

Introduction

Surface water management in Pinellas County is impacted by both natural and human activities and circumstances. The topography of the County is flat to gently sloping with generally sandy soils and a high groundwater table. The population of Pinellas County is the fifth largest in the State, residing within the State's second smallest county in physical size (280 square miles), and remains the most densely populated County in the State. While structural drainage facilities, such as culverts and channels, were traditionally designed to accommodate increases in surface water runoff associated with the loss of natural systems, the development activities required to support the County's population have also contributed over time to the disruption of natural surface water drainage patterns. The result of increasing urbanization has been increased impervious surface areas and surface water runoff, decreased natural infiltration and recharge, diminished wetlands, altered floodplains, polluted surface waters, and impacts on our native wildlife and plant species.

Pinellas County's urban landscape generates a variety of industrial, commercial, household and roadway residues and contaminants. These contaminants, accumulating between rainfall events, can be flushed into the County's drainageways, storm sewers, ponds, lakes and ultimately into Tampa Bay and the Gulf of Mexico during storm events. The longer the duration between storm events, the greater the accumulation of pollutants. Studies prepared for the Tampa Bay Estuary Program also support a greater association between air quality, airborne contaminants and water quality degradation. Over time, the receiving waters for these contaminants can become increasingly degraded until dependent wildlife and plant populations become stressed and begin to decline.

Today, however, the approach to drainage - or more accurately, surface water management - is increasingly holistic. Since the 1970s, regulatory requirements addressing project design for flood control have become increasingly comprehensive, addressing water quality as well as quantity. Now, at the turn of the 21st century, we are well into the process of performing comprehensive watershed and ecosystem assessments. Flooding problems may be addressed today with a floodplain restoration project instead of a structural improvement. Habitat restoration may be included as a component of a traditional flood control project, and flood control projects are undertaken in the context of their cumulative impacts within a larger watershed perspective. The protection and restoration of coastal waters has become an increasing priority and the County is an active participant in efforts to restore Tampa Bay and surrounding estuarine waters. The Surface Water Management Element of the Pinellas County Comprehensive Plan has been therefore designed to reflect the-comprehensive and functional systems-based approach to surface water and watershed management being carried out today by the Pinellas County Board of County Commissioners.

BACKGROUND

Before the 1970's, stormwater drainage systems were often modified in a haphazard manner. A perceived improvement in one area could be inadvertently contributing to the detriment of an area upstream or downstream. In early recognition that a more comprehensive approach was required in order to accomplish efficient and effective stormwater management, the Pinellas County Board of County Commissioners adopted the Pinellas County Master Drainage Plan in 1978 to be used as a foundation for the County's long range storm water management program. The Master Drainage Plan was subsequently amended in the 1980's to include the Storm Drainage Basin Studies, which analyzed each of the 52 drainage basins to determine current (at the time of the study) and the assumed ultimate build-out conditions. In the 1990's, Pinellas County began developing Watershed Management Plans. These plans are intended to respond to the most current conditions in each watershed, and take a number of parameters into account, including flooding problems, water quality, social and recreational uses of the watershed and policy issues, including, more recently, Total Maximum Daily Loads.

Watershed Management Plans advanced the earlier Basin Study approach and today represent the most accurate accounting of surface water conditions and management needs for County watersheds. Watershed plans are developed for individual watersheds based on specific needs and priorities. These plans comprise the foundation of Pinellas County's Surface Water Management Program today, and influence long range capital planning as well as annual funding priorities. In addition to comprehensive watershed planning, the County also responds to unexpected flooding insures and emergencies, frequently based on citizen complaints. Overall, Pinellas County has been able to build a mature surface water management program based on the initial foundation of the original Master Drainage Plan.

Pinellas County Master Drainage Plan

The Pinellas County Master Drainage Plan defined stormwater runoff patterns under existing and ultimate urbanized conditions at the time. Based upon the associated analysis, the Plan proposed major drainage improvements to alleviate existing drainage deficiencies and also identified future drainage requirements necessary to accommodate future growth.

The Pinellas County Master Drainage Plan was originally developed in 1976, and was ultimately adopted by the Pinellas County Board of County Commissioners (BCC) on April 19, 1978. Almost all municipalities in the County also adopted the Pinellas County Master Drainage Plan (in 1978) with the knowledge that more detailed drainage basin studies would have to be prepared for the 52 drainage basins within Pinellas County. The 52 Pinellas County Storm Drainage Basin Studies were subsequently completed in 1985 and still comprise the foundation for a countywide approach to stormwater management today. In May 1985, the Pinellas County Master Drainage Plan was amended to include the completed Storm Drainage Basin Study.

