mean concentrations (EMCs) for the project were obtained from reference values published in the paper "Stormwater Loading Rate Parameters for Central and South Florida" (Harper, 1999) and from the Pandit study discussed in Section 4.2.4. The Harper values are widely used in the State of Florida, as they are the result of intensive research into numerous pollutant loading studies performed by various entities over the last decade. These values were developed with the intention that they be used for the estimation of annual pollutant loadings in master planning studies which rely on land use specific EMCs. They are often tuned to EMC values developed in site-specific studies such as the one performed by Pandit.

Table 4-4 lists the EMCs by land use type used in the pollutant modeling calculations in this Master Plan. These values were in most cases similar to values used by the SJRWMD in their studies of watersheds in the IRL vicinity.

TABLE 4-4
EMCs for TSS, TN, and TP Based on Land Use

Land Use	TSS (mg/L)	TN (mg/L)	TP (mg/L)
Commercial - High Intensity	94.3	2.8	0.43
Commercial - Low Intensity	81.0	1.2	0.15
Residential - High Density	71.7	2.4	0.49
Residential - Medium Density *	41.6	2.3	0.45
Residential - Low Density	19.1	1.8	0.18
Recreational/Open Space	11.1	1.3	0.05
Transportation	50.3	2.1	0.34
Water **	0	0	0
Wetland	10.2	1.6	0.19

* EMCs Derived from Pandit Study, all others from Harper.
** Zero values used to reflect Banana River area, other water area negligible.

All of the EMC values from the Harper reference were considered applicable for use used except for two categories: the "water" and "residential - medium density" land uses. For the "water" land use, all concentrations were assumed to be null as the water land use was essentially entirely made up of Banana River areas and associated marsh lands. These areas represent the target receiving water. Reference values for the "water" land use typically represent inland water bodies such as ponds, lakes, and detention/retention areas.

The "residential - medium density" land use EMC values from the Pandit study of the LaRiviera watershed (Section 4.2.4) were considered representative. This is due to the watershed being made up of one small, homogeneous residential subbasin. The EMCs for the mixed land use Northshore outfall from the Pandit study were not considered directly applicable as both the land area and distribution of land uses from the study differed from those used in the Master Plan. Because of these differing assumptions in land use characteristics, it was not possible to calibrate the composite EMC value to different land uses within the area contributing to the Northshore outfall.

The use of the reference EMC values is considered reasonable, but with an understanding of the inherent inaccuracies of reference EMC values. The reference values were compiled utilizing studies through out Central and South Florida. Although that would be considered directly applicable to Cocoa Beach from a climate standpoint, it is important to realize that differences in land uses may be significant, particularly when comparing values that may weigh heavily towards inland areas rather that coastal communities. Actual variation between pollutant runoff concentrations may be significantly varied even between similar land uses. For example, TSS loads may be significantly higher and nutrient concentrations lower in a high-density commercial area near a coastal beach when compared to a similar commercial area inland within a primarily agricultural community. With this qualification in mind, the loading values produced through the application of these EMCs should be considered for project planning purposes and evaluation of gross effects of land use change. They would not be expected to accurately predict actual runoff concentrations without some further refinement such as performed in the Pandit study.

4.4.3 Pollutant Loading Model Description and Methodology

Utilizing the watershed data acquired through the Stormwater Master Plan, the computer program Visual SWMM was used to continuously simulate stormwater runoff from the project area. Visual SWMM uses the Runoff block from a modified EPA SWMM version 4.3 engine to perform hydrological and runoff estimations. The only data difference between the current and 1943 cases within the model calculations was the actual land uses themselves, along with associated impervious area assumptions. The same rainfall, evaporation, soils and associated infiltration data was used for both cases to allow for a focused comparison of pollutant loadings based strictly on land use. The end result was the generation of pollutant load data for each case that was considered to represent only the impacts of the change in development from 1943 to present, following the intent of the SJRWMD procedures.

Using the subbasin specific characteristics developed for the flooding assessment model, effective runoff "coefficients" for each subbasin were used to accurately estimate runoff volumes. This allowed individual pollutant loadings to be calculated for each modeled subbasin, which could then be summed on an outfall and total basin basis for comparison. The pollutant loads were calculated on a total mass basis for the current and 1943 land use cases utilizing published and site specific event mean concentration (EMC) data (described above). No routing related pollutant treatment, attenuation, or settling effects were considered initially. Once the initial pollutant load results were generated, the effects of BMPs were evaluated using spreadsheets as described in detail in the BMP Evaluation section of the Master Plan (Section 5).

Rainfall data is the single most important group of hydrological data required by SWMM to estimate stormwater runoff. As discussed in Section 2, rainfall data from the Melbourne airport was used for the continuous simulation used for estimation of annual pollutant loads. The use of an analytical model such as SWMM rather than a spreadsheet model is considered to allow for a more accurate representation of the effects of small storm events that normally may not generate any significant runoff but would register as rainfall with respect to an annual total. Incorporating the rainfall depth from these small storm events into the total used for pollutant load calculations can lead to overestimation of actual runoff and accordingly pollutant loads when using a simplified spreadsheet model. Evaporation was also used to renew surface depression storage and was also subtracted from rainfall during the simulation as described in Section 2. Actual rainfall and evaporation data was used for the years of 1990-1993, which were determined to be the most representative contiguous 4-year period in the last decade (fairly good distributions of small and large storm events with varying intensities). The annual loading results for each of these 4 years was then averaged on a model node by node basis to determine average annual loading values.

Using the project subbasin delineations and soils data, infiltration and runoff areas were input into the model. The Horton method of infiltration was used to support the continuous simulation, which uses a decay coefficient and a recharge factor to simulate the saturation and drying out of soils prior to, during, and between rainfall events. The infiltration parameters are discussed in detail in Section 3 with regard to the flooding model. Model parameters influenced by land use (impervious areas, depressional storage, etc.) were calculated separately for the current and 1943 land use cases as summarized in Section 3. A detailed tabular summary of all the pertinent land use, impervious area, and model parameter data is included in the Section 3 appendices.

4.5 POLLUTANT LOADING ASSESSMENT RESULTS

4.5.1 Existing and 1943 Cases

Using the pollutant loading calculation procedures discussed in the previous section, the *EXISTING BASELINE* and *1943* case annual pollutant loads were calculated by individual subbasin with the Visual SWMM model. For TSS, TN, and TP, loads were calculated on a pounds of pollutant per year basis. For freshwater, the runoff excess values per subbasin were calculated in cubic feet per year, then represented in terms of million gallons per year. These volumes both represent the "pollutant" aspect of the freshwater as a negative impact to the lagoon, but also a "resource" volume available for aquifer recharge or reuse. The *EXISTING AREA WEIGHTED* case was also calculated for each pollutant using subbasin specific area weighting factors applied to the *EXISTING BASELINE* case. For each pollutant, the individual subbasin totals were summed to provide basin totals and further summed to provide City-wide totals.

The results of the pollutant load modeling for the *1943, EXISTING BASELINE, and EXISTING AREA WEIGHTED* cases are included by subbasin in Appendix 4-A. The City-wide totals are summarized in Table 4-4 and shown on Figure 4-7. The pollutant modeling results for these cases are also shown by basin, model node, and outfall on the pollutant load distribution maps included as exhibits to this section.

These results indicate in excess of 90% reduction in TSS, TN, and TP loads would be necessary to meet the 1943 levels. The *EXISTING AREA WEIGHTED* case does provide some marginal reduction in these percentages but they still remain in excess of 90% in all cases. The primary benefit in considering the *EXISTING AREA WEIGHTED* case is with respect to the runoff volume comparison where a significant (~9%) difference is noted. This is attributable to the fact that the majority of the areas that existed in 1943 are now of commercial or high-density residential land use. These areas contribute more runoff in comparison with the recreational and medium density residential areas that make up much of the land area that was added since 1943.