The Pinellas County Master Drainage Plan (MDP) encompassed all of Pinellas County, a land area of 280 square miles. Exceptions to this area were the Gulf-front beach communities. They were not addressed in the Plan because their drainage systems were considered too small to be appropriately designated at the time and, hence, did not meet the criteria for inclusion in the Master Drainage Plan. The County was divided into 52 drainage basins which, in some cases, have been further divided into homogeneous sub-basins, each draining

approximately 200 acres. This delineation of basins and sub-basins remains essentially the same today, although certain refinements have occurred throughout the years, as a result of individual watershed assessments. **Figure 1** depicts each basin, or watershed, in Pinellas County.

Master Drainage Plan and Technical Advisory Committee

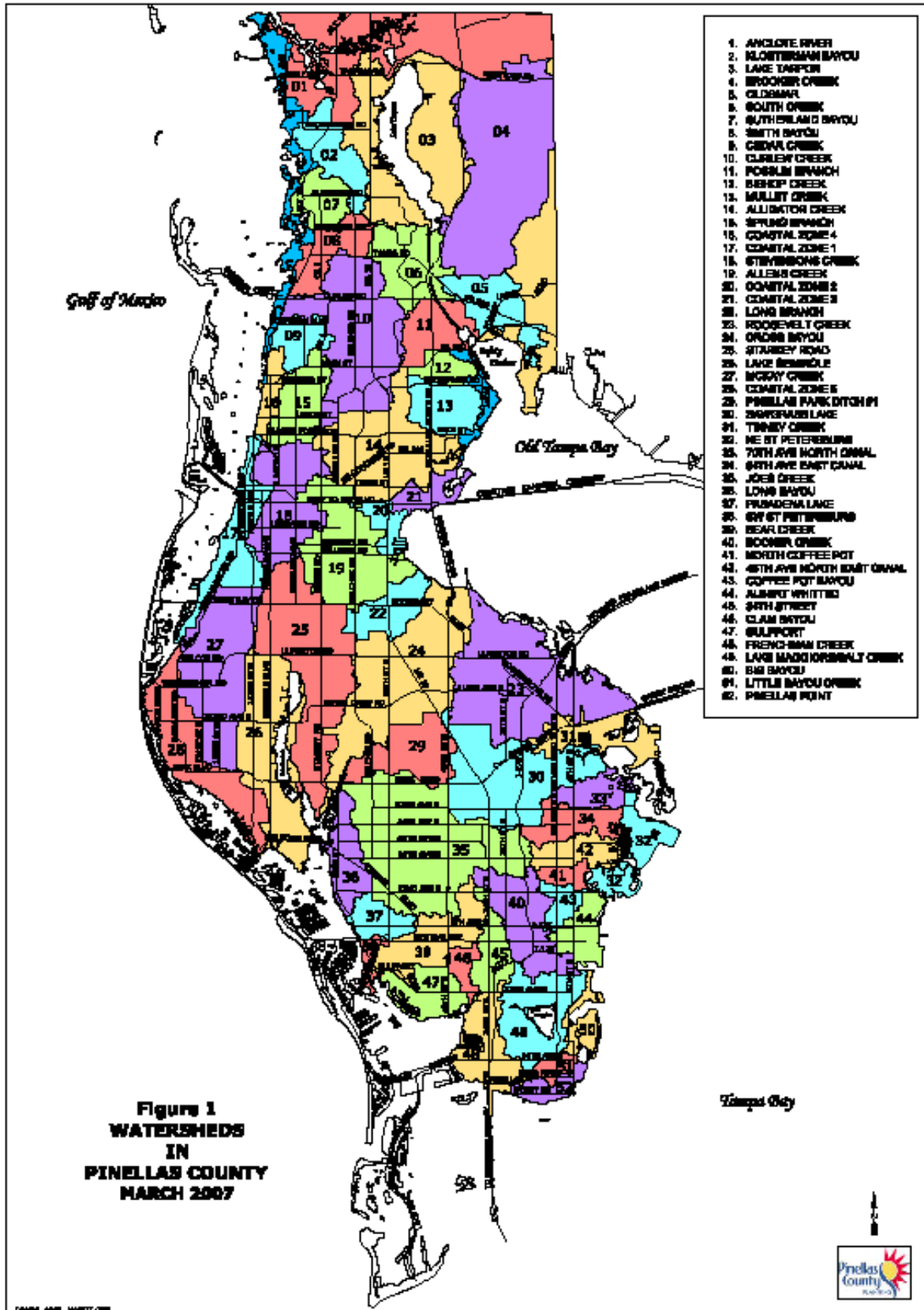
In order to develop the MDP, an extensive amount of coordination was required between local, state and federal government entities as well as the general public. Since the study was initially performed without regard to political or jurisdictional boundaries, it was necessary to coordinate the development of the MDP with the engineering departments of each political entity within a specific drainage basin. Consequently, a Drainage Technical Advisory Committee (TAC) was established to provide policy guidance and local governmental input into the formation of the MDP. Contact with federal and state regulatory agencies was initiated to obtain hydrologic and hydraulic information, water quality data, current drainage plans, and drainage criteria guidelines.