4.5.2 EXISTING BMP and FULL BMP Cases

The *EXISTING BASELINE* pollutant load results were then input into a series of computer spreadsheets for analysis. This allowed the effects of pollutant removal efficiencies associated with existing and proposed BMPs to be evaluated. The first benefit of the spreadsheet evaluation was to apply to the current case reductions in annual pollutant loads based on BMPs that currently exist within the City (retention ponds, swales, etc.). As described in Section 4.3, this *EXISTING BMP* case was considered to provide an accurate representation of the actual existing conditions. Using the same spreadsheet methodology the *FULL BMP* and *CIP BMP* cases were then calculated. The specific details regarding the various assumptions and applications of BMPs for the *Existing* and *FULL BMP* cases along with detailed pollutant loadings results are discussed in detail in the "BMP Evaluation" (Section 5) of the Master Plan.

The annual totals on a City-wide basis for the *EXISTING BMP and FULL BMP* cases are also summarized on Table 4-4 and shown by pollutant on the graphs on Figure 4-7. As can be seen from the data, the differences in resulting loadings for the *EXISTING BMP* case compared to the *EXISTING BASELINE* case are significant. Over 73% difference in loadings is indicated for TSS while approximately 54% for both TN and TP and only 20% for freshwater. Comparing the percent reduction from the 1943 case, the *EXISTING BMP* case

does not represent a significant difference compared to the *EXISTING BASELINE* case as the percentages are still in excess of 86%. Since the 1943 values are of such small proportion regardless of the analysis scenario, it is more useful to look at the reduction in total loads to see the benefit in BMP pollutant reduction.

From this analysis, the PPLRG can be considered to reduce annual loadings as follows (from existing BMP pollutant loading to 1943 loading):

- **TSS** by approximately 88% (from 58,546 to 6,806 pounds)
- **TN** by approximately 87% (from 3,386 to 453 pounds)
- **TP** by approximately 91% (from 531 to 50 pounds)
- **Freshwater** by approximately 82% (from 306 to 54 million gallons)

Accordingly, the TAPLRG can be considered to reduce annual loadings as follows (from existing BMP pollutant loading to full BMP loading):

- **TSS** by approximately 43% (from 58,546 to 33,257 pounds)
- **TN** by approximately 31% (from 3,386 to 2,325 pounds)
- **TP** by approximately 30% (from 531 to 374 pounds)
- **Freshwater** by approximately 32% (from 306 to 209 million gallons)

4.5.3 CIP BMP Case

The CIP project list was input into the BMP evaluation spreadsheets to determine the specific impact to the pollutant loading results. The specific BMPs representing the *CIP BMP* case along with detailed results are discussed in the CIP portion of the Master Plan (Section 6). This *CIP BMP* pollutant loading case was then compared to the *FULL BMP* and *EXISTING BMP* cases which established the site specific TAPLRG. The results of this comparison are also summarized in Table 4-5 and Figure 4-7.

The results indicate that the *CIP BMP* case comes close to the pollutant reduction performance of the *FULL BMP* case, with only a 2-6% difference in overall pollutant reduction for TSS, TN, and TP. The reduction in runoff volume was less pronounced but still significant differing by approximately 15% from the *FULL BMP* case.

The CIP projects appear to provide a good effort at meeting the TAPLRG. Considering the approximations and inherent estimations used in the pollutant loading calculation process, the CIP projects may in fact provide nearly the same level of water quality benefit as indicated in the full BMP implementation. This would need to be confirmed during the implementation process through reevaluation of the pollutant loading model utilizing actual project data. The City's CIP implementation along with significant actions by others (FDOT, Golf Course) could achieve a very beneficial level of pollutant reduction that would put the City in a good, if not excellent position with regard to the upcoming TMDL regulations.

4.5.4 Basin Comparison

Figure 4-8 highlights the breakdown of pollutants by basin. Of all the basins, E exhibits the highest pollutant load contribution across the board, with C, D, F, and G also with larger

relative contributions. These results would be expected as these are the largest basins in size and have a higher relative percentage of commercial areas in comparison to the others.

Figure 4-9 presents a comparison of the model results with the measured water quality data presented in Section 4.2.3. The figure summarizes the TSS results by outfall, sorted corresponding to the water quality classification. Data statistics are provided showing that the model results generally indicate higher pollutant loadings corresponding to the areas of poorer water quality. These results may be a useful tool in prioritizing future water quality data gathering efforts and BMP implementation.

Data summaries of annual pollutant loads by basin for the *EXISTING BMP, FULL BMP*, and *CIP BMP* cases are included in Appendix 4-A.

4.6 CONCLUSION

The information provided in this section provides the background and assessment necessary to proceed with the evaluation of alternatives to address water quality. The initial pollutant loading results indicate a significant difference (90%+) in pollutant loading between the current cases and the historical case. This historical 1943 has been used as a guideline "Provisional" Pollutant Load Reduction Goal case, or "PPLRG".

Application of just this PPLRG in some instances for some municipalities may be sufficient to guide stormwater programs until the final TMDL regulations are established. In the case of Cocoa Beach, this PPRLG does not appear to represent a realistic goal given the unique circumstances of the City's land area. As discussed in Section 4.3.2, it was considered appropriate to also look at pollutant reduction targets with respect to technical limitations, economics, and other constraints. Accordingly, a "Technically Achievable" Pollutant Load Reduction Goal case, or "TAPLRG" was developed based on the BMP evaluation methodology summarized in Section 5 of this Master plan. **The TAPLRG provides a means to realistically assess the City's current level of service with respect to water quality and gauge the effectiveness of the CIP program summarized in Section 6 of this Master Plan. Implementation of the CIP program will allow the City to move towards reaching the TAPLRG of:.**

- **TSS** = 25,289 pounds/year;
- **TN** = 1,601 pounds/year;
- **TP** = 157 pounds/year;
- **Freshwater** = 97 Mgallons/year

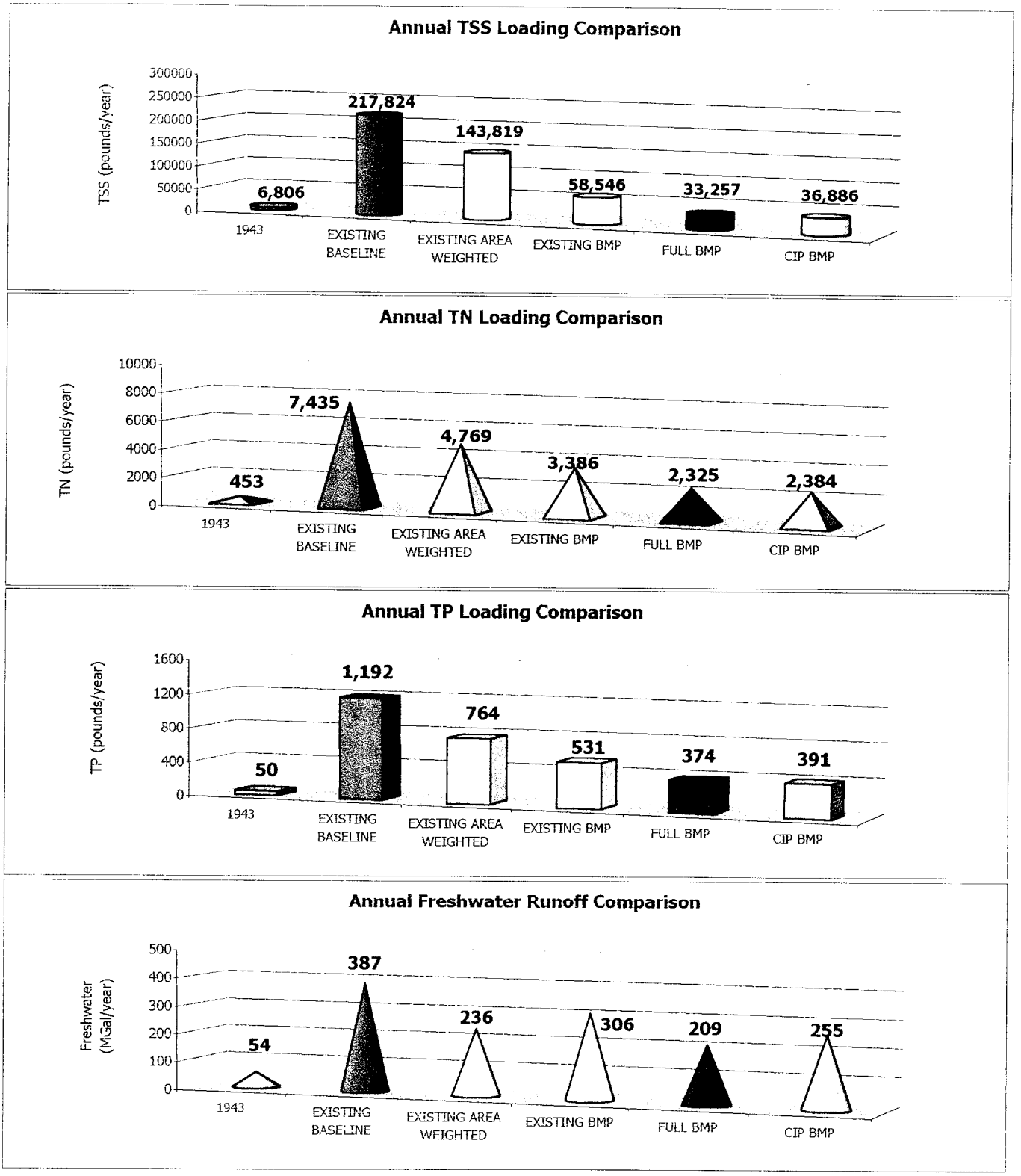
These water quality assessment procedures were based upon current SJRWMD methodologies. As such, it is expected that the pollutant load reduction goals coupled with the CIP developed in this Master Plan will provide a technically justifiable means of improving water quality. This proactive, partnering approach to addressing water quality should place the City in the best possible position with respect to compliance with the upcoming TMDL regulations.

TABLE 4.5
POLLUTANT LOADING CASE RESULTS SUMMARY
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA

POLLUTANT LOADING CASE	*TSS*			*TN*			*TP*			*FRESHWATER*		
	Annual Loading (pounds/year)	PLRG		Annual Loading (pounds/year)	PLRG		Annual Loading (pounds/year)	PLRG		Annual Loading (million gallons/year)	PLRG	
1943	6,806			453			50			54		
EXISTING BASELINE	216,184	*PPLRG* Difference between Existing BMP and 1943		7,352	*PPLRG* Difference between Existing BMP and 1943		1,176	*PPLRG* Difference between Existing BMP and 1943		382	*PPLRG* Difference between Existing BMP and 1943	
EXISTING AREA WEIGHTED	143,819			4,769			764			236		
EXISTING BMP	58,546	51,740	88.4%	3,386	2,933	86.6%	531	482	90.6%	306	252	82.3%
		TAPLRG Difference between Full BMP and Existing BMP			*TAPLRG* Difference between Full BMP and Existing BMP			*TAPLRG* Difference between Full BMP and Existing BMP			*TAPLRG* Difference between Full BMP and Existing BMP	
FULL BMP	33,257	25,289	43.2%	2,325	1,061	31.3%	374	157	29.6%	209	97	31.6%
CIP BMP	36,886	CIP Pollutant Reduction		2,384	CIP Pollutant Reduction		391	CIP Pollutant Reduction		255	CIP Pollutant Reduction	
		21,660	37.0%		1,002	29.6%		141	26.5%		51	16.6%

Provisional PLRGs (PPLRG), based on 1943 seagrass coverage, are being evaluated by SJRWMD as a target for local governments in pollution reduction. Due to the difference in land are between 1943 and 2001, this goal is unrealistic for Cocoa Beach as see from the table. The Technically Achievable PLRG (TAPLRG), which considers all possible BMPs to reduce pollution, is an achievable target for the City of Cocoa Beach in meeting regulatory and water quality standards.

FIGURE 4.7
TOTAL ANNUAL POLLUTANT LOADING COMPARISON
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA



The Existing Area Weighted case was included to highlight the impacts to pollutant loadings based on the increased land area between 1943 and present. This case was not used in any of the other pollutant load comparisons or PLRG development.

FIGURE 4.8
POLLUTANT LOADING COMPARISON BY BASIN
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA

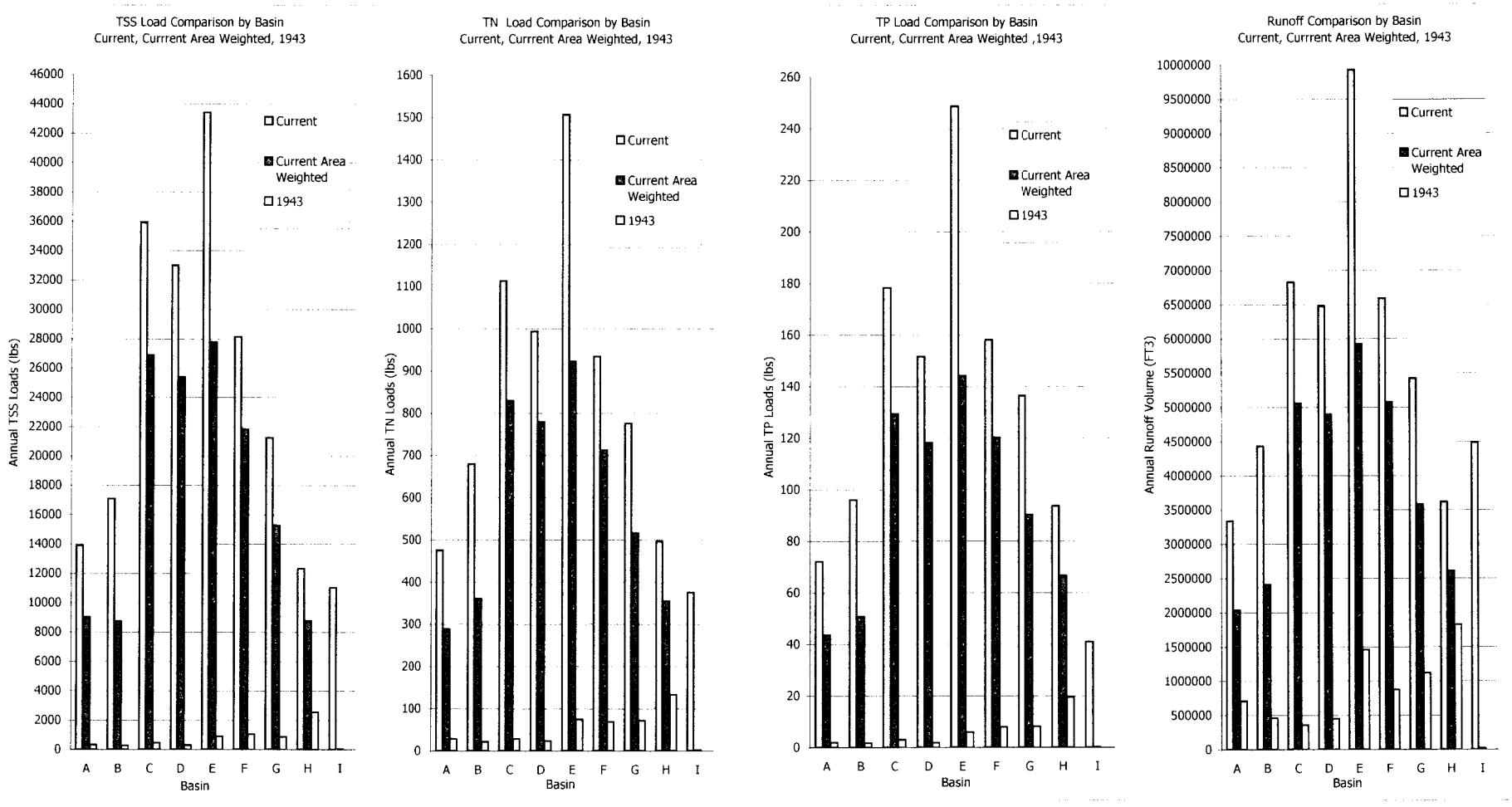