The study approach included field surveys, drainage basin delineation, compilation of existing and planned land use, hydraulic analysis, organization of data for computer analysis, analysis of alternatives, and preparation of the individual Storm Drainage Basin Studies. Field surveys were performed for all drainage channels having watersheds in excess of 200 acres. Included in the surveys were channel cross sections, surveys of existing drainage structures, and surveys of lake outlets. Following these surveys, the drainage basins were further divided into sub-basins of approximately 200 acres. Information on drainage facilities, the drainage network, and existing and planned land uses were organized for computer analysis. Hydraulic analysis was performed for present and future land use conditions, and for existing and planned drainage facilities under 5, 10, 25, 50 and 100-year storm events

In more urbanized areas, it was necessary to obtain information on existing local drainage plans in order to make the MDP's recommendations consistent with such plans. The Storm Drainage Basin Studies were phased to allow local community input and comment during their preparation. Initially, each community was contacted to obtain information on local flooding, flood boundaries, current drainage plans and potential solutions to drainage problems. This information was used to verify flood elevations from the Pinellas County Storm Drainage Basin Study and to formulate MDP alternatives. Subsequent contact was made after alternatives had been identified for each drainage basin and presented at preliminary modification meetings. At these meetings, proposed drainage alternatives were discussed and the most appropriate selected for incorporation into the MDP.

For each of the identified 52 basins (see **Figure 1**), an individual Technical Appendix was developed during the preparation of the Pinellas County Storm Drainage Basin Study. These Appendices contained detailed information on existing conditions, including land uses, within each individual drainage basin.

**FIGURE 1
WATERSHEDS AND WATERBODIES IN PINELLAS COUNTY**



Storm Drainage Basin Studies

The primary focus of the Storm Drainage Basin Studies was major drainage systems, defined as open channels draining areas averaging 200 acres. Underground pipes 54 inches in size or larger (or an equivalent system) draining areas of 200 acres or more were also analyzed. However, Master Drainage Plan recommendations were made only for major drainage systems.

The Gulf beach communities are characterized by sheet flow and tidal influences, not major natural drainage features, and, as mentioned before, since they do not drain areas of 200 acres or more, they were not addressed in the Master Drainage Plan, and were considered to be representative of local drainage systems.

Mathematical simulation through computer modeling was utilized in an effort to incorporate the primary factors affecting the rainfall/runoff relationship in a specific drainage basin (e.g., surface area, soil moisture and permeability etc.), while also maintaining the needed flexibility to accommodate constantly changing data. After runoff was routed from the land surface area through the drainage channel and storage system, frequency statistics were computed at key locations to determine the recurrence interval of various flood flows. In this way, short duration high intensity storms which have a more severe impact on upstream portions of a drainage basin were accounted for, as were longer duration high volume events which typically have more critical impact downstream. A detailed explanation of the programming and calibration process may be found in the original Technical Appendices of the Storm Drainage Basin Study.

Study Approach

This was the approach used to determine whether a drainage system, adequate under present conditions, would be adequate in the future. If drainage improvements were needed upstream of a drainage channel or culvert, analysis was conducted under the assumption that the identified improvements would be implemented. The number and character of alternatives addressed varied considerably from basin to basin. Urbanized areas had fewer options than sparsely developed areas because of the lack of available land as well as prohibitively high land costs.

As previously mentioned, the County, in developing the MDP, pursued a regional approach with 52 identified basins, or "regions." Major drainage projects were developed after assessing the entire basin. It was not considered economical, in the short or long term, to implement a number of independent projects if a major drainage improvement would resolve a number of flooding problems. Regional retention and detention areas, as well as the preservation of existing storage areas, were major components of the County's MDP, as well as the stormwater management program and plans today.

Evaluation Criteria

Criteria were established to evaluate the various alternatives and provide guidance in selecting final Master Drainage Plan recommendations. These included the following:

Economics - Economic considerations included construction, land acquisition, right-of-way acquisition, and operation and maintenance costs. Less costly alternatives were generally given a higher priority. In those instances where the lowest cost alternative was not selected, it was the result of several overriding factors.

Hydrology - The reliability and performance of a drainage system varies depending on the frequency of the selected rainfall event. Typically, stormwater management programs should plan for 25-year and 100-year storm events. When analyzing alternatives for the 25-year storm event, it is equally as important to assess the impacts of recommended solutions on the 100-year storm event as well. The recommended alternatives for the 25-year event may affect the flood elevations of the 100-year storm event with the same drainage configurations.

Environmental - Positive and negative impacts on water quality and other environmental resources were also considered in development of the MDP. Typically, structural measures (e.g., channelization, structure replacement, etc.) can result in adverse water quality which affects the native wildlife and vegetation; while natural storage and nonstructural measures imply positive water quality effects and preserve the natural environment. As a result, recommended drainage alternatives were analyzed independently to determine their overall impacts on the environment.

Intangible benefits - Throughout the planning process, considerable thought was given to aesthetics, public acceptance, liability exposure and other factors which are difficult to quantify. These factors were taken into consideration on a site-by-site basis in conjunction with other established drainage criteria. Many of the recommendations included provisions for joint use areas such as parks and bikeways along floodways, recreation areas such as soccer fields in detention ponds, and non-obstructing facilities such as parking lots in floodplains. These joint use areas not only contributed to community development and storm water management efforts, but also to the efficient use of public and private lands.

Maintenance - Maintaining drainage channels, structures and storage areas can be very expensive and time-consuming. As a result, each of the recommendations within the Master Drainage Plan were analyzed as to the degree of required maintenance.

Design Alternatives

Proposed improvements for the 52 drainage basins within Pinellas County were selected from a series of alternatives generated for each basin. These alternatives propose various solutions to present and potential flooding conditions and include structural improvements, channelization, diversion, detention/retention storage, natural storage and floodway zoning. These alternatives are briefly described below:

Structural improvements - Improvements were designed to retain the 25-year 6-hour storm within the channel banks and keep houses from being inundated by the 100-year 24-hour storm. Each structural improvement listed in the structural improvement inventory (located in the Pinellas County Storm Drainage Basin Study - Technical Appendix for each basin) was evaluated for capacity, setting, and structural condition. Structures which did not pass the 25-year flood without causing significant backwater or over-topping were recommended for improvement or replacement. Where feasible, nonstructural improvements were also recommended.

Channelization - Many developments were already encroaching into floodplains, causing flooding along streams. When possible in such instances, it was necessary to provide additional channel capacity in order to reduce existing and/or potential flooding. Channel improvements may take the form of concrete ditch pavement, vertical sheet walls, grassed waterways, bank stabilization, ditch checks or diversion canals. Whenever possible, natural stream channels were preserved.

Erosion and sedimentation control - Areas of high-flow velocity are typically subject to erosion, and those of low-flow velocity are subject to sedimentation. Due to the erosive nature of Pinellas County's sandy soils, particular care had to be taken regarding velocities. Options available for solving erosion and sedimentation problems included stabilization of banks, reduction of channel velocities, reducing bends in channels, providing sedimentation basins, avoiding abrupt channel transitions, maintaining adequate velocities through structures, slowing velocities in areas of high topographic relief and paving channel bottoms. Utilization of these techniques reduces erosion and the resultant sediment transported downstream.

Water quality - The enhancement and preservation of water quality was derived as a secondary benefit from the utilization of floodplain zoning or storage areas. Where water quality was a prime consideration, retention ponds - or some other means of quality control - were recommended.

Storage - Various forms of storage, including retention and natural storage, were evaluated. Where flood peaks are a defined problem, it is sometimes desirable to propose reducing them by artificially impounding water in detention ponds. Detention ponds must, however, be properly sized and located so that desired flow attenuation is accomplished in a cost-effective manner. Where the primary objective was to reduce or delay peak flows, multi-use detention areas were proposed. Since detention areas are wet for only short periods of time and they were considered for use as parks and/or recreation areas during dry periods. In order to preserve the ecology of environmentally sensitive low-lying areas, natural storage areas were also designated. Natural storage areas do not require excavation, yet are effective in improving water quality, providing aquifer recharge, and reducing the downstream impacts of flooding.