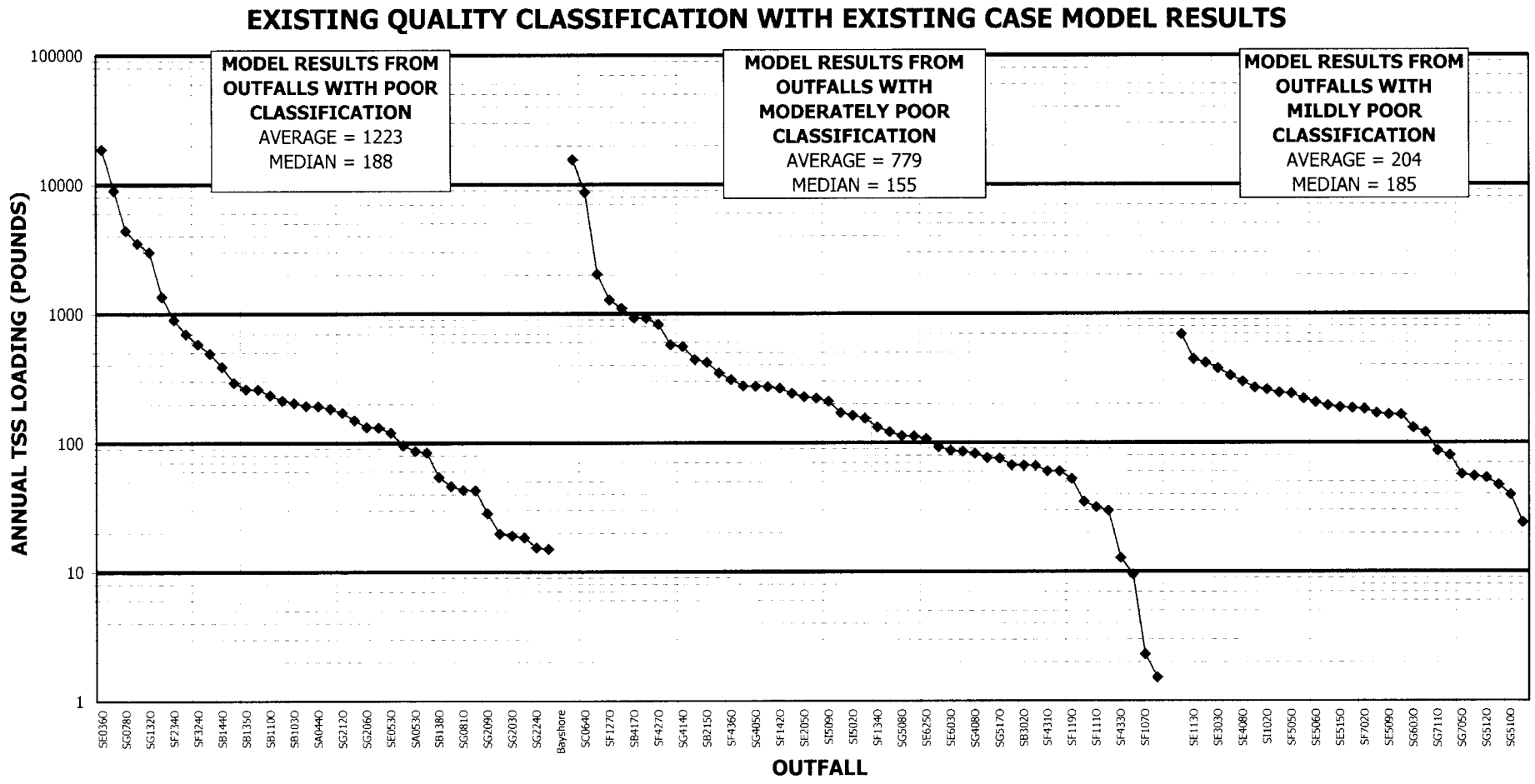



FIGURE 4-9
COMPARISON OF WATER QUALITY PROBLEM CLASSIFICATIONS BY OUTFALL TO MODEL RESULTS
STORMWATER MASTER PLAN
CITY OF COCOA BEACH, FLORIDA