***Retention Pond near Intersection of
Sunset and Hercules***

Floodplain regulation - Floodplain and floodway regulations provide non-structural alternatives to reduce flooding. For example, land use and zoning regulations may strictly regulate or restrict development in the 25-year and/or 100-year floodplains. Sufficient drainage area along an entire drainage channel was reserved in some cases in order for the channel and overbank to be kept free of encroachment so that the 100-year storm could be carried without substantial increases in flood elevations. In portions of a drainage channel, where flood elevations exceeded the overbank, it was sometimes desirable to preserve this occurrence rather than alter it. In so doing, water quality was enhanced, erosion was reduced, and flood peaks were attenuated.

SURFACE WATER MANAGEMENT TODAY

The Pinellas County Comprehensive Plan

The identification of drainage basins as the scale of study for the Master Drainage Plan initiated the beginning of a watershed-based management approach that was subsequently incorporated into the Comprehensive Plan in 1989, forming the basis for the County's watershed planning program today.

The Comprehensive Plan committed the County to implementing individual approved management plans to address flooding problems and ensure that projects were designed to meet current stormwater standards. In addition and significantly, the original Comprehensive Plan, adopted in 1989, committed the County to achieving measurable improvements in overall water quality in the waters of Pinellas County. With these mandates, the County built on the foundation of the Master Drainage Plan and outlined a comprehensive watershed-based management approach for the County's watersheds. Following the adoption of the 1989 Comprehensive Plan, Pinellas County embarked on its ambitious program of surface water management using watershed boundaries as the parameters for surface water planning initiatives, creating Watershed Management Plans to update information contained within the MDP. Watershed Management Plans are now the priority for Pinellas County's surface water management program.

A Comprehensive Approach to Surface Water Management

As already described, the County recognized very early, and began to address the concern in the original MDP and its associated Storm Drainage Basin Studies, that stormwater control in isolation of the impact on the larger natural system is short-sighted. With adoption of the Comprehensive Plan, the County focused increasingly on combining resource protection with traditional stormwater control requirements.

Today, in addition to the conventional drainage program goals of flood control and erosion control, the County's surface water management and watershed planning goals include the conservation, protection and restoration of County waters, the conservation and protection and restoration of wildlife habitat, the protection of coastal areas in order to maintain or enhance water quality, biodiversity and estuarine productivity.

All of these considerations take the County well beyond the approach, as proactive as it was for its time, of the 1978 Master Drainage Plan, and its subsequent update to include the Storm Drainage Basin Studies, and represent a truly progressive program of comprehensive surface water management and planning. This approach acknowledges not only components of the Master Drainage Plan and the individual Storm Drainage Basin Studies, but also includes local drainage projects, and incorporates watershed-by-watershed planning initiatives, water quality improvements, economic influences and wildlife habitat enhancement and restoration projects. The development of watershed management plans, required to be consistent with, and implement Comprehensive Plan directives, effectively update the County's Surface Water Management Program, one drainage basin at a time.

Pinellas County's approach to watershed planning is consistent with state and federal regulatory directives, including Chapter 62-40 of the Florida Administrative Code, the State's Water Policy, as amended. The watershed approach is also consistent with the guidelines of the Environmental Protection Agency's 1996 document entitled: *Watershed Protection: A Statewide Approach*, that aims to prevent pollution, achieve and sustain environmental improvements, and meet other goals important to the community.

The County's watershed approach is a functional systems approach to natural resources management which not only sets goals for water quality, but also addresses drainage problems, habitat improvement, and protection and enhancement of wildlife. Through this holistic approach, the Pinellas County Comprehensive Plan will continue to expand on the targeted goals of reducing pollutant loads and improving water quality and biodiversity, as well as meeting stormwater control requirements necessary to protect both lives and property.

The County's watershed planning initiatives are also been coordinated with ongoing initiatives such as the SWFWMDs Surface Water Improvement and Management Program (SWIM), the Comprehensive Watershed Management Plan (CWM) for the Pinellas-Anclote Watershed, and the Tampa Bay Estuary Program (TBEP). With Lake Tarpon being designated as a SWIM waterbody in 1989 and Tampa Bay being selected by the U.S. Environmental Protection Agency (EPA) as part of its National Estuary Program in 1990, the opportunities for exchanging information and developing comprehensive management plans have been greatly expanded by multi-agency participation and involvement in these activities. With the designation of Total Maximum Daily Loads, the County will also become more of a partner with the U.S. Environmental Protection Agency and the Florida Department of Environmental Protection, in an effort to meet certain goals set for the reduction of pollutant loads into impaired waterbodies